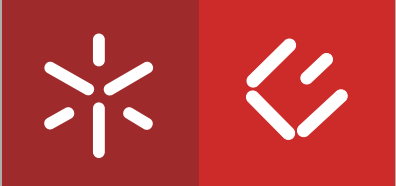


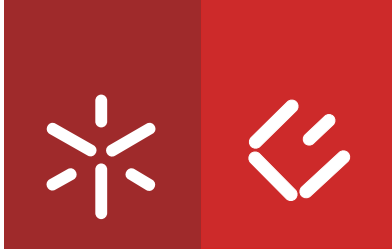


Performance of Public Hospitals Across the River Jordan

Wasim Idris Mustafa Sultan

Universidade do Minho
Escola de Economia e Gestão





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Wasim Idris Mustafa Sultan

Performance of Public Hospitals Across the River Jordan

Ph. D. Thesis in Business Administration

Work developed under the supervision of
Professor Doctor José António Almeida Crispim

April 2018

STATEMENT OF INTEGRITY

I hereby declare having conducted my thesis with integrity. I confirm that I have not used plagiarism or any form of falsification of results in the process of the thesis elaboration. I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

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Ph. D. in Business Administration.

April 5th, 2018

Name **Wasim Idris Mustafa Sultan.**

Signature:

A handwritten signature in blue ink, appearing to be 'Wasim Idris Mustafa Sultan', written in a cursive style.

ABSTRACT

Given the lack of performance measurement system and the absence of regular and organized reports in public hospitals in the West Bank and Jordan, the focus of the thesis is on measuring performance with the aim of identifying areas for potential improvement. The analysis, although it does include Jordan, mainly addresses the transitional context in the West Bank. Throughout the research studies, we have argued that it would be misleading to judge hospital performance in the West Bank without considering the historical and ongoing associations with Jordan, the implications of international donors, or the need to identify and measure vital organizational signs. To understand the many dimensions of hospital performance, we have developed a framework of analysis that utilized domain theory and Donabedian's (1980) approach to health care assessment. The produced structure supports the three-key decision-makers in the provision of public hospital services: (1) health professionals; (2) managers; and (3) policymakers and donors, linking them with three organizational constructs: (1) structure; (2) processes; (3) and outcomes. These decision makers will be the users of the information generated by the research, while the three constructs refer to the areas in which the performance measures are rooted. The existing relevant literature is descriptive and does not contemplate the use of analytical techniques. The thesis extends the aim of previous work by four research studies while filling this gap in the Palestinian literature. This work is the first to quantify, analyze and discuss performance measures of public hospitals in this region. The work addresses two major performance dimensions: the productive efficiency and the effectiveness of medical interview. Throughout the embedded studies, two methods are employed: (1) the Data Envelopment Analysis (DEA) with the extensions of the Malmquist index and Tobit regression; and (2) multivariate statistical techniques like Canonical correlation and cluster analysis. For the first dimension, we analyzed the operational data of two sets of nationally representative hospitals (from the West Bank and Jordan) during the period 2010 - 2015, and for the second dimension, we conducted a survey of doctors from private and public hospitals in the West Bank with 369 valid responses. Due to historical, social, and cultural associations, it is important to start by introducing Jordan's role in health care provision in the West Bank. Therefore, we compare and evaluate the relative performance of public hospitals during 2010 - 15 in both countries. The obtained results show that the improvements in productive efficiency during the study period were driven by new technologies in West Bank and by managerial innovation in Jordan. Then, we perform a

longitudinal analysis of the efficiency of Palestinian public hospitals in to identify potential savings in health care expenditures given the actual context of decrease of international donations, the deteriorating economy of the country and the increasing health needs. Despite the improvement of 4% in the technical efficiency, hospitals showed regress in productivity over the period 2010-15. However, this regress was attributed to technological regress. The main predictors that explain hospital efficiency are bed occupancy rate, outpatient-inpatient ratio, size of the hospital, availability of primary centers within the governorate, the percentage of the available public to beds, and location. Following, we conducted a deeper investigation concerning the technical efficiency and scale efficiency of the Jordanian public hospitals since they set the benchmark for productive efficiency in this region. Finally, in our fourth research work related to the second dimension of performance, we describe Palestinian doctors' views on Patient-Centered Care (PCC) and explore contextual drivers associated with their perceived views. Results show that only 45% of the participants knew about PCC. Doctors with positive views are older, married, specialists, previously familiar with PCC, and working in private hospitals. Results also highlighted performance gaps between public and private hospitals and suggested room for improving the doctors' interpersonal skills. The final value given by the research studies will only be fully acquired when the relevant decision makers understand the identified failures and response to overcome them.

Keywords: Performance; Public hospitals; Transitional context; River Jordan.

RESUMO

Dada a falta de sistemas de medição de desempenho e a não existência de relatórios organizados e regulares nos hospitais públicos da Cisjordânia e da Jordânia, o foco do trabalho desenvolvido foi medir o desempenho nestes hospitais, a fim de identificar áreas de possível melhoria. A análise aborda principalmente o contexto de transição na Cisjordânia nos últimos trinta anos, embora inclua a Jordânia. Ao longo dos estudos que compõem a pesquisa, argumentamos que seria enganador julgar o desempenho hospitalar na Cisjordânia sem considerar as associações históricas e em curso com a Jordânia, as implicações dos doadores internacionais ou a necessidade de identificar e medir sinais vitais organizacionais. Para compreender as muitas dimensões do desempenho hospitalar, elaboramos um quadro de análise que utilizou a teoria do domínio e a abordagem de Donabedian (1980) para a avaliação dos cuidados de saúde. A estrutura desenvolvida apoia os três decisores chave na prestação de serviços hospitalares públicos: (1) profissionais de saúde; (2) gestores; e (3) decisores políticos e doadores, vinculando-os com três construções organizacionais: (1) estrutura; (2) processos; (3) e resultados. Estes decisores serão os utilizadores das informações geradas pela investigação, enquanto as últimas três construções se referem às áreas em que as medidas de desempenho se inserem. A literatura relevante existente é de natureza descritiva e não contempla o uso de técnicas analíticas. Os quatro estudos realizados procuram preencher esta lacuna. Este trabalho é o primeiro a quantificar, analisar e discutir indicadores de desempenho dos hospitais públicos nesta região. A investigação aborda duas grandes dimensões de desempenho: a eficiência produtiva e a eficácia do processo de entrevista médica. Os principais métodos utilizados são o DEA com extensões ao índice de Malmquist e à regressão de Tobit, e técnicas estatísticas multivariadas como métodos de correlação canônica. Relativamente à primeira dimensão, analisamos os dados operacionais de dois conjuntos de hospitais (da Cisjordânia e da Jordânia), nacionalmente representativos, durante o período 2010-2015, e para a segunda dimensão realizamos um inquérito a médicos de hospitais privados e públicos da Cisjordânia com 369 respostas válidas. Devido às associações históricas, sociais e culturais, é importante começar por estudar a influência da Jordânia na provisão de cuidados de saúde na Cisjordânia, portanto, comparamos e avaliamos o desempenho relativo dos hospitais públicos durante 2010-2015 em ambos os países. Os resultados obtidos mostram que as melhorias na eficiência produtiva durante o período de estudo foram impulsionadas por novas tecnologias na Cisjordânia e por melhorias na gestão na Jordânia. Em

seguida, realizamos uma análise longitudinal da eficiência dos hospitais públicos palestinos na Cisjordânia, a fim de identificar potenciais poupanças em despesas de saúde, dado o contexto atual de diminuição de doações internacionais, débil situação económica do país e necessidades crescentes de saúde. Os resultados mostram que durante o período de 2010-15. Melhorias na gestão são necessárias. Os principais preditores que explicam a eficiência hospitalar são: a taxa de ocupação de camas; a taxa de tratamento ambulatorio; dimensão; disponibilidade de centros primários; rácio entre camas públicas a privadas; e localização. Em seguida, uma investigação mais aprofundada sobre a eficiência técnica e de escala dos hospitais públicos da Jordânia é feita uma vez que constituem a referência para a eficiência produtiva nesta região. Finalmente, no nosso quarto trabalho de investigação, relacionado com a segunda dimensão, estudamos a prestação de serviços de cuidados centrados no paciente (*patient centered care*, PCC) entre os médicos palestinos e exploramos os principais elementos contextuais associados ao seu desempenho. Os resultados mostram que apenas 45% dos participantes conheciam o PCC. Os médicos com bom desempenho são mais velhos, casados, especialistas, familiarizados com o PCC e trabalham em hospitais privados. Os resultados também destacaram lacunas de desempenho entre hospitais públicos e privados e sugerem que há espaço para melhorar as habilidades interpessoais dos médicos. O valor final dado pela pesquisa só será totalmente adquirido quando os decisores relevantes compreenderem as falhas identificadas e tomarem medidas para as ultrapassar.

Palavras-chave: Desempenho, Hospitais Públicos, Contexto de Transição, Rio Jordão.

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In memory of my late wife "Lina"

LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
ALOS	Average Length of Stay
ANOVA	Analysis of Variance
BCC	Banker Charnes Cooper
BOR	Bed Occupancy Rate
BSC	Balanced Score Card
CAT	Communication Assessment Tool
CCA	Canonical Correlation Analysis
CCR	Charnes Cooper Rhodes
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
DRS	Decreasing Returns to Scale
DV	Dependent Variable
EC	Efficiency Change
ERS	Efficient Reference Set
FTE	Full-Time Employee
GDP	Gross Domestic Product
GS	Gaza Strip
ICU	Intensive Care Unit
IRS	Increasing Returns to Scale
IV	Independent Variable
JMoH	Jordanian Ministry of Health
MANOVA	Multivariate Analysis of Variance

MI	Malmquist Index
NGO	Non-Governmental Organization
OPT	Occupied Palestinian Territories
PA	Palestinian Authority
PCBS	Palestinian Central Bureau of Statistics
PCC	Patient-Centered Care
PLO	Palestinian Liberation Organization
PMoH	Palestinian Ministry of Health
PMMS	Palestinian Military Medical Services
PNC	Palestinian National Council
PPRQ	Provider Patient Relationship Questionnaire
PTE	Pure Technical Efficiency
SD	Standard Deviation
SDRS	Socially desirable Response Set
SE	Scale Efficiency
SFA	Stochastic Frontier Analysis
SPC	Statistical Process Control
TC	Technological change
TE	Technical Efficiency
TQM	Total Quality Management
UNHCR	United Nations High Commissioner for Refugees
UNRWA	United Nations Relief and Works Agency
VRS	Variable Returns to Scale
WB	West Bank
WHO	World Health Organization

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CHAPTER 1

Introduction

Saturday afternoon, on 22 July 2017, the last day of the summer school on “Quality and Organizational Excellence,” I had the great opportunity to share talks, during the farewell party, with one of the global quality leaders. The wise Emeritus Professor has just presented his outstanding research about the role of quality and excellence in shaping the future. During his session, he elaborated the context of Japan and the Western countries then he visited some exciting initiatives in the United Arab Emirates. When I introduced myself as Palestinian, he said “Palestinians ... the survivals”. There is considerable merit in his phrase, he moved to the other side of the world and recapitulated different context settings. From a practical point view, he has drawn attention to a different performance story and a different management agenda from what he has just discussed in the session. I believe that Palestinians can go beyond just survival and improve the quality of life in the Occupied Palestinian Territories, in this regard, health care is essential.

The scope of health care services goes beyond the individual benefits of patients; it also includes the impact on the family and the community. Also, health care expenditures usually contribute to a significant part of a country’s economy. Therefore, better health conditions can enhance the well-being and the growth of the country. Hospitals are the main providers of healthcare services; therefore, adequate hospital service has a main bearing on the health of the public. Hospital organizations operate ensuring better access to high-quality care services while controlling for better utilization of the limited resources (Jon A Chilingirian & Sherman, 2011). The role of their managers and policymakers facing resource constraints can’t be played without a sense of decision-making based on performance measurement (Lebas & Euske, 2002). The purpose of this thesis is to measure the performance of public hospital across the River Jordan.

Jordan, on the East Bank of the River Jordan, has continuing social, cultural, and historical associations with the Palestinians living in the West Bank of the River (see the map in Figure 1.2). The shared demographic characteristics and the simple fact of geography make their lives interrelated and Jordan’s stake in West Bank as unavoidable (Ashton, 2009). Further, the health care system in West Bank evolved as part of the healthcare system in Jordan during 1950-1988. Currently, around one-half of the Jordan population is of Palestinian ancestry (Al-Din et al., 1996; Karolyi, 2017).

The Occupied Palestinian Territories (OPT) in 1967 comprise the West Bank including East Jerusalem and Gaza Strip. The history of the OPT is branded by the chronic conflict between the Palestinians and the Israelis. The never-ending conflict seemed to come to an end when the Middle East peace process was settled and after the Madrid conference in 1991, then the Oslo Accords in 1993 and the establishment of the Palestinian Authority in 1994. Despite the international economic support to encourage building peace, regrettably, the peace process reached a deadlock and failed to resolve the conflict. The Palestinians constructed a picture that the two-state solution is unbelievable.

While noticeable progress has been made in building the yet to be “The State of Palestine” after Oslo Agreements, ground reality suggests otherwise. The situation is remaining complicated and problematic as witnessed by more isolation between cities and more restrictions on movement. The Israelis control over water, electricity, borders, movements, and communication infrastructure amongst others, the Palestinians have limited self-rule. Being frozen at midway in the peace process, the status of the Occupied Palestinian Territories is rather uncertain, because, it is neither attached to Israel nor a self-governing country. The post-agreement settings created quasi-structured and quasi-recognized institutions that made the daily life of the Palestinians indeed harder.

The Palestinian Authority (PA) currently administers the healthcare and the education sectors in the OPT. The Palestinian healthcare system is made up of fragmented services evolved across different regimes (Giacaman et al., 2009) and heavily influenced by the political environment within which it is enacting (Saltman, 1997). Palestine is a country in transition, a state of rebuilding the main institutions of the country affects all the relevant subsystems. The fragile political context, uncertainty, the unique geographical separation between West Bank and Gaza Strip, the deteriorating economy, and the pressure of the international aids characterize the transitional context for Palestinian health policy development (Hamdan & Defever, 2002). This unique context has implications on the priority settings and the process of health policy implementation. Therefore, in practice, the integration of health policies and health delivery operations is not just a matter of combining the two.

The thesis addresses the performance of public hospitals in West Bank (WB) as well as in Jordan. Because WB experienced the transition and the ongoing health reforms, the case of WB is considered in more detail throughout the thesis. Since 1988, the disengagement of legal and administrative ties between West Bank and Jordan and the subsequent political movements initiated more influential role of Palestinian administration of health care in West Bank.

Therefore, throughout this research, Jordan is proposed as a base context that helps to analyze and to understand the performance of the Palestinian public hospitals in WB.

To sum up, with the aim of evaluation and improvement, this research work is intended for generating information by performance measurement at the hospital level from an operations perspective. The produced information purposes three key influencing domains within public hospitals: policy, administrative management, and professional services. The employed Data Envelopment Analysis (DEA) methodology and Patient-Centered Care (PCC) approach are universal and well known in various healthcare contexts. For this purpose, two vital performance aspects have been addressed: the productive efficiency from 2010 through 2015 and the delivery of PCC. Because health care reforms revolve around performance measurement, it is hoped that the delivered intrinsic value of our findings will guide health professionals, managers, and policy makers improving the provision of public hospital services.

1.1 Motivation

The Palestinian Authority is considered as one of the largest receivers of the international aids, of which about 8% is allocated to the healthcare sector (Hamdan & Defever, 2002). Donors are international organizations, and United Nations Agencies as well as local Non-Governmental Organizations (NGOs). The external funds after Oslo Accords in 1993 are efforts made by the international community to resolve the conflict in Palestine-Israel through economic encouragements (Shehada, 2015). Even though, the absence of a Palestinian vision of the required effective reforms scattered efforts from achieving the desired improvements (Giacaman, Abdul-Rahim, & Wick, 2003). During the last years, some accomplishments in the physical capacity building had been reached (Hamdan & Saleem, 2013). Still, the response of healthcare system to the health problems of 4.88 million Palestinians is disorganized and inadequate (Giacaman et al., 2009; PCBS, 2017).

The national strategic plan for health care is established for the sake of having a strategy and was never evaluated or deployed throughout the health care providers. Accordingly, the use of spontaneous policies and the intuition-based decisions within healthcare organizations are common practices. In this case, approaching performance by measuring the implementation of organization's strategy will be worthless. As an author of this thesis, Palestinian myself living in West Bank had observed the gap between the rhetoric of policymakers and practices in the public hospitals.

In practice, the Palestinian healthcare policies reflect the political point view to fulfilling previous promises of the public authorities about shouldering the responsibilities of the Palestinians. Hence, policies are not developed with considerations being given to the capabilities of healthcare providers or the developing country's infrastructure. For example, the applied governmental insurance schemes cover most of the population. As a result, on the public-sector side and to implement these policies, managers and professionals operate in a difficult working environment. Many public hospitals are over occupied and work in crisis mode. Therefore, the good operational practices are not secured. To solve the problem, the Palestinian Ministry of Health dedicates about 40% of its budget to purchase hospital services from non-governmental local referral hospitals or spend public money for cross-border medical care transfers.

So far, in response to the absence of performance measurement system, the need for real indicators from practice which evaluates productivity and efficiency suggests itself. Their measurement could maintain the economic benefits of the achieved capacity building. The universality of the Data Envelopment Analysis (DEA) methodology to approach performance improvements prevail in health care organizations and provides large utilization possibilities (Elg, et al., 2013).

Moreover, based on a literature review, Saleh et al. (2015) concluded that studies in healthcare in the East Mediterranean Region are descriptive, cross-sectional in nature, and the provider-patient relationship is an area of significant concerns (M. Ali, Debela, & Bamud, 2017). Therefore, there is a need for understanding the provider-patient relationship and how providers perceive the importance of delivering Patient-Centered Care (PCC).

In Palestine, the modest relevant literature is descriptive and lacks empirical sound of the use of analytical techniques. Although, previous research enhanced efforts for health care reform initiatives and often highlighting the weaknesses and the political constraints, had inadvertently dropped the importance of performance measurement and the provider-patient relationship.

Finally, measurement is not an end in itself (Behn, 2003), but, represents the departure point to inform effective decision making for rational distribution of resources that define the type and direction of reforms the country may take to improve public health services.

1.2 The empirical context

1.2.1 Historical evolution of public hospitals in Palestine

Some hospitals in East Jerusalem were established during the 19th century by the Western Christian Missionaries when Palestine was incorporated into the Ottoman Empire during 1514-1918, these hospitals are still working and provide healthcare service (Giacaman et al., 2009). During 1918-1948, under the British Mandate, three types of medical organizations were operating in Palestine: the chain of missionary hospitals; the British government department of health; and the Hadassah medical organization, the latter served the Jews (Kligler, 1932). Israel was established in 1948, the remaining part of Palestine comprises West Bank including East Jerusalem and Gaza Strip. To date, they are occupied by Israel since 1967, hence called the Occupied Palestinian Territories (OPT).

From 1950 to 1967, West Bank was unified with Jordan, while Egypt administered Gaza Strip. During this period, the state of weak expansion of health services stimulated the Palestinians to build a chain of charitable health care services and some private medical centers. Between 1967 and 1993, the Israeli military administration of the West Bank and Gaza provided inadequate public services which did not exceed the essential services of primary health care providers. Accordingly, the Palestinians depended on the Israeli health care providers and some neighboring Arab Countries (Giacaman et al., 2009). During the same period, between 1967 and 1988, administrative and legal ties were kept between Jordan and West Bank. The Jordanian institutions and health regulatory bodies were the only recognized entities in the Palestinian healthcare markets.

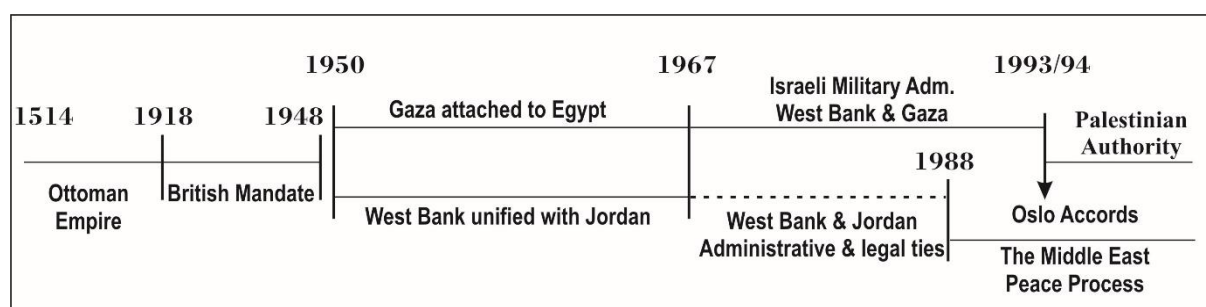


Figure 1. 1 Chronological review of the history of Occupied Palestinian Territories.

In 1988, the King Hussein of Jordan announced the severance of all administrative and legal ties with the occupied West Bank (Office of King Hussein I, 2000). Jordan continues to provide institutional support in respect of training, education, accreditation bodies, and professional

licensing needs. Since 1988, the Palestinian Liberation Organization (PLO) shouldered more formal and more effective role in healthcare provision. At present, strong associations between the two countries are continuing, for example, a considerable proportion of health care professionals and specialist doctors working in WB are educated and trained in Jordan. Figure 1.1 (developed by the author) labels the relevant turning points that shaped the country's history.

1.2.2 Palestinian health care system and demographic profile

The whole area of the OPT is 6170 km² of which the West Bank (WB) is 5800 km², and Gaza Strip (GS) area 365 km². According to the Palestinian Central Bureau of Statistics (PCBS), by the end of the year 2016, the estimated population of the Palestinian Territories was 4.88 million. Of which 49.2 % are females, 2.97 million are living in WB, and 1.91 million are living in Gaza Strip (see the map Figure 1.2). The median age is 19.8 years, and 39.4% of the population is under 15 years old. The age group (0 – 4 years) is 15% while for the age group over 65 years constitute only 2.9 % of the population (PCBS, 2016).

Table 1. 1 Distribution of Palestinian hospital beds and primary health care centers in 2016.

Hospitalization	Regions	Public*	Others**	By region	Hospitalization
General	WB	1414 (32.2%)	1222 (28%)	2636 (60.2%)	4385 (73%)
	Gaza	1328 (30.2%)	421 (9.6%)	1749 (39.8%)	
Specialized	WB	180 (15.7%)	437 (38.2%)	617 (53.9%)	1144 (19%)
	Gaza	293 (25.6%)	234 (20.5%)	527 (46.1%)	
Rehabilitation	WB	0.0	141 (76.2%)	141 (76.2%)	185 (3.1%)
	Gaza	0.0	44 (23.8%)	44 (23.8%)	
Maternity	WB	0.0	213 (72.9%)	213 (72.9%)	292 (4.9%)
	Gaza	43 (14.7%)	36 (12.4%)	79 (27.1%)	
Total by region	WB	1594 (44.2%)	2013 (55.8%)	3607 (60%)	
	Gaza	1664 (69.4%)	735 (30.6%)	2399 (40%)	
Total beds		3258 (54.3%)	2748 (45.7%)	6006 (100%)	6006 (100%)
Primary care centers	WB	422 (69.4%)	186 (30.6%)	608 (80.0%)	
	Gaza	49 (32.2%)	103 (67.8%)	152 (20.0%)	
Total		471 (62.0%)	289 (38.0%)	760 (100%)	

*Public beds are hospital beds owned and managed by the Palestinian Ministry of Health (PMoH, 2015a)
**Others, hospital beds owned and managed by four providers other than the PMoH.

The Palestinian health care system comprises five primary providers of health care services, the Palestinian Ministry of Health (PMoH), the United Nations Relief and Works Agency for

Palestine Refugees (UNRWA), Non-Governmental Organizations (NGOs), Palestinian Military Medical Services (PMMS), and private for-profit organizations. The provision of health care services includes eleven administrative regions (governorates) in West Bank. They are Jenin, Tubas, Tulkarm, Nablus, Qalqillya, Salfit, Ramallah, Jericho, Bethlehem, Hebron, and East Jerusalem. We use the terminology “public” to denote the organizations owned and managed by the government and the terminology “others” for other providers.

The Palestinian Ministry of Health is the leading health provider and bears the most substantial burden of health provision (PMoH, 2015a). The ongoing budget of the PMoH was about \$500 million, salaries were 47% of the budget, and the country’s total health expenditure was \$1400 million in 2015 which accounted for 10.7% of the GDP (PCBS, 2017).

There are 80 hospitals in Palestine, 50 hospitals are in West Bank (60.1% of total beds), and 30 hospitals are in Gaza Strip (39.9% of all the beds), with a total number of 6,006 beds. 73% are general beds, 19% specialized beds, 3.1% rehabilitation beds and 4.9% maternity beds. Table 1.1 summarizes the distribution of the country’s hospital beds and the distribution of primary healthcare centers.

1.2.3 Jordanian health care system and demographic profile

The whole area of Jordan is 88,802 km². The estimated population by the end of the year 2016 was 8,185,384 (see Figure 1.2). The age group (0 – 14 years) is 35% while for the age group over 65 years constitute only 3.9 % of the population. The increase in estimated population during the last five years is attributed to the flow of Syrian refugees (World Fact, 2016).

The Jordanian healthcare system comprises public, private, charitable and International sectors. The public sector involves (1) Jordanian Ministry of Health (JMoH) which owns and manages the public hospitals; (2) the Royal Medical Services; (3) the medical services in public universities; and (4) the health services in the ministries and government institutions. These service providers operate collaboratively with four Council organizational bodies: The Higher Health Council; the Jordanian Medical Council; the Jordanian Nursing Council; and the Food and Drug Administration (JMoH, 2015b).

Out of 12,407 hospital beds distributed in 104 hospitals in Jordan, the JMoH owns and operates 31 public hospitals, which supply capacity of 4693 beds (37.8% of the total capacity), in addition to 1538 different primary health care centers. The budget in 2014 accounts for 8% of the Gross Domestic Product (GDP) which is about \$36,338 million (JMoH, 2015b).

The two health care provision systems in West Bank and Jordan are comparable: the government health expenditures per person are alike (World Bank, 2015); the two governments provide most of the population with national insurance schemes, and both countries don't employ family practice model for primary health care. Therefore, their public hospitals are required to shoulder the main burden of the provision of public health care services. It is worth noting that new reports find that government expenditure per person is nearly ten times higher in Israel than in the OPT (Haaretz, 2017), it is reasonable not to compare West Bank with Israel in respect of healthcare provision.



Figure 1. 2 Map of the region across the River Jordan

Source: https://joshberer.files.wordpress.com/2009/12/map1_un47.jpg

1.3 Research Objectives

This research process primarily demonstrates the practice of performance measurement, in seeking potential improvements, by employing advanced techniques in a transitional healthcare context. The conducted analysis is designed to inform decision-makers about performance from an operational standpoint. The primary objective of this thesis is to generate classes of information on *how well are the public hospitals across the River Jordan are performing?* The generated information provides empirical sound from practice in respect of two vital measures of performance: the productive efficiency and the delivery of the Patient-Centered Care (PCC).

This thesis aims to provide three classes of information to three principal actors in public hospital settings: (1) policymakers; (2) hospital managers; and (3) health professionals. Each domain can benefit from the relevant set of information according to their domain's structure and work modes to achieve the projected output improvements collectively. It is worth mentioning that the three domains are interrelated or sometimes overlapping. However, the interactions between the three domains are beyond the scope of this thesis.

The embedded studies employ two procedures are the Data Envelopment Analysis (DEA) methodology and the PCC approach. Both DEA and PCC are universally recognized in the healthcare literature. Hence, the past forty years or so has seen a proliferation in the number of conferences, workshops, books, and published research papers in the fields of DEA and PCC. There have, however, not been any research made in the case of interest of this thesis.

The need for information to stimulate action and organizational learning emphasizes the importance of performance measurement (Brignall & Ballantine, 1996). Each empirical work considers in more detail one principal actor in need of the generated information. Chapter Two targets policymakers and public authorities in West Bank and Jordan and International donors, Chapter Three targets hospital managers in West Bank, Chapter Four targets hospital managers in Jordan, Chapter Five targets professionals in West Bank.

The purposes of our endeavor are the following: First, to improve performance by positioning and benchmarking best performers. Second, to confirm priority actions by exploring the factors that influence getting high levels of organizational performance and bringing priority attention by highlighting performance problems. Third, to control public money spending on purchasing hospital services from referral hospitals in West Bank by identifying potential savings in public hospitals. Fourth, to learn from analyzing productivity change over time and the sources of inefficient performance. Fifth, to locate training needs and interpersonal skills among doctors

and medical students. And sixth, to help to organize the international aids given to the Palestinians and to avoid wasteful scattered projects.

1.4 Delimitations

The Occupied Palestinian Territories comprise the West Bank (WB) including East Jerusalem and the Gaza Strip. Hospitals in Gaza Strip are excluded in this work for many limitations: (1) The geographical separation between West Bank and Gaza, the Palestinians are not allowed to travel across them. (2) The 2008 and 2014 wars against Gaza makes the context of hospital operations incomparable. (3) The Palestinian internal conflict since 2006 escalated with the split of Palestinian Authority into a government in WB and a government in Gaza, hence, the operational data of Gaza available in the Palestinian Ministry of Health in West Bank is unreliable.

Whereas this thesis investigates the performance of public hospitals in WB and Jordan, Jordan is proposed as the reference case context that helps to analyze the evolution of public health services in West Bank as facing the transitional circumstances. Therefore, the work primarily focuses on West Bank. This assumption builds on observed reality, healthcare system and Palestinian medical institutions in West Bank evolved as part of the healthcare system in Jordan during 1950-1988.

We measure the performance of two representative sets of public hospitals in WB and Jordan from the operational perspective at the public hospital level using operational data during the period 2010-2015. The lack of public reporting of operational data of other healthcare providers restricted the author to employ DEA to public hospitals only. Doctors in private hospitals were surveyed as well as doctors in public hospitals (Chapter Five). The collected primary data is statistically analyzed to understand hospital doctors' views on PCC in West Bank.

1.5 Performance measurement

1.5.1 Performance measurement of healthcare delivery

The term performance is widely used in all fields of management; it refers to the action, the result of the action and the success of the result compared to some benchmark. The concept is seen in strategic management, human resources management, psychology, accounting, operations management amongst other fields (Zairi & Jarrar, 2000). Performance measurement is a complex continuous process with the aim of doing better all the time (Sinclair & Zairi,

1995). Since the purpose of management is to create a continuous flow of value, the measurement of performance is equated to a measurable value (Lebas & Euske, 2002).

Despite the intensive literature on performance measurement, there are few published definitions on the subject (Adair et al., 2006). Neely et al. (1995) identified three performance-related concepts; performance measurement is the process of quantifying the efficiency and the effectiveness of action, then performance measure as a metric used in the quantifying process, and performance measurement system as the set of metrics used in the process. Performance measures are the vital sign of the organization that quantifies how well the activities within processes or outputs of the process achieve specified goals (Hronec & Andersen, 1993).

There is a universal consensus on the potential benefits of performance measurement in a healthcare context (Adair et al., 2006). Performance measurement offers managers and policymakers the opportunity to secure health system improvement, which can boost the well-being as well as the standard of living of any nation (Jon A Chilingerian & Sherman, 2011). As regard healthcare, performance measurement is not a new effort; evidence shows that patient outcomes data were collected at the hospital of the University of Pennsylvania as early as the middle of 18th century (McIntyre, Rogers, & Heier, 2001). In Palestine, the origins of the public health statistics can be traced back to 1925 (Kligler, 1932).

The process of measuring performance in healthcare organizations is a challenge, because of the distinctive characteristics of health care services and because of the various perspectives of many stakeholders with complex goals (Hariharan, Dey, Moseley, Kumar, & Gora, 2004; Loeb, 2004; Portela et al., 2016). The professionals, the managers, the policymakers, and the patients are key stakeholders with different perspectives and different interests. The goals of hospitals are multiple, conflicting, and intangible. Hence, reaching equilibrium between the efficiency and effectiveness of their operations is a challenge, saying it another way, reaching this equilibrium is viewed as a factor that can intensify the friction between professionals and managers (Witman et al., 2011).

Ozcan (2008b) defines performance as a combination of efficiency and effectiveness; the two terms are interrelated, each one can be affected by or influences the other (Nayar et al., 2013). While efficiency is about the economic way of getting things done “doing things right,” effectiveness deals with the ends “doing the right things” (Robbins, DeCenzo, & Coulter, 2017). Hospitals might try to be efficient by reducing the patients’ hospitalization days, but they may not be effective if patients get sick soon after being discharged. They can also be effective but

not efficient, the hospital's target is to utilize the limited resources efficiently without compromising on quality.

Therefore, the healthcare literature distinguishes between clinical perspective and managerial perspective that interact with each other to evaluate performance (Jon A Chilingirian & Sherman, 2011). This could be seen another way; efficiency and quality perspectives and when evaluated together allow the measurement of "value" of healthcare delivered (Portela et al., 2016).

Regarding the clinical perspective, managers and professionals use measurement for evaluating, controlling, and improving medical practice. Compared with the abundant literature to improve managerial performance, the empirical research to improve professional service practices by applying performance measurement is relatively rare (De Vos et al., 2009). Statistical Process Control (SPC) tools are used in the healthcare context to improve the clinical process (Atkinson, 1993). Based on literature review, Thor et al. (2007) concluded that SPC is a useful tool and can help various stakeholders in improvement efforts in healthcare service practices.

About managerial perspective, the management literature identified three perspectives to approach performance measurement (Elg et al., 2013): First, the accounting perspective that emphasizes integration between planning and budgeting. Second, the strategic control perspective that emphasizes the deployment of goals and policies in addition to the links between different management levels and links with operations. Performance measurement systems developed as a central element of organizational control via links between set objectives and achievements (Amaratunga et al., 2001). Third, the operational perspective that emphasizes the quantifying of efficiency and effectiveness of activities (Neely, 2007; Neely et al., 1995).

A popular tool for strategic management in health care organization is the Balanced Score Card (BSC) developed by Kaplan and Norton in 1992 (Kaplan & Norton, 1995). It is applied in health care organization and used to follow-up and analyze activities (Kaplan & Norton, 2005; Kollberg & Elg, 2006). The BSC includes financial and non-financial dimensions and allows for integrating management and professional views. BSC won great interest in the public sector as well as in private sector. The BSC require specific key characteristics to help organizations to identify an appropriate set of measures to assess their performance, for example, measures

are derived from the strategy (Kollberg & Elg, 2011). We exclude the use of BSC in our methods because healthcare strategies in Palestine or Jordan are absent in hospital operations.

The thesis addresses performance measurement at the hospital level and from the operational perspective. According to Nayar et al. (2013), hospital performance measurement can be seen regarding two aspects: efficient operations and quality care services. That includes the managerial and clinical perspective of performance in the case of healthcare services (Portela et al., 2016). We included four empirical works that investigate two components of performance. First, by employing DEA methodology, the works discuss the efficient performance of public hospitals as a measure of the observed produced healthcare services to what resources are required to produce it. Performance is viewed as a relative concept across the sample of the investigated hospitals. Second, the effectiveness of medical interview by investigating aspects of Patient-Centered Care (PCC) approach. PCC is well documented as a key attribute in the measurement of the quality of healthcare services.

1.5.2 Performance measurement of healthcare delivery in developing countries

Although it has long been appreciated that performance management is essential for efficient and effective outcomes of organizations, interests in performance measurements in the developing countries particularly in the Middle East are recent (Neely, 2007). Performance management within healthcare context becomes increasingly complex in the settings of a developing country due to poorer health care system infrastructure and other economic, political, and societal factors (J. Griffin, Keskinocak, & Swann, 2013). Particularly, in the Middle East countries, healthcare demand and spending are rising sharply (Alhawsawi & Barach, 2017) and Arabic-speaking countries made limited progress in quality management (Tannock & Ahmed, 2008).

Evidence from developing countries shows that quality and efficiency problems are pervasive in health care (Andaleeb, 2001). Because DEA is the data-driven methodology, the lack of data and the absence of reporting in developing countries had restricted the DEA research (Linh Pham, 2011; Mogha, Yadav, & Singh, 2016). Further, based on a literature review on quality of care in the East Mediterranean Region, the authors found that patient relationship is an area of significant worries (Alhawsawi & Barach, 2017; M. Ali et al., 2017). The thesis aims to fill a gap in the DEA literature and the doctor-patient relationship literature in the developing countries context.

1.6 Conceptual framework

The questions behind the research objectives guided the overall investigations conducted in the thesis. The first question is, *what to measure?* Based on performance literature, the thesis addresses aspects of the productive efficiency among public hospitals and the delivery of PCC among Palestinian doctors in hospitals.

The second question is, *who will use the generated information by measuring performance?* Based on the Domain Theory, performance measurement in human services organizations can be described based on three domains: policy domain, management domain, and service (professional) domain (Kollberg & Elg, 2011; Kouzes & Mico, 1979). At the policy level, transparency through public reporting of performance measurement is encouraged to help to benchmark (Elg et al., 2013). In the healthcare context, professional domain is acknowledged as having the main influence.

Because performance measurement must rest on value judgment in healthcare context is essential, the Donabedian's (1966) model to approaching the assessment of quality of care “structure - process - outcomes” has gained widespread acceptance. He presumes that quality of medical care reflects a current of values and goals and can be judged by examining the three constructs. The judgment could be applied to several, attributes, aspects, properties, and ingredients within each construct (Donabedian, 2005). He also suggests that assessment can be approached by examining the process of care rather than outcomes, by examining whether what is called “good” medical care has been applied. This trilogy has been accepted as an approach to judge quality of care (Moore, Lavoie, Bourgeois, & Lapointe, 2015; Sainfort & Ferreira, 1990).

Donabedian (2005) established the relation between structure-process-outcome. The outcome construct represents recovery and improvements in health status and patient experience resulting from physical, mental, and psychosocial treatments. The process construct represents how well providers and staff deliver certain healthcare services and procedures and may contribute to improved outcome. Finally, the structure construct represents physical characteristics of healthcare settings as full-time professionals and other features related to capacity that can provide high care protocols; these comprise organization, human, material, and technology in which health care processes take place. Based on the Domain Theory and the Donabedian's model, Figure 1.4 illustrates the proposed conceptual model to manage performance.

The model captures three domains (three key contributors):

- 1- Healthcare professionals as doctors:
- 2- The policymakers as the Ministry of Health and other Medical Associations.
- 3- The hospital managers.

The model also captures three constructs:

- 1- Structure (or inputs).
- 2- Process (or operations).
- 3- Outcome (or outputs).

According to Donabedian's model (2005) "*good structure increases the likelihood of good process, and the good process increases the likelihood of the good outcome.*" This hypothesis is illustrated in the proposed conceptual model as the flow of value.

The proposed model links the three domains (actors) with the three constructs (operations) by continuous actions to improve performance, they are:

- 1) Generate three sets of information by measurements associated with the role of three domains. Each set of information is created by judging the structure, the process, or the outcome. Hence, nine areas of performance measures are created (see Figure 1.5). Because each domain (professionals, managers, or policy makers) operates by different and contrasting principles, success measures, structural arrangements, and working models. Hence, each area in Figure 1.5 has its aspects and attributes or said another way, has its performance measures.
- 2) Make decisions based on the generated information by performance measurement.
- 3) Implement the new decisions to improve structure, process, or outcome.
- 4) Measure again (Step 1).

These three actions (measure - decide – implement) is a continuous cycle of continuous performance management with the aim of always doing better.

Therefore, the proposed model suggests a map of performance measures to evaluate efficiency aspects as well as another similar map to evaluate effectiveness aspects. It is worth noting that efficiency and effectiveness are interrelated to represent the delivered value of performance. When taken together, allow for the measurement of value of the provided healthcare services.

Figure 1.5 illustrates one layer of the proposed measurement system. In total, nine areas of performance measurement for efficiency aspects and other nine areas of performance measurement for effectiveness aspects can be produced. For example, the shaded area represents the role of professionals (aspects related to capacity) in the construction of better hospital's structure.

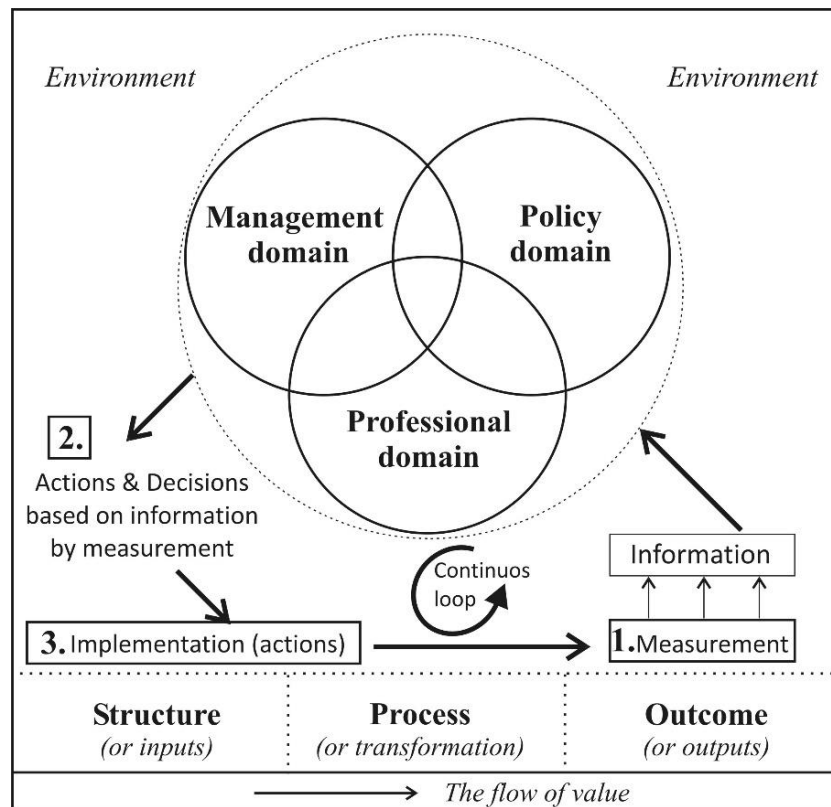


Figure 1. 3 Conceptual Model, the continuous **value creation** of performance measurement.

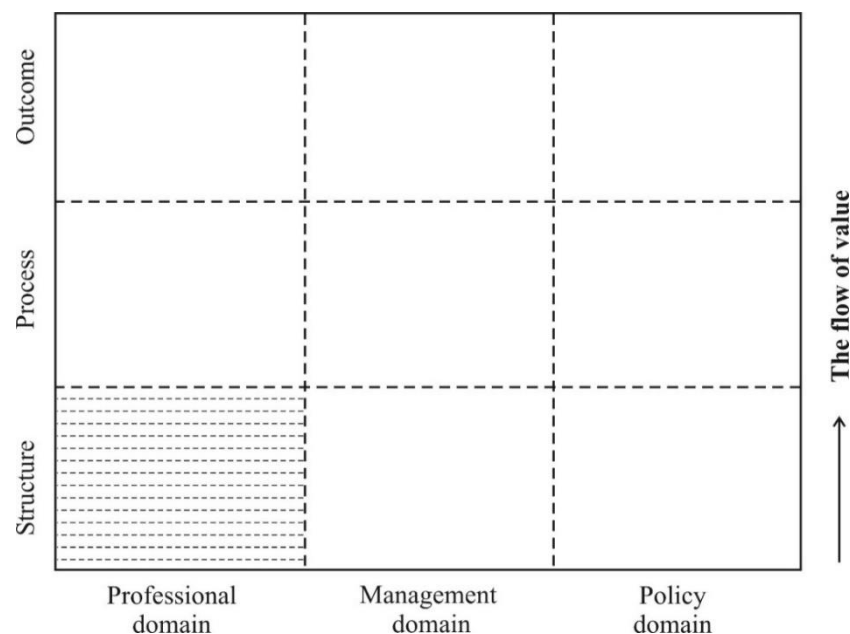


Figure 1. 4 Proposed performance measurement system for hospital operations

1.7 Methods

The thesis addresses the measurement of two main components of performance, the productive efficiency and the effectiveness of medical interview. Hence, two key steps were followed and helped to organize the thesis into two main parts. In general, the Data Envelopment Analysis (DEA) methodology (Chapters 2-4) and the Patient-Centered Care (PCC) approach (Chapter 5) are the methods used to achieve the planned research objectives.

The first part includes three empirical works and employs two milestones DEA models, namely the CCR (Charnes, Cooper, & Rhodes, 1978) and the BCC (Banker, Charnes, & Cooper, 1984). These two models have become standards in the literature of performance measurement under the assumptions of constant and variable returns to scale respectively (Despotis et al., 2016). DEA is a universal methodology in healthcare evaluation and widely used non-parametric methodology to evaluate performance (Gouveia et al., 2016; Liu, Lu, & Lu, 2016; Mitropoulos, Mitropoulos, & Sissouras, 2013). Finally, DEA is widely used in the assessment of the productive efficiency in all domains of healthcare organizations. The Management domain (Portela et al., 2016), the policy domain (Kawaguchi, Tone, & Tsutsui, 2017), and the professional domain (Jon A Chilingirian, 1995; Fiallos, Patrick, Michalowski, & Farion, 2015).

The used data is derived from the annual reports published by the two Ministries of Health in West Bank and Jordan. The three DEA studies of this part investigate many aspects of productive efficiency of hospitals across the River Jordan. The first DEA study “Chapter Two” focuses on policy implications on efficiency. This chapter follows the work of Charnes, Cooper, & Rhodes (1981) and disentangles healthcare policy and managerial efficiencies throughout the case of West Bank and Jordan. Then “Chapter Three” takes the DEA research further by employing Malmquist Index (MI) and Tobit Regression throughout the case of West Bank. Finally, “Chapter Four” extends the uses of estimated efficiency scores obtained from DEA models to address scale efficiency, peer grouping, and target settings throughout the case of Jordan.

The second part of the thesis “Chapter Five” includes the fourth empirical work and describes the doctors' views on Patient-Centered Care (PCC) in the hospitals of West Bank and explores how the hospital and other clinical characteristics impact their perceptions of the importance of delivering PCC. To achieve this purpose, a sample of 369 Palestinian hospital doctors completed the 16 scale items of Provider-Patient Relationship Questionnaire (PPRQ). Doctors were also asked to report eight scale items measure the level of influence of eight contextual

factors on their perceptions in work practice. This work employs statistical Multivariate Analysis including Canonical Correlation.

To familiarize the reader with the two methods that we applied throughout the thesis, it seems worth to introduce the DEA and the PCC methodologies in the healthcare context. We briefly clarify them and introduce some relevant hospital studies in the following subsections.

1.7.1 Data Envelopment Analysis (DEA) methodology

The concept efficiency is, in the broad sense, a statement about performance of processes transforming a set of inputs into a set of outputs that illustrates the utilization of resources (Førsund & Hjalmarsson, 1974). It is a comparison between observed and optimal values of producer's output and input (Fried *et al.*, 2008). Through his pioneering work, Farrell (1957) defined technical efficiency as the firm's success to produce the maximum feasible amount of output from a given amount of input or producing a given amount of output using the minimum level of inputs where both the inputs and the outputs are correctly measured.

Technical or productive efficiency of a firm is a statement of its success in using as small as possible inputs to produce a given level of outputs. In that sense, it is possible to distinguish a perspective of output expansion from a perspective of input contraction (Portela, 2014).

The productivity of a producer is defined as the ratio of its output to its input (Hollingsworth, 2008). Variations of this measure over time, either across producers or through time, is productivity change. Then, productivity growth becomes the difference between output growth and input growth (Fried *et al.*, 2008).

Performance Analysis of hospitals using DEA is based on the production theory in economics. Farrell (1957) argued that trying to find a theoretical efficient production function in a complex process is unsatisfactory. Therefore, he provided a method to estimate productive efficiency by comparing the firm's performance with an empirical efficient production function based on the best performers frontier obtained in practice. The starting point of DEA was the work of Charnes *et al.* (1978), using Farrell's views the production possibility set, the authors provided an operational framework to assess the relative efficiency of multiple-input-multiple-output production units. The method measures the relative efficiency of a homogeneous group of Decision Making Units (DMUs) such as hospitals. DEA is a mathematical linear programming methodology based on the Frontier approach (Liu, Lu, Lu, & Lin, 2013a), by which we can determine the extent of resource utilization by estimating the best performers' frontier (Chowdhury & Zelenyuk, 2016).

The flexible and generic definition of DMU made the successful DEA applications in many different types of entities. The use of DEA engaged in many activities, in many contexts, and operate in many countries (Cooper, Seiford, & Zhu eds., 2011). In the healthcare context, the broad methodological framework of the DEA models allowed for extensive applications. DEA applications ranged from doctor to hospital and from productivity to quality frontiers (Jon A Chilingerian & Sherman, 2011).

Since the advent of DEA, more than ten thousand studies that estimated the performance of different kinds of entities and production activities were published (Emrouznejad & Yang, 2017). Sherman (1984) published the first paper measuring hospital efficiency, the power of applying DEA in hospital settings is best stated in his work: *“Data Envelopment Analysis (DEA), is field tested by application to a group of teaching hospitals. DEA is found to provide meaningful insights into the location and nature of hospital inefficiencies as judged by the opinion of a panel of hospital experts. DEA provides insights about hospital efficiency not available from the widely used efficiency evaluation techniques of ratio analysis and econometric-regression analysis”*. Details of hospital efficiency studies employing the DEA methodology can be found in a review work of Hollingsworth (2008).

DEA has many benefits that make it suitable for measuring the efficiency of public hospitals are: (1) analysis considers the complex nature of hospital operations of multiple outputs and multiple inputs, (2) it does not require a prior identification of a production function, (3) efficiency is measured relative to the highest observed performance rather than against some average and (4) it does not require information on prices (Odeck & Alkadi, 2001). Since the public hospitals are part of the public service sector where there is no price information on the services produced, the DEA approach is well-suited for measurement purposes throughout this thesis.

DEA literature addressed procedural concerns related to applying DEA as a method for performance evaluation. Golany & Roll (1989) suggested a systematic application procedure of DEA method. Dyson et al. (2001) and discussed pitfalls when using the DEA method and suggested many protocols that deliver robust analysis: (1) State of homogeneity among the DMUs. (2) The number of inputs and outputs when compared to the number of DMUs, (3) The Clear purpose of the DEA exercise, (4) The importance of the model orientation. Then, Cook, Tone, & Zhu (2014) addressed several issues to consider when choosing DEA model as orientation, the number of inputs and outputs, and the nature of the data available.

To illustrate Farrell’s method to measure the technical efficiency using the DEA methodology, a proposed set of nine virtual hospitals is given in Table 1.2. Each hospital utilizes two types of resources (nurses, doctors) and produces one unitized output (50 discharges).

In a simple form, when a hospital has a single output “y” and is produced from two inputs, X1 is the number of nurses/50 discharge/month and X2 is the number of doctors/50 discharge/month. Figure 1.3 illustrates the production possibility set (frontier), i.e., the maximum output produced from all input combinations or expressed as a mathematical formulation:

$$y = f(X1, X2) \quad (1.1)$$

Figure 1.3 illustrates the operating points of the hospitals on the x-y axis. From the input-oriented perspective, by definition (producing a given amount of output using the minimum level of inputs), one can judge hospitals which use fewer inputs to get the one-unit output as more efficient.

Table 1. 2 For illustration, nine hospitals are using two inputs to produce one unitized output.

Hospital	H1	H2	H3	H4	H5	H6	H7	H8	H9
Nurses	4	7	8	4	2	5	6	6	5
Doctors	3	2	1	2	4	2	4	3	3
output	50	50	50	50	50	50	50	50	50

Therefore, the line-segments connecting H3, H4, and H5 represent the estimated efficient frontier. Measuring the efficiency of a hospital consists of comparing it with a hypothetical hospital that uses the resources in the same proportion. For example, H1 uses a hypothetical hospital made up of H4 and H5.

DEA determines how efficiently an operating unit (hospital) converts inputs (resources) into outputs (services) when compared with other hospitals. DEA implements the relative efficiency definition: a production unit is to be rated as fully (100%) efficient based on what had been achieved if and only if the performances of peer production units do not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs.

In practice, operating units have multiple inputs and outputs, the efficiency of an arbitrary unit “j” can be expressed as:

$$Efficiency\ of\ unit\ j = \frac{weighted\ sum\ of\ unit\ j's\ outputs}{weighted\ sum\ of\ unit\ j's\ inputs} \quad (1.2)$$

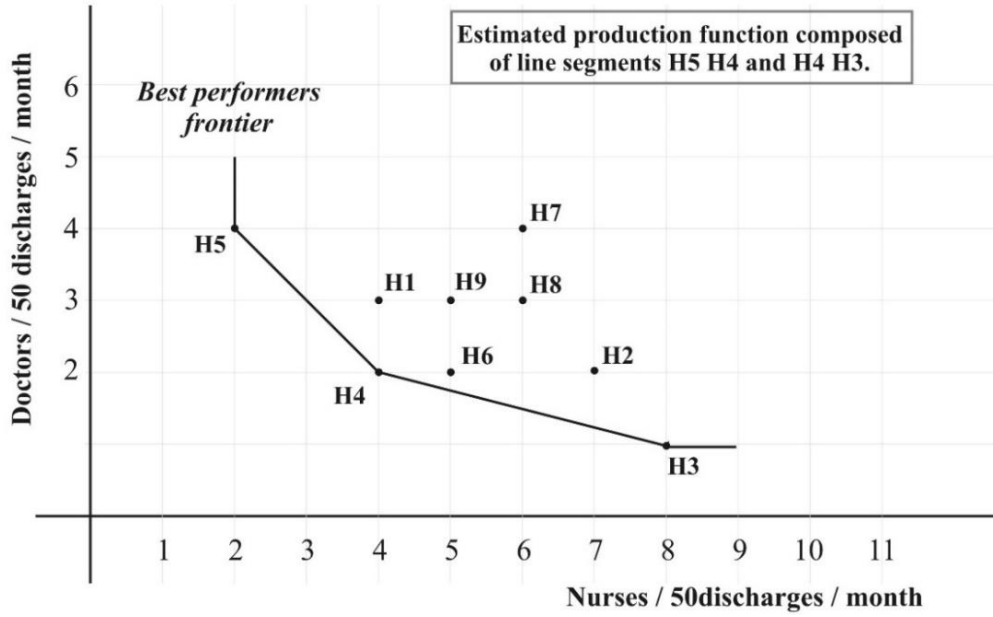


Figure 1. 5 Illustration of Farrell's method to estimate the efficient production function.

The definition in Equation 1.2 requires weights to be identified. Because it is difficult to define a common set of weights across all the units of interest, by arguing that each operating unit has its own particular value system and may legitimately define its set of weights, the problem of finding common weights can be solved (Boussofiane *et al.*, 1991). Charnes *et al.* (1978) proposed a model to score the efficiency of a set of units, efficiency for unit j as:

$$Max \theta_o = \frac{\sum_{r=1}^t u_r y_{rjo}}{\sum_{i=1}^m v_i x_{ijo}} \quad (1.3)$$

Subject to,

$$\frac{\sum_{r=1}^t u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \quad j = 1, 2, \dots, n$$

$$u_r \text{ and } v_i \geq 0 \quad \text{for all } i \text{ and } r$$

Where, u_r = the weight assigned to output r , and v_i = the weight assigned to input i , y_{rj} = the amount of output r for unit j , and x_{ij} = the amount of input i for unit j , t = number of output variables, m = number of input variables, and n = number of operating units (hospitals) under evaluation.

The solution of the linear programming problem maximizes the efficiency of unit j subject to efficiencies of all other units in the set having an upper value of one. The fractional programming model in Equation 1.3 may be converted into a linear model 1.4. The linear programming form will be:

$$\theta^* = \text{Max } \theta_o \sum_{r=1}^t u_r y_{rjo} \quad (1.4)$$

Subject to,

$$\sum_{i=1}^m v_i x_{ijo} = 1$$

To prevent unbounded solutions, we also require the sum of the weighted inputs for the unit under investigation (unit j) to equal one.

$$\sum_{r=1}^t u_r y_{rj} \leq \sum_{i=1}^m v_i x_{ij} \quad j = 1, 2, \dots, n$$

$$u_r \text{ and } v_i \geq 0 \quad \text{for all } i \text{ and } r$$

A separate linear programming problem is solved for each observed unit in the DEA problem to estimate the optimal efficiency score θ^* . Because the sum of weighted inputs for the unit under investigation must equal one, and its sum of the weighted outputs (being maximized) cannot exceed this value, the maximum estimated efficiency value for the unit under investigation is also one. Thus, units that are efficient will have a DEA efficiency score of 100% (Ragsdale, 2014, p. 106).

1.7.2 Patient-Centered Care (PCC) approach

The importance of catching the tangible and intangible aspects of health care services was also addressed in performance literature (Zigan et al., 2007). Coordination, team performance measures and their linkages with patient outcomes, and doctors' communication skills are examples of intangible aspects of health care (Temkin-Greener et al., 2004; Zigan et al., 2007). The doctors' Interpersonal and communication skills had a significant impact on high-quality care and became a precondition by many regulatory organizations in America and Canada amongst others as the sixth competence to practice medicine (Calhoun et al., 2009; Rider et al., 2006).

Patient-Centered Care (PCC) employs that patients are informed, about their circumstances are considered, and they share decisions in their care for the most available benefits (Illingworth, 2010). It is recognized as a measure of the quality of healthcare. Based on the evidence, research shows that implementing PCC practices promotes patients' adherence and improves health outcomes (Gremigni et al., 2016; Robinson et al., 2008). From a clinical point of view, PCC recognizes the belief that healing involves knowing the patient as a person as well as accurately

diagnosing his illness (Epstein, 2000). Patient-Centered Care, Patient Centeredness, and Patient-Centered Communication are used interchangeably in the healthcare literature.

PCC is a popular methodology in the theory and practice of medical interview with many models to implement its principles (Robinson et al., 2008). The literature is replete with conceptual models in the realm of doctor-patient relationship and frameworks for teaching and assessing communication skills from different perspectives. Such as the framework for educating and evaluating communication skills (Makoul, 2001), the essential elements of communication in the medical encounter “Kalamazoo Checklist” (Brunett et al., 2001). Frankel & Stein (1999) developed the Four Habits Model; it applies a behavioral approach to the medical encounter. Makoul, Krupat, & Chang (2007) developed and tested the Communication Assessment Tool (CAT). CAT is a reliable and validated assessment tool for physician performance to gauge interpersonal and communication skills. Finally, Provider-Patient Relationship Questionnaire (PPRQ) is a self-assessment tool developed by Gremigni et al. (2016). Sommaruga et al. (2017) applied the PPRQ to examine self-perceived PCC among healthcare professionals in Italy. We used the PPRQ instrument in the PCC empirical study attached in this thesis in Chapter Five.

Despite the agreement on PCC benefits, there is a gap between the theory and the implementation among professionals (van den Brink-Muinen et al., 2002). The Agency for Healthcare Research and Quality (AHRQ) reported that only around 45% to 62% of the patient encounters “always” used the PCC approach (E. Kelley et al., 2005).

A question suggests itself in our work, why blending DEA and PCC? Doctors make and control 80% of the resource input decisions in health care systems and the variations in doctors’ resource utilization may arise from inefficient decision-making (Eisenberg, 1986). Without considering the relevant information on patient’s history, personal circumstances, health status, and needs, the doctor will often be unable to deliver high-quality care, resulting in unscheduled readmission and wasteful duplications (P. C. Smith, 2005). Although a good medical interview with patients is perceived as time-consuming, when intentions appropriate diagnosis and treatment course, serves as the basis for effective and efficient practices in the provision of hospital services. Donabedian (2005) considers the logical use of information to arrive at a decision and the way to obtain information as an evaluation element in both value and efficiency of medical care. Otherwise, the clinical procedures will be costly. In that regard, Patient-Centered Care (PCC) is perceived as the right thing to do (Epstein & Street, 2011). Implementing PCC practices makes up a common understanding of the patient’s condition that

will help the doctor getting the relevant information and execute the best possible clinical strategy (Oates et al., 2000). Compliance with PCC practices would support the confluence of managers and professionals to improve performance.

1.8 Contributions of this thesis

Many contributions are made up throughout this research projects. From an operational standpoint, the work has the privilege of being the first to introduce real indicators and thorough discussion of the performance of public hospital services in West Bank and Jordan. Contributions are attributed to the appended four empirical works as well as to their integrated unit as a thesis project; the contributions can be summarized as follows:

- Provides a balanced approach that evaluates performance at three levels: policy; administrative management; and professional services within public hospitals context and three organizational constructs: structure; process; and outcome (thesis).
- Provides detailed discussion and historical evolution of the unique transitional health care context of West Bank and employs across country analysis as a policy measure of performance (thesis).
- Surfaces the need for and the benefits of designing and implementing a performance measurement system in West Bank as well as in Jordan (thesis).
- Addresses DEA knowledge gap. The first empirical illustration of the use of DEA in West Bank, and the second in Jordan (chapters 2,3, and 4).
- Provides real indicators in practice for organizing the role of international funds. This will help in resolving the measured weaknesses avoiding wasteful duplication in reform projects (chapters 2 and 3).
- Identifies the inefficiencies attributed to policies in West Bank and Jordan (chapter 2)
- Surfaces the often-neglected role of Jordan in the literature on the evolution of provision of health care services in West Bank (chapter 2).

- The thesis takes the existing DEA research further and generates in-depth information by employing longitudinal data analysis using Malmquist index and Tobit regression (Chapter 3).
- Explores factors of inefficient performance among the public hospitals in West Bank (chapter 3).
- Provides evidence of Palestinian emphasis on physical capacity building rather than intangible dimensions of performance in West Bank. Findings show that hard aspects preceded the soft aspects (chapter 3).
- Provides step-by-step managerial information to improve the performance of each Jordanian public hospital (chapter 4).
- The thesis addresses PCC knowledge gap. For the first time investigates PCC behaviors among Palestinian doctors (chapter 5).
- Identifies factors that drive better PCC behaviors and suggests straightforward improvement (chapter 5).
- Explores the weaknesses in an essential quality attribute in respect of provider-patient relationship and identifies factors for improving PCC behaviors to investment in (chapter 5).

1.8 Appended empirical works

The research objectives presented in Section 1.3 are elaborated in the appended papers. Hence all papers take the main objective as a starting point (*to generate sets of information on how well the public hospitals across the River Jordan are performing?*). The papers, however, differ concerning what performance dimension is investigated, the domain of information produced, methods used, and a case of interest. Table 1.3 depicts the included papers concerning these categories.

Table 1. 3 Intersection of the included empirical studies with the objectives of the thesis¹

Paper	Thirty Years after Disengagement with Jordan: Are the Public Hospitals Reforming Efficiently in West Bank?	Longitudinal Analysis of Efficiency of Palestinian Public Hospitals in West Bank.
Chapter	2	3
Performance Domain	Productive efficiency Policy, management, and donors	Productive efficiency Policy, management, and donors
Method	DEA-CCR and DEA-BCC	DEA, Malmquist index, and Tobit regression
Design	Longitudinal	Longitudinal
Case study	West Bank & Jordan	West Bank
Purpose	Purpose 1,2 & 6	Purpose 1, 2, 4, & 6
Paper	Evaluating the Productive Efficiency of Jordanian Public Hospitals.	Compliance of Palestinian Hospital Doctors with PCC behaviors.
Chapter	4	5
Performance Domain	Productive efficiency Management	Effective process (medical interview) Professionals
Method	DEA & slacks DEA model	Descriptive design using a self-evaluation survey.
Design	Longitudinal 2010-2014	Cross-sectional
Case study	Jordan	West Bank
Purpose	Purpose 1 & 4	Purpose 1 & 5

¹ It is worth noting that: purpose (1) improve by doing things differently and benchmarking; purpose (2) confirm priority by exploring performance drivers; purpose (3) control public money expenditures; (4) learn from longitudinal analysis and benchmark previous periods; purpose (5) Train and educate professionals for more appropriate soft skills; and (6) reorganize international funds and avoid wasteful duplications (Amaratunga et al., 2001; Behn, 2003).

1.9 Organization of this thesis

The thesis is organized as follows:

Chapters 2: Thirty Years after Disengagement with Jordan: Are the Public Hospitals Reforming Efficiently in West Bank?

The chapter begins with an introduction to the strong associations between Jordan and West Bank, the relevant literature, and the research problem. Section 2.2 describes the data and materials employed, research design follows the DEA work of Charnes *et al.* (1981), and procedures conducted within each stage of analysis. Section 2.3 presents the main findings in graphs presentations format and discusses the relevance of the results. Section 2.4 shows the concludes and provides the limitations and further research. Appendix A presents the mathematical formulations of the employed models. Finally, Appendix B in Chapter Two includes the results formatted in Tables as graphs were embedded within the text.

Chapters 3: Longitudinal Analysis of Efficiency of Palestinian Public Hospitals in West Bank.

The chapter takes the basic DEA models; namely, the BCC and CCR models further and employs longitudinal analysis and Tobit regression for in-depth analysis within a proposed conceptual model. The chapter begins with an introduction to the economic evolutions of building the capacity of hospitals in West Bank and literature review. Section 3.2 describes the data and materials employed, research design of the three steps of work DEA, Malmquist index, and Tobit regression. Section 2.3 presents the main findings and thorough discussion; longitudinal analysis decomposes changes in efficiency into changes in technology and efficiency. The econometric model identified factors influencing inefficient performance. Section 3.4 presents the concludes and provides the limitations and further research. Appendix C presents year-specific results of Malmquist index analysis. Finally, Appendix D includes efficiency scores and transformations applied in Tobit regression.

Chapters 4: Evaluating the Productive Efficiency of Jordanian Public Hospitals.

The chapter elaborates further application of information generated from the DEA models. The study employed the basic DEA models; namely, the BCC and CCR models, the slack-based model is also employed. After the introduction, the research problem, and literature review, section 4.2 methods, and the production model are introduced. Section 4.3 comprises five stages of analysis, in each stage, results and discussion are provided. Section 4.4 concludes and provides the limitations of the study.

Chapters 5: Compliance of Palestinian Hospital Doctors with PCC behaviors.

The chapter introduces the Patient-Centered Care approach, definition, frameworks, implementation, education matters, and compares public hospitals with other types of hospitals. The introduction part provides detailed working conditions of the Palestinian doctors, the biopsychosocial model and the conceptual model of the study. Section 5.2 presents a thorough literature review. Section 5.3 is the research design, questionnaire, data and sample, and descriptive analysis and clustering of the respondents. Section 5.4 presents the main results of the Multivariate Statistical Analysis and the Canonical Correlation. Factors that underpin doctors' views on delivering PCC behaviors are explored. Section 5.5 concludes and provides the limitations and future research. Finally, Appendix E includes the final version of the used questionnaire.

Chapters 6: Concludes the thesis by summarizing the main research findings presented in the thesis and provides future research directions.

1.10 Publications and works based on this thesis

Published in international journals:

- Sultan, W. I., & Crispim, J. (2016). Evaluating the Productive Efficiency of Jordanian Public Hospitals. *International Journal of Business and Management*, 12(1), 68. <http://dx.doi.org/10.5539/ijbm.v12n1p68>

Submissions being processed in international journals:

- Compliance of Palestinian Hospital Doctors with PCC behaviors. Submitted to the “Value in Health” Journal www.journals.elsevier.com/value-in-health . Status: under review.
- Longitudinal Analysis of Efficiency of Palestinian Public Hospitals. *BMC Health Services Research - Journal - Springer*. Status: under editorial assessment
- Thirty Years after Disengagement with Jordan: Are the Public Hospitals Reforming Efficiently in West Bank? Submitted to The Journal of the Egyptian Public Health Association. <http://journals.LWW.com/ephaj/pages/default.aspx>. Status: new submission.

In proceedings of an international conference:

- Sultan, W. I., & Crispim, J. (2016). The impact of Physicians on Patients Seeking Hospital Services: Information Asymmetry Combines with Shifts in Perceived Quality. *Proceedings of 2nd International Conference on Quality Engineering and Management ICQEM, July 13-15, 2016 – Guimaraes – Portugal*.

Presentations:

- [Inefficiency Associated with cross-functionality in hospitals: A DEA approach. 5th Workshop on Efficiency and Productivity Analysis, Challenges in University and Faculty Assessments, 5th October 2015, Universidade Católica, Porto, Portugal.](#)
- Compliance of Palestinian Hospital Doctors with PCC Behaviors. Conference on “Ethical Management and Sustainability Studies.” Ph.D. in Business Administration program, May 31st 2017, School of Economics and Management, University of Minho, Braga, Portugal.

CHAPTER 2

Thirty Years after Disengagement with Jordan:

Are the Public Hospitals Reforming Efficiently in West Bank?

ABSTRACT

Since 1950, the health care services in West Bank (WB) evolved as part of the Jordanian healthcare system. The Jordan's severance of the administrative and legal ties with West Bank in 1988 initiated the effective role of the Palestinians in the provision of public healthcare services in WB. Due to the continuous historical, social, and cultural associations, Jordan's stake in healthcare provision continued, and it is still noticed in the West Bank. Since the establishment of the Palestinian Authority in 1994, reform efforts were subsidized much by the international aiding agencies to rebuild the country's institutional capacity. To give a realistic evaluation of Palestinian achievements in the conduct of healthcare, we examine the relative performance of public hospitals during 2010-2015 in West Bank and Jordan. We employ Data Envelopment Analysis (DEA) models to distinguish between within-country managerial efficiencies and public policy "program" efficiencies across the two countries. The study follows two key steps, the first step evaluates managerial efficiencies and explores trends in performance. Then, the second step evaluates program efficiencies. Hospitals improved their year-specific managerial efficiency within-country during the study period. Improvements in managerial efficiency were driven by scale effects in West Bank and by pure technical enhancements in Jordan. The inefficient performance was less attributed to the public policies in West Bank than in Jordan.

Keywords: DEA; Public Hospitals; Managerial efficiencies; Program efficiencies; West Bank; Jordan.

2.1 Introduction

2.1.1 Historical evolution

The consistent concerns of Jordan about West Bank (WB) are driven by the historical religious, economic, political, cultural, and social ties between Jordan and the Palestinians living in WB, as well as, the simple fact of geography (Ashton, 2009). On 24 April 1950, the "The Emirate of Trans-Jordan" unified with West Bank into one state of "The Hashemite Kingdom of Jordan"

that comprised the East and the West Banks of River Jordan. The Palestinians were granted the Jordanian nationality (Abu-Odeh & Delvoie, 2000; Al Madfai, 1993). Despite the Israeli military occupation of West Bank and Gaza Strip in June 1967, Jordan's concerns continued with Palestinians living in West Bank. The evolvement of different aspects of the Palestinians' lives continued to be strongly associated with Jordan (Al Madfai, 1993, p. 25). Examples are: the Jordanian curriculums, legislation, and the healthcare regulations continued to be applied in West Bank. In the early nineties, as well as many other sectors, the Jordanian healthcare institutions were the only recognized boards in the Palestinian healthcare markets. Up to date, Jordan controls over traffic across the bridge connecting the two banks of the River Jordan, it is the only exit point for the Palestinians (Al Madfai, 1993, p. 141), and Jordan acts as custodians of the holy sites in East Jerusalem.

On 31 July 1988, King Hussain of Jordan broke off all the administrative and legal ties with the Israeli-Occupied West Bank of the River Jordan (Office of King Hussein I, 2000). The disengagement decision is a turning point in a long story of Jordan's relations with the Palestinians (Abu-Odeh & Delvoie, 2000, p. xi), and initiated new perspectives in the strategy and actors of the peace process in the Middle East (Al Madfai, 1993, p. 195). The post-disengagement settings allowed for an effective role of the Palestinian Liberation Organization (PLO) to act internationally as the sole legitimate representative of the Palestinians and challenged PLO to shoulder the Palestinian responsibilities (Karolyi, 2017). Even though, the historical associations between Jordan and the Palestinians brand Jordan's stake in the Middle East Peace Process as unavoidable. Further, currently, around one-half of the Jordanian population is of Palestinian ancestry (Al-Din et al., 1996; Karolyi, 2017).

In that regard, the role of the PLO transformed from liberation movement to independence movement (Said, 1989). The PLO is struggling for an independent state in the Occupied Palestinian Territories OPT. The OPT since June 1967 comprises the West Bank including East Jerusalem and Gaza Strip. On 15 November 1988, the Palestinian National Council PNC endorsed the Palestinian Document of Independence for Palestine on the OPT under the principles and provisions of the United Nations Charter. Later, the Middle East peace conference convened in Madrid in 1991, then the Oslo Peace Accords in 1993 between the Palestinians and the Israelis took place, and the Palestinian Authority was established in 1994. The administration of the public healthcare providers was transferred from the Israeli Civil Administration to the Palestinian Ministry of Health, but other providers named: The UNRWA,

the Non-Governmental Organizations NGOs, and for-profit private hospitals continued as they had been before (Hamdan & Defever, 2002).

It is felt that the interrelations remain silent and substantially impact many aspects of the Palestinians' lives as well as the Jordanians' lives. Because the public health sector experienced the transitional administration, a good understanding of the Palestinian achievements in the conduct of public healthcare delivery should account for the contextual interrelations with Jordan (Saltman, 1997). To do that and from an analytical perspective, a reliable measure is needed to gauge the public healthcare policies in West Bank. The comparability with Jordan after thirty years of disengagement could be useful.

2.1.2 Pertinent literature

Few descriptive studies addressed the status of the Palestinian healthcare system, although often highlighting the weaknesses and the political constraints, had inadvertently dropped the historical associations with Jordan. Hamdan & Defever (2002) identified the characteristics of the transitional setting. Giacaman et al. (2003) analyzed the obstacles that faced reform efforts. Batniji et al. (2009) described the health and well-being conditions in addition to maternal and child health issues. Giacaman et al. (2009) described the historical evolution of the Palestinian healthcare system. Others provided statistical evidence on the Palestinian healthcare practices and healthcare professionals (Haj-Yahia et al., 2015; Hamdan & Saleem, 2013; Rashed & Hamdan, 2015; Verdonk et al. , 2007).

Researchers also addressed the ongoing reform efforts in rebuilding the providers' capacity and the implications of the international funds and donor policies. The external funds are efforts by the international community to resolve the conflict in Palestine-Israel through economic encouragements (Ashton, 2009), and about 8% of these supplies are dedicated to healthcare sector (Giacaman et al., 2003). Nevertheless, due to the descriptive nature and lack of systematic documented working data, earlier research didn't provide a performance measure from a realistic point view to check the Palestinian achievements in respect of healthcare delivery. Since performance is a relative concept and considering these circumstances, there would be no better alternative than benchmarking Jordan.

2.1.3 Research problem

Up to date, the institutional relations between Jordan and West Bank can be noticed in West Bank. The Palestinian Medical Association in Ramallah is part of the Jordanian Medical Association in Amman. The -250 beds- hospital "Al Makkassed" in East Jerusalem is still

recognized as a teaching hospital by the Jordanian Medical Board (PMoH, 2015a). Another public -275 beds- hospital in Hebron officially named “Hebron Governmental Hospital” is still known among the public as “Alia” after the name of the daughter of King Hussain “Princess Alia.” The same observation goes to “Al Hussain Hospital” in Bethlehem. Finally, bearing in mind that medical professionals are key decision-makers in healthcare delivery and their institutional background has impacts on their decisions, the proportion of accredited Palestinian specialists by the Jordanian Medical Council is not insignificant.

While these forces influence the operations of the Palestinian hospitals, their managers also implement the country’s policies to deliver public health care services. Their performance is a consequence of management efforts and policy development to improve hospitalization services. Hence, this work evaluates management efficiency within the country as a distinct from the program efficiency.

To meet the information needs of public authority and international donors, we introduce a realistic benchmark to judge the country’s relative performance concerning healthcare delivery. We pay attention to performance differences between West Bank and Jordan from two perspectives, the managerial perspective within the country and the program perspective across the two countries. The study goes to answer the following research question: *as compared with Jordan, are the public healthcare policies reforming efficiently in West Bank?*

2.1.4 The measurement of relative efficiency in healthcare context:

Improvements in healthcare are important as the scope of health care services goes beyond the care provided for the patients, it also includes the impact on the family and community (Fitzsimmons & Fitzsimmons, 2006). Efficiency is a measure of performance and has been a question of great interest as organizations have struggled to improve performance (Cook & Seiford, 2009b). Therefore, health organizations have been under increasing pressure to improve performance (Jon A Chilingerian & Sherman, 2011).

Operations researchers show a greater emphasis on performance measurement of professional service organizations (Stock et al., 2017). Performance is a relative concept and could be measured for the organizations (e.g., hospitals) by reference to the observed performance in the previous periods or relative to similar organizations within the same period (R. Griffin, 2013, p. 34).

Because it is difficult to define the significance of each input or the synergy between production factors in a complex professional service process, it is very problematic to specify a theoretical

efficient production function with the aim of measurement. The question of measuring productive efficiency and its importance for the economic policymakers was best stated sixty years ago in the seminal work of Farrell (1957). Farrell succeeded to solve the problem of measuring productive efficiency by combining the measurement of multiple inputs into a single satisfactory measure of efficiency. Farrell's method to estimate productive efficiency compares the observed performance of an organization or industry with an empirical production frontier based on the best results obtained in practice.

Charnes et al. (1978) operationalized Farrell's approach and introduced the Data Envelopment Analysis (DEA) methodology to measure the efficiency of a homogeneous group of Decision Making Units (DMUs). DMU is any productive organization "from a small shop to a hospital to a whole economy." It is a nonparametric linear programming-based method for performance evaluation where multiple performance dimensions exist (Liu et al., 2016). DEA develops best performers frontier and assigns efficiency score for non-frontier hospitals according to their distance to the efficient frontier.

The basic DEA model, known as the DEA-CCR model in the literature, assumes constant returns to scale CRS in hospital operations. In practice, not all DMUs operate at an optimal scale. Førsund & Hjalmarsson (1974) introduced the decomposition of Farrell's original measure of productive efficiency into separate scale efficiency and technical efficiency. Then, using the piece-wise linear frontier, the decomposition was considered by Banker et al. (1984) in the DEA-BCC model which accounts for Variable Returns to Scale (VRS).

It is informative to know whether any inefficiency is the consequence of hospitals' scale of operations or managerial practices. Scale inefficiency informs how far a hospital is operating from the most productive size for a given input-output mix.

To help managers capture the components of inefficient operations, the sequential analysis of the DEA-CCR and the DEA-BCC models allow for the computation of three types of efficiencies (Cooper, Seiford, & Tone, 2007):

- (1) Overall efficiency (OE) as measured by the distance to the DEA-CCR frontier.
- (2) Pure technical efficiency (identified as managerial efficiency (ME) in this work) as measured by the distance to the DEA-BCC frontier.
- (3) Scale efficiency (SE) which reflects the proportion of inefficiency caused by the given scale of operations. It is measured by the ratio (DEA-CCR score / DEA-BCC score).

DEA is a methodology that has been successfully used to evaluate the performance of different healthcare markets (Valdmanis et al., 2017). DEA is the preferred method when evaluating health care providers as it has many advantages: (1) DEA is a non-parametric method and doesn't require a prescribed functional form. (2) Can handle multiple variables and produce a single measure of efficiency. (3) Each hospital is compared with every other hospital in the sample to estimate best performers frontier. (4) It avoids the need for prices or prior assumptions of weights (Jon A Chilingerian & Sherman, 2011; Hollingsworth, 2008). Due to the multiple-product nature of hospitals and the multiple-value of various stakeholders, hospitals received the most research attention in DEA empirical works (S. Chen et al., 2016; Liu et al., 2013a; Eyob Zere, 2000). One of the first applications of DEA was to assess the efficiency of policies within which managers work as separate from the efficiencies of the managers themselves (Charnes et al., 1981).

Besides comparing the entire social and economic performance across countries (Adler et al., 2010; Chervenak & McCullough, 2001; Golany & Thore, 1997; Ramanathan, 2006), DEA is widely applied in the healthcare markets (Liu et al., 2013a; Valdmanis et al., 2016). Based on literature review, Hollingsworth (2008) found that researchers applied DEA to compare the efficiency of hospitals across countries to gain insights into the efficiency of different means of healthcare delivery. It has often been used to evaluate the outcomes of care providers and health reforms (Ozcan & Luke, 2011; van Ineveld, van Oostrum, Vermeulen, Steenhoek, & van de Klundert, 2015). A recent theme in DEA literature evaluates the healthcare systems across countries (Ozcan & Khushalani, 2017; Samut & Cafri, 2016).

In this work, we separate efficiencies of managers themselves (identified as managerial efficiency) from the efficiencies of policies within which managers operate (identified as program efficiency) by following the method of Charnes et al. (1981). Hence, we employ the basic DEA models in two key steps. In the first step, we analyze the managerial and scale efficiencies within each country. In the second step, we notionally drop the inefficiencies of the first step, then DEA assessment is carried out comprising a merged set of all the hospitals from the two countries. The observed inefficiencies in the second step are attributable to differences in public policies in each country rather than to hospital management.

2.2 Methods and data

2.2.1 Sample and data

The relevant data in West Bank and Jordan was derived from the annual health reports published by the Palestinian Ministry of Health (PMoH) and the Jordanian Ministry of Health (JMoH) respectively. We analyzed two nationally representative sets of public hospitals. Out of 13 public hospitals in West Bank, the analysis includes 11 hospitals. We excluded a newly established hospital and another psychiatric hospital. We analyzed a six-year period of 66 Palestinian observations. For Jordan, out of 30 public hospitals, we analyzed 22 hospitals, three psychiatric hospitals, two obstetric hospitals, and one pediatric hospital were excluded. The excluded hospitals don't comply with DEA requirements due to different operational measures. Then, to avoid bias in our judgment, we excluded the largest two hospitals in Jordan as they are three times larger than any hospital in West Bank (JMoH, 2015a; PMoH, 2015a). Table 2.1 illustrates the sample characteristics in during 2015.

Table 2. 1 Public Hospitals in Jordan and West Bank 2015

22 public hospitals in Jordan				11 public hospitals in WB	
Hospital	Beds	Hospital	Beds	Hospital	Beds
J01 AL-Zarqa	496	J12 AL-Ramtha	110	P01 Yatta	36
J02 Princess Basma	202	J13 Princess Raya	94	P02 Salfit	50
J03 Prince Faisal	178	J14 Ghor AL-Safi	82	P03 Jericho	54
J04 Jarash	116	J15 Mua'th Bin Jabal	75	P04 Nablus / Watani	55
J05 AL-Hussein / Salt	152	J16 Queen Rania	72	P05 Qalqillya	58
J06 Dr. Jameel Totanji	140	J17 AL-Mafraq	70	P06 Tulkarm	117
J07 Ma'an	131	J18 AL-Yarmouk	67	P07 Beit Jala (Hussain)	131
J08 AL-Iman	130	J19 AL-Shuneh (South)	60	P08 Jenin	163
J09 AL-Karak	165	J20 Abu - Obaidah	60	P09 Nablus / Rafidia	200
J10 AL-Nadeem	120	J21 Eiman\ ma'di	58	P10 Ramallah	238
J11 Prince AL-Hussein	120	J22 Princess Salma	38	P11 Hebron (Alia)	275

2.2.2 Production model of public hospitals

The public hospitals have the mission of serving the public demand as given and must manage their limited resources accordingly. Hence, when seeking efficiency assessments, it is recommended to employ the input-oriented DEA models with the aim of input minimizing rather than output maximizing (Lindlbauer et al., 2016). We applied the DEA-CCR and the

DEA-BCC models to score the overall efficiency, managerial efficiency, and scale efficiency (Banker et al., 1984; Charnes et al., 1978).

There is no standard set of input-output measures in the DEA literature to analyze the efficiency of hospitals (Narcı et al., 2015). The fundamental principle, to identify variables, is to have a clear understanding of the “process” being evaluated among hospitals (Cook et al., 2014). We used output measures that represent the level of social orientation in public health, measures gauge benefits achieved in respect of three functional areas; admissions (inpatient days), outpatient visits, and emergency services. We used inputs that characterize the employed labor and capital to produce hospital services.

The three main output measures are: (1) inpatient services as measured by the total number of annual care days rather than a number of cases to account for case-mix adjustment (Chowdhury et al., 2014); (2) outpatient services as measured by the total number of annual visits (Narcı et al., 2015); and (3) the emergency services as measured by the total annual number of cases served without admission (Kawaguchi, Tone, & Tsutsui, 2014).

On the input side, labor input measures represent three groups of personnel, the full-time employed doctors, the full-time healthcare cadre (e.g., nurses and technicians in para-medical departments), and the full-time administrative cadre (Narcı et al., 2015; Ozgen & Ozcan, 2004). The number of hospital beds represents the capital input measure (Chowdhury & Zelenyuk, 2016). Table 2.2 presents the distribution of input-output variables used during the study period from 2010 through 2015.

Table 2. 2 Distribution of input-output measures during the period 2010-2015.

Period		Input measures				Output measures		
		Hospital beds (X1)	Doctors FTEs* (X2)	Health FTEs (X3)	Admin. FTEs (X4)	Inpatient days (Y1)	Outpatient visits (Y2)	EM. visits (Y3)
West Bank N = 66								
2010-15	Mean	116	48	180	75	36765	40540	63632
	St. Dev.	9	3	12	3	3380	3262	3871
Jordan N = 132								
2010-15	Mean	113	76	270	74	25158	105283	75598
	St. Dev.	6	6	11	3	1545	6481	4163
* FETs, Full-Time Employees. EM, Emergency								

2.2.3 Within country analysis: the assessment of overall and managerial efficiencies

This step of analysis applies the basic DEA models; the CCR model (Charnes *et al.*, 1978) and BCC model (Banker *et al.*, 1984), the CCR model estimates the overall efficiency and the BCC model estimates the managerial efficiency. Then, in the next step, we apply a procedure developed by Charnes *et al.* (1981) to estimate program efficiency. The type of information drawn from these models achieves our research objective.

When longitudinal data is available for hospitals, different ways of analyses can provide alternative views of hospital performance. Window Analysis and DEA-Malmquist Index are known in the DEA literature to approach the efficiency changes over time (Bowling, 2014; Färe *et al.*, 1994). These methods elaborate further on the performance changes of the individual hospital. However, we are looking for a realistic indicator to evaluate the relative success of the evolving public hospital services in West Bank in respect of Jordan, rather than to produce individual tables for each hospital.

We conducted a 6-year evaluation for two sets of hospitals from 2010 to 2015. The first set comprises 66 observations in West Bank. The second set comprises 132 observations in Jordan. We applied a procedure that captures the year-specific variability in performance of hospitals (Boussofiane *et al.*, 1991; Sarkis & Talluri, 2002). For each country, we treated every hospital as a different DMU every year; the yielded DEA estimates are the observed relative efficiencies compared with best performers over the six years of study within that country. The applied procedure avoids the misleading results of efficiency change between consecutive years when DEA assessment is carried out separately for each year. Since performance measurement is relative, the increase in efficiency of one hospital between consecutive years could be attributed to an actual improvement or attributed to a regress in the efficiency (frontier shift) of the whole set of hospitals. Moreover, simultaneous assessment of 66 Palestinian observations and 132 Jordanian observations improves the discrimination power of the DEA estimator (Cook *et al.*, 2014).

2.2.4 Across country analysis: the assessment of program efficiency

We follow the work of Charnes *et al.* (1981) to evaluate the program efficiency of public healthcare delivery in West Bank compared to Jordan. An attempt would be valid if the managerial inefficiency (Section 2.2.3) within the country is notionally eliminated and all the hospitals are treated as being managerially efficient. This adjustment could be made by moving inefficient hospitals to their frontier within each set of hospitals. As we applied input-oriented

DEA-BCC, reducing all the inputs by the estimated inefficiency score will position all the hospitals on the efficient frontier of their country. After these adjustments have been made up, the new DEA-BCC assessment is carried out comprising a merged sample of all hospitals from West Bank and Jordan ($66 + 132 = 198$ observations). Hence, any new inefficiencies observed will be attributable to the country's public policy rather than to local hospital management. The mathematical linear programming formulation of the CCR and BCC models is presented in Appendix A.

2.3 Results and discussion

As we are employing input-oriented DEA models, in this sense, the resulting efficiency score of a given hospital has the following operational information: it is the maximum proportion of input levels the hospital, if efficient, should spend to secure at least its current output level. For example, efficiency score of 0.85 for a hospital means that this hospital should have used only 85% of what it had expended or could save 15% of its resources while producing the same observed output levels. Inefficient hospital benchmarks a composite hospital of its reference set to improve performance. Because we are addressing market level rather than hospital level, the technique used to design a reference set at hospital level is out of the scope of this work (Aghamolaei et al., 2014; Al-Shammari, 1999; Boussofiene et al., 1991).

The following subsections are organized according to our research objective and convey three main results: (1) Overall and managerial efficiency scores of 66 Palestinian observations; (2) Overall and managerial efficiency scores of 66 Jordanian observations; and (3) the program inefficiency scores across the two countries.

2.3.1 Overall efficiency and managerial efficiency of public hospitals in West Bank

Figure 2.1 illustrates the Palestinian results presented in Table 2.3, the year-specific mean efficiency scores of 11 public hospitals. Overall Efficiency scores (OE) represent the relative performance as measured by the radial distance to the best performers among the 66 Palestinian observations. The DEA-CCR scores revealed ten efficient observations (15%) in the overall sense. In this regard, these hospitals are managerially efficient and operating under optimal scale. Managerial Efficiency (ME) shows 20 observations efficient (30%) as given by the DEA-BCC scores, the difference observed in some efficient hospitals is the scale inefficient observations. They are ten hospitals.

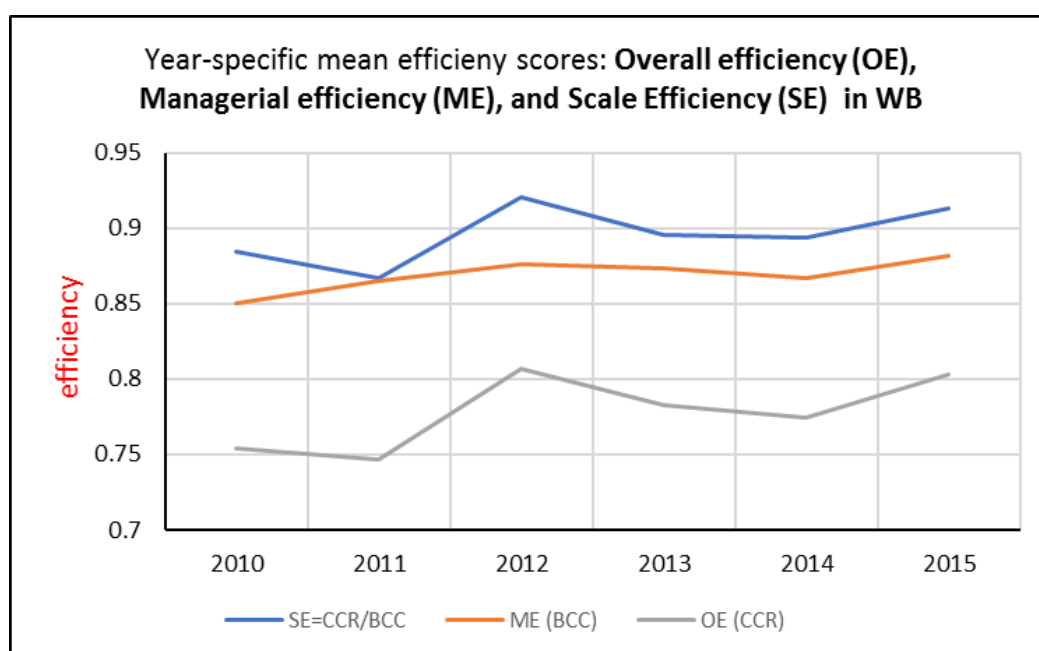


Figure 2. 1 Year specific mean managerial and overall efficiencies of public hospitals – West Bank (2010-2015).

Table 2. 3 Year specific mean efficiency scores of hospitals in West Bank and Jordan.

West Bank (N = 66)	2010	2011	2012	2013	2014	2015**	Average Total
<i>Overall efficiency*</i>							
Mean efficiency	0.75	0.75	0.81	0.78	0.77	0.80	0.78
Efficient hospitals	2	1	2	2	2	1	10
<i>Managerial efficiency</i>							
Mean efficiency	0.85	0.87	0.88	0.87	0.87	0.88	0.87
Efficient hospitals	4	3	3	3	4	3	20
<i>Scale efficiency</i>							
Mean efficiency	0.88	0.87	0.92	0.90	0.89	0.91	0.90
Efficient hospitals	2	1	2	2	2	1	10
Jordan (N = 132)	2010	2011	2012	2013	2014	2015	Average Total
<i>Overall efficiency</i>							
Mean efficiency	0.78	0.77	0.82	0.76	0.83	0.86	0.80
Efficient hospitals	4	0	3	2	7	8	24
<i>Managerial efficiency</i>							
Mean efficiency	0.89	0.88	0.90	0.87	0.90	0.94	0.90
Efficient hospitals	9	3	6	4	10	12	44
<i>Scale efficiency</i>							
Mean efficiency	0.87	0.88	0.91	0.88	0.91	0.92	0.90
Efficient hospitals	4	0	3	2	3	8	24

*Overall efficiency (CCR scores), Managerial efficiency (BCC scores), and scale efficiency (CCR score / BCC score)

** The boldface data in 2015, because the year 2015 shapes the possible future improvements.

The overall efficiency as given by the year specific mean CCR scores improved during the study period from 75% in 2010 to 80% in 2015. Even though, hospitals in 2015 could produce the observed level of outputs using 20% fewer inputs than they did. It is worth noting the peak "overall efficiency" is 81% in 2012. The Palestinian Ministry of Health invested in largely installing the Medical Information System in public hospitals; this may explain progress achieved in efficiency in 2012. The year-specific managerial efficiency (ME) as given by the mean BCC scores shows slightly positive change from 85% in 2010 to 88% in 2015.

It is useful to witness the parallel shape of scale efficiency (SE) with the overall efficiency (OE). This finding suggests that, during the study period, changes in OE are driven by changes in SE rather than by changes in ME. The mean managerial efficiency (as given by the mean BCC scores) is 88% in 2015 and suggests 12% room for performance improvement, the 12% inefficiency is mainly attributed to poor managerial practices. On the other hand, the 9% scale inefficiency is attributed to poor allocation of resources or technologies (Ozgen & Ozcan, 2004). The year-specific individual scores are presented in Table 2.4 within Appendix B.

2.3.2 Overall efficiency and managerial efficiency of public hospitals in Jordan

Figure 2.2 illustrates the results of examining Jordanian hospitals as presented in Table 2.3, the year-specific mean efficiency scores of 22 public hospitals. Efficiency scores represent the relative performance as measured by the radial distance to the best performers among the 132 Jordanian observations.

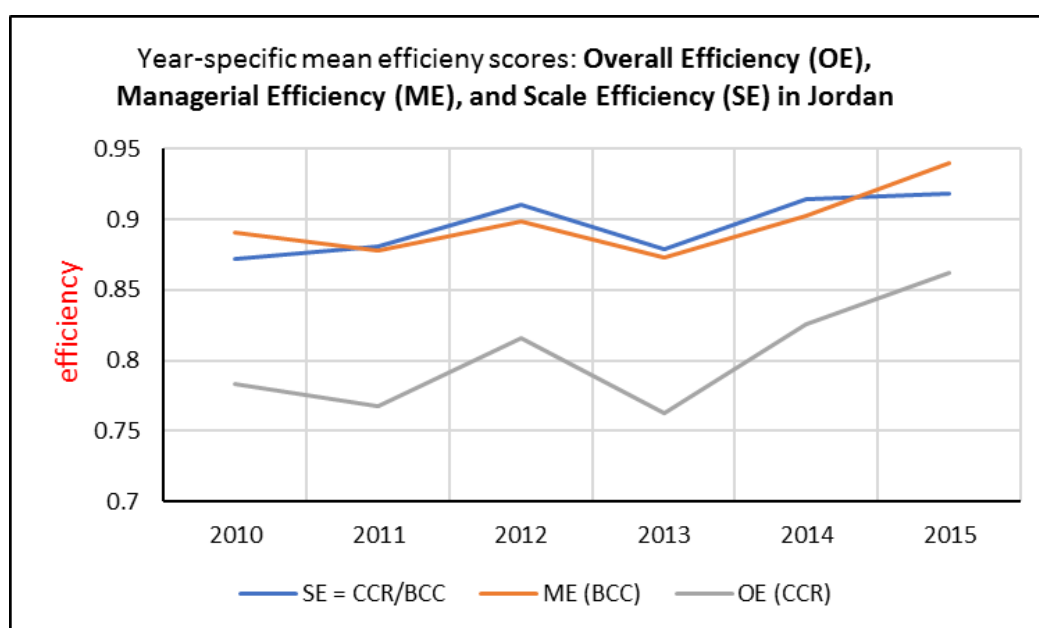


Figure 2. 2 Year-specific mean managerial and overall efficiencies of public hospitals- Jordan (2010-2015).

The CCR scores revealed 24 efficient observations (18%) in the overall sense. The managerial best practices frontier shows 44 observations efficient (33%) as given by the BCC scores, the observed difference is the 20 scale inefficient observations.

During the study period, the overall efficiency improved from 78% in 2010 to 86% in 2015. Even though, hospitals in 2015 could produce the observed level of outputs using 14% fewer inputs than they did. Managerial efficiency shows 6% possible improvement in 2015 as given by the mean BCC scores; this is mainly attributed to poor managerial practices (Ozgen & Ozcan, 2004). On the other hand, the 8% scale inefficiency in 2015 is attributed to poor allocation of resources and technologies among the Jordanian hospitals.

The remarkable result is the consistent progress and a promising trend in managerial efficiency since 2013, from 87% in 2013 to 90% in 2014 then to 94% in 2015 as given by the DEA-BCC scores. The mean year specific of managerial efficiency has a parallel shape with the overall efficiency, which reveals that progress in overall efficiency is driven by gains in managerial efficiency rather than by changes in scale efficiency. The year-specific individual scores are presented in Table 2.5 within Appendix B.

So far, changes in mean overall efficiency scores of public hospitals were shaped differently in West Bank and Jordan during the study period. In West Bank, efficiency progress was driven by improvements in scale efficiency levels. In Jordan, efficiency progress was driven by improvements managerial performance.

2.3.3 Across country analysis: program implications on hospital performance

For comparing the healthcare programs in West Bank and Jordan, we notionally eliminate the estimated managerial inefficiency of the first step of this study (Subsections 2.3.1 and 2.3.2). The new DEA-BCC assessment provides the means for comparing the programs. The basic idea is to drop the inefficiencies attributed to poor managerial practices before carrying out the new assessment. Since all the hospitals have become on the efficient frontier within the country, the new assessment captures new inefficiencies that are attributable to the country's programs and not management (Charnes et al., 1981).

Figure 2.3 illustrates program efficiency scores in West Bank and Jordan as given by the DEA-BCC model, Table 2.6 and Table 2.7 within Appendix B show the relevant results. Public hospitals' performance shows differences (0%-4%) in mean program efficiency between the hospitals in West Bank and hospitals Jordan in favor of West Bank.

A single sample T-test was conducted to determine if a statistically significant difference exists between mean program efficiency of Jordanian hospitals and mean program efficiency of Palestinian hospitals. During the first three-years (2010-2012), Jordanian program efficiency reported different mean scores compared to Palestinian program efficiency ($p < 0.025$). For example, in 2010, the difference reported - 4% ($M = 0.94$, $SD = 0.05$) in favor of Palestinian programs compared to Jordanian programs $t(21) = -2.78$, $p = 0.001$. However, during the second three-years of the study period (2013-2015), the Jordanian program efficiency reported similar mean scores ($p > 0.025$). For example, in 2015, the difference reported - 1.6% ($M = 0.96$, $SD = 0.05$) in favor of Palestinian programs compared to Jordanian programs $t(21) = -1.603$, $p = 0.124$.

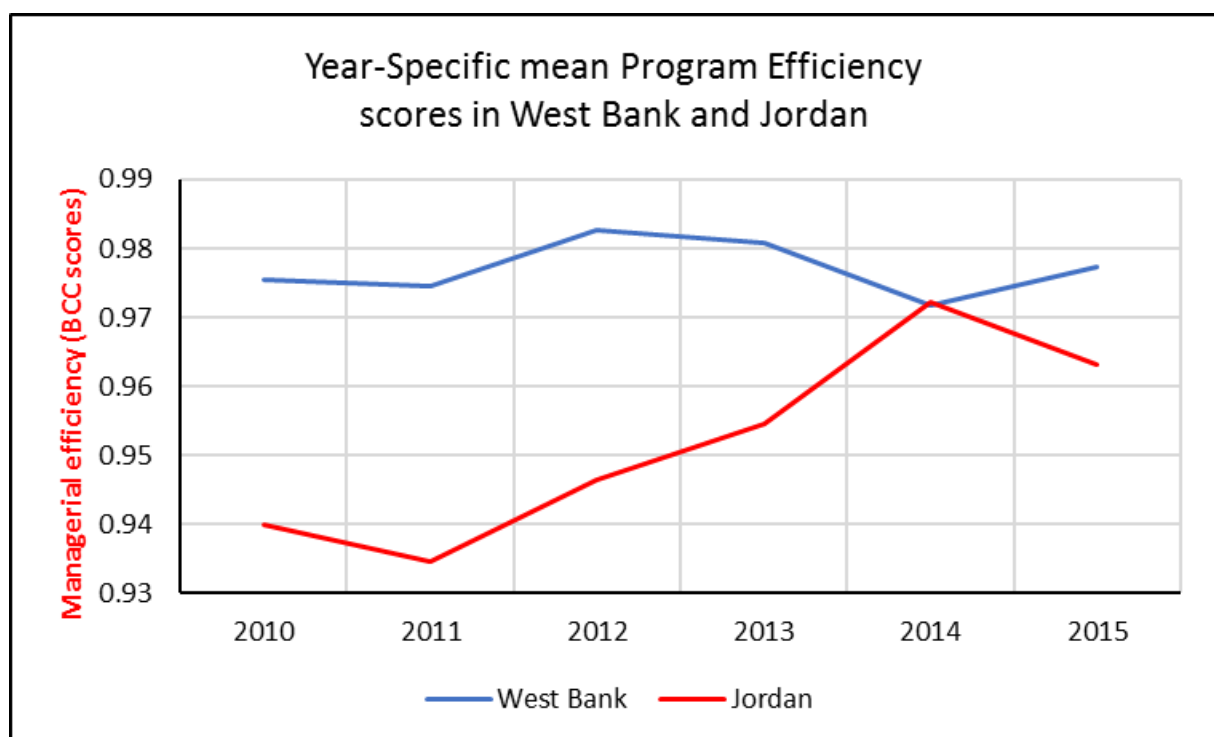


Figure 2. 3 Program Efficiency: Year-specific mean DEA-BCC scores after eliminating the managerial inefficiency within the country.

To sum up, this study addresses the relative position of Palestinian healthcare programs in West Bank after thirty years of disengagement with Jordan. In this regard, the accumulated outcomes of the two countries' programs towards public hospital services are compared. Findings show that the implications of Palestinian programs on efficient hospital performance have the edge over the Jordanian programs during 2010-2012. Saying it another way, in West Bank, the inefficient performance is less attributed to public programs than in Jordan during in the first three years of the study period. However, the Jordanian programs show consistent progress

during the years 2011-2014. Therefore, the two countries' programs have similar program efficiency means during 2013-2015.

The ability of a hospital to transform inputs into outputs is influenced by its managerial efficiency and external operating environment (Johnson & Kuosmanen, 2012). Therefore, relating the measures of inefficiency to the characteristics of operating environment provides a better understanding of efficiency differences, the association between such contextual factors and efficiency difference could be done through the second stage of analysis. Further research on the topic to determine the factors that drive the outperformance of Palestinian hospitals to outperform the Jordanian hospitals.

Although all the investigated hospitals are public and don't compete, it was felt that the market characteristics of each country may impact efficiency. Palestinian Authority applies health insurance schemes that cover most of the population. Therefore, Palestinian public hospitals are asked to meet the created high demand (Hamdan & Saleem, 2013). The average bed occupancy rate was 88% during 2015 while it was 65% in Jordan during the same period that explains higher levels of capacity utilization in West Bank. Previous evidence supports the impact of bed occupancy rate on efficiency (Chowdhury & Zelenyuk, 2016; P N Mujasi & Kirigia, 2016).

Another reason the estimated efficiency values in West Bank and Jordan may be the external international fund and the considerable amount of financial and technological investments supported by the international donor in Palestinian hospitals (Giacaman et al., 2009). This, in turn, makes a hospital bed more equipped with medical and paramedical devices and becomes more productive. However, in our analysis, we did not include this nontraditional input.

Finally, the working market-structure may influence the efficiency of a hospital. In West Bank, the percentage of public hospital beds of all the beds is 61%. In Jordan, this is 38.7% of all the beds. This could influence people seeking hospital treatment, thus determine the demand and the observed output levels.

2.4 Conclusions and future research

Using data from 2010 through 2015, we employed DEA models to analyze the productive efficiency of public hospital markets within West Bank and Jordan. We analyzed public hospitalization services within the distinct country conditions of the Occupied Palestinian Territories, particularly after thirty years of Jordan's decision to end the long institutional, legal, and administrative ties prolonged from 1950 to 1988 with West Bank. After a transition period,

the affiliation of the public hospitals in West Bank was transferred to the Palestinian public authorities. This work makes a major contribution by extending the descriptive literature of historical associations between the Occupied Palestinian Territories and Jordan with a comparative measure of public policy implications on hospital performance.

This study took the Palestinian health literature further by highlighting Jordan's ongoing stake in the Palestinian healthcare sector. Results offer a realistic indicator by employing operational analysis to evaluate the productive efficiency of public hospitals. Findings provide evidence of the prescribed uneven emphasis of the Palestinian public authorities on the physical capacity (Hamdan & Saleem, 2013) and the considerable amount of financial and technological investments (Giacaman et al., 2003).

In West Bank, managers of the identified hospitals with poor management as given by the DEA-BCC model should investigate further their managerial practices applied in their hospitals. The Palestinian policymakers can draw from the identified scale inefficiencies an appropriate resource distribution plan. Since the overall mean efficiency score is inadequate (78%) and scale efficiency drives the time-based progress during the study period, the operating conditions explore the question of appropriate adoption with technological investments and the adequate managerial efforts to capture the acquired benefits of technology (Ozgen & Ozcan, 2004).

In Jordan, the average overall efficiency score recorded 80% with a promising trend in 2015. However, the changes over time were driven by managerial improvements and not scale efficiency progress. Despite the similarity in changes of hospital performance, changes were driven differently in West Bank and Jordan. Time-based improvements were attributed to management in Jordan and attributed to new technologies in West Bank.

Health policies contributed differently to the achieved levels of efficiency across the two countries. The inefficient performance was less attributed to policies in West Bank than the corresponding effect in Jordan. The Palestinian policy implications on hospital performance have the edge over the Jordan policies during 2010-2012. In Jordan, the continuous improvements in policies during 2011-2014 positioned the two countries at the same level in 2014 but turned again less supportive in 2015.

The results of this study are useful and surfaced the significance of operational trade-offs to enhance the productivity of public hospitals; even though, our findings don't adjust for quality differences as our analysis considers only quantities of services provided and resource distribution. It will be more informative to include qualitative data in future. Unfortunately,

data associated with qualitative information, as in many other developing countries, is not available. Researchers can use instruments as surveys, interviews, or recordings to quantify the quality of patients' care and their satisfaction. It will be useful to elaborate further and investigate causes behind poor management practices among hospitals in West Bank.

Appendix A.

The mathematical formulations of Data Envelopment Analysis model.

For n Decision Making Units DMU with m inputs and s outputs, The DEA-CCR input oriented envelopment model that builds Constant Returns to Scale CRS efficient frontier has a mathematical linear programming formulation (Charnes *et al.*, 1978):

$$\begin{aligned} \theta^* &= \text{Min } \theta_o & (2.1) \\ \text{S.T} \\ \sum_{j=01}^{j=n} \lambda_j x_{ij} &\leq \theta x_{io} & i = 1, 2, \dots, m \\ \sum_{j=01}^{j=n} \lambda_j y_{rj} &\geq y_{ro} & r = 1, 2, \dots, s \\ \lambda_j &\geq 0 & j = 1, 2, \dots, n \end{aligned}$$

Where:

DMU_o represents one of the n DMUs under evaluation, and x_{io} and y_{ro} are the i^{th} input and r^{th} output for DMU_o, respectively.

The DEA-CCR input oriented envelopment model that builds Variable Returns to Scale VRS efficient frontier requires an additional set of convexity constraint of the dual linear programming algorithm (Equation 2.1); the sum of lambdas to be one. The additional constraint is written as Equation 2.2 (Banker *et al.*, 1984):

$$\sum_{j=01}^{j=n} \lambda_j = 1.0 \quad (2.2)$$

Appendix B. Year-specific results of relative efficiency presented in Tables.

Table 2. 4 Year-specific relative efficiency scores of hospitals in West Bank.

Hosp.	DEA-CCR model scores						DEA-BCC model scores					
	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
P01	1	0.92	1	0.89	0.98	0.97	1	0.99	1	0.99	1	1
P02	0.57	0.66	0.67	0.57	0.58	0.64	0.83	1	0.88	0.88	0.9	0.9
P03	0.49	0.51	0.67	0.63	0.6	0.65	0.84	0.8	0.88	0.85	0.83	0.93
P04	0.97	0.93	0.99	1	1	0.98	1	0.95	1	1	1	0.99
P05	0.88	0.68	0.71	0.78	0.77	0.82	1	1	0.85	0.89	0.87	0.87
P06	0.62	0.63	0.69	0.72	0.69	0.69	0.67	0.71	0.74	0.76	0.73	0.73
P07	0.73	0.72	0.82	0.73	0.65	0.68	0.85	0.79	0.84	0.75	0.67	0.69
P08	0.75	0.78	0.77	0.65	0.71	0.78	0.77	0.8	0.77	0.7	0.76	0.78
P09	0.64	0.64	0.76	0.76	0.75	0.78	0.66	0.66	0.76	0.79	0.78	0.81
P10	0.64	0.74	0.8	0.88	0.79	0.84	0.73	0.82	0.92	1	1	1
P11	1	1	1	1	1	1	1	1	1	1	1	1
Ave.	0.75	0.75	0.81	0.78	0.77	0.80	0.85	0.87	0.88	0.87	0.87	0.88

Overall (CCR scores), pure technical (BCC scores) and scale (CCR score / BCC score) efficiencies.

Table 2. 5 Year-specific relative efficiency scores of hospitals in Jordan.

Hosp.	DEA-CCR model scores						DEA-BCC model scores					
	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
J01	1	0.79	0.97	1	0.9	1	1	0.86	0.97	1	0.9	1
J02	1	0.95	1	1	1	1	1	0.97	1	1	1	1
J03	1	0.97	1	0.98	1	1	1	0.97	1	0.98	1	1
J04	0.83	0.78	0.66	0.59	0.72	0.77	0.83	0.79	0.66	0.61	0.73	0.82
J05	0.81	0.59	0.78	0.65	0.71	0.74	0.81	0.59	0.8	0.69	0.74	0.78
J06	0.84	0.88	0.91	0.84	0.9	1	0.85	0.9	0.92	0.85	0.9	1
J07	1	0.95	0.9	0.81	1	0.94	1	0.98	0.92	0.85	1	0.96
J08	0.83	0.68	0.74	0.67	0.79	0.9	0.83	0.68	0.75	0.72	0.8	0.94
J09	0.62	0.66	0.79	0.72	0.58	0.51	0.66	0.7	0.85	0.8	0.63	0.56
J10	0.73	0.72	0.92	0.8	1	1	0.78	0.76	0.94	0.84	1	1
J11	0.12	0.69	0.69	0.62	0.78	0.75	0.59	0.84	0.73	0.68	0.81	0.81
J12	0.65	0.73	0.85	0.73	1	0.85	0.73	0.8	0.86	0.8	1	0.89
J13	0.74	0.78	0.7	0.66	0.8	0.87	0.83	0.87	0.81	0.78	0.89	0.98
J14	0.89	0.91	0.93	0.91	0.95	0.9	0.97	0.98	1	0.98	1	1
J15	0.87	0.68	0.76	0.76	0.78	1	1	0.88	0.87	0.89	0.87	1
J16	0.51	0.6	0.51	0.56	0.48	0.46	0.92	1	0.88	1	0.9	0.98
J17	0.84	0.87	0.91	0.96	1	1	0.9	0.96	0.96	0.98	1	1
J18	0.84	0.87	0.89	0.8	1	0.91	0.89	0.91	0.92	0.91	1	0.95
J19	0.78	0.49	0.54	0.52	0.5	0.77	1	0.88	0.92	0.85	0.86	1
J20	0.96	0.95	1	0.98	0.8	1	1	0.99	1	0.99	0.83	1
J21	0.78	0.77	0.88	0.72	0.87	0.88	1	1	1	1	1	1
J22	0.6	0.58	0.62	0.5	0.6	0.72	1	1	1	1	1	1
Ave.	0.78	0.77	0.82	0.76	0.83	0.86	0.89	0.88	0.90	0.87	0.90	0.94

Table 2. 6 Policy implications on relative efficiencies in West Bank.

Post adjustment DEA-BCC assessments.						
Hosp.	2010	2011	2012	2013	2014	2015
P01	1	1	1	1	1	1
P02	0.99	1	1	0.97	0.95	0.97
P03	0.94	0.97	0.98	0.98	0.96	0.96
P04	0.92	0.94	0.97	1	1	0.98
P05	1	1	1	1	1	1
P06	0.99	1	1	1	1	0.99
P07	0.98	0.98	1	1	1	1
P08	0.99	0.95	0.99	0.99	0.99	1
P09	1	1	0.96	0.93	0.95	0.94
P10	0.93	0.95	0.93	0.93	0.84	0.91
P11	0.99	0.93	0.98	0.99	1	1
Average	0.98	0.97	0.98	0.98	0.97	0.98

Table 2. 7 Policy implications on relative efficiencies in Jordan

Post adjustment DEA-BCC assessments.													
Hosp.	2010	2011	2012	2013	2014	2015	Hosp.	2010	2011	2012	2013	2014	2015
J01	1	1	1	1	1	1	J12	0.93	0.9	0.98	0.87	1	0.95
J02	1	1	1	1	0.94	1	J13	0.91	0.95	0.92	0.93	0.94	0.96
J03	1	0.99	1	1	1	1	J14	0.92	0.91	0.93	0.98	1	0.91
J04	0.96	0.98	1	0.95	1	0.85	J15	0.93	0.94	0.96	1	1	1
J05	1	1	0.95	0.96	0.97	0.92	J16	0.98	1	0.94	1	0.97	1
J06	0.87	0.87	0.84	0.84	0.9	1	J17	0.91	0.85	0.93	0.95	0.9	1
J07	0.9	0.81	0.84	0.93	0.92	0.85	J18	0.91	0.97	0.97	0.97	0.92	0.94
J08	0.98	0.98	1	0.98	1	0.99	J19	1	0.91	0.88	0.95	1	1
J09	0.86	0.81	0.9	0.94	0.91	0.9	J20	0.96	0.98	1	1	0.91	1
J10	0.87	0.92	1	0.86	1	1	J21	1	0.9	0.98	1	1	0.97
J11	0.86	0.96	0.92	0.89	0.99	0.95	J22	0.93	0.93	0.88	1	0.99	1
Average							0.94	0.93	0.95	0.95	0.97	0.96	

CHAPTER 3

Longitudinal Analysis of Efficiency of Palestinian Public Hospitals in West Bank

ABSTRACT

Background: The Palestinian Ministry of Health dedicates about 40% of the annual budget to purchase hospitalization services from local and regional referral hospitals. While health needs and expenditures in the Occupied Palestinian Territories are growing, the international donations are declining, and the economic situation is worsening. To manage this context, potential savings in expenditures will have favorable outcomes regarding public hospitals services.

Methods: This study examined technical efficiency longitudinally among 11 public hospitals in West Bank from 2010 through 2015 targeting a total of 66 observations. Nationally representative data were derived from the official annual health reports. We applied input-oriented Data Envelopment Analysis (DEA) models to estimate efficiency scores. To elaborate further on performance, we used DEA-based Malmquist Index and Tobit regression model with the aim of analyzing productivity variations and exploring the drivers of inefficient performance.

Results: In the year 2015, the mean efficiency under constant returns to scale assumption was 86%. There was 4% increase in the mean efficiency scores compared with 2010. Malmquist index (MI) analysis shows that over the period 2010-15, public hospitals saw a loss in productivity. Regress was attributed to technological effects rather than losses in technical efficiency. The significant Tobit model showed six predictors explaining the inefficient performance of a hospital ($p < 0.01$) are: bed occupancy rate; outpatient-inpatient ratio; size; availability of primary centers; the percentage of public beds; and hospital location.

Conclusion: This work surfaced managerial implications: hospital managers should enhance a parallel know-how action with the adoption of new technologies; the purely inefficient hospitals have room for improvements. Based on scale efficiency findings, the policy may consider resource transfer plan and appropriate investment. The scope of this study is limited to performance management of public hospitals. For a better understanding of the Palestinian market, further research on private hospitals, the quality outcomes, and patient satisfaction could be useful.

Keywords: DEA, Public hospitals, Malmquist index, Tobit regression, West Bank.

3.1 Background

Building the capacity of the Palestinian public healthcare sector evolved following the establishment of the Palestinian Authority in 1994 (Hamdan & Saleem, 2013), where healthcare reforms are supported by international donations (Giacaman et al., 2009). These funds are efforts by the international community to resolve the conflict in Palestine-Israel through economic encouragements (Shehada, 2015). Recently, the country suffers deteriorating economy, the unemployment rate in Gaza Strip was 41.6% and was 16.3% in the West Bank in the 1st quarter of the year 2015 (PCBS, 2016).

In the Occupied Palestinian Territories (OPT), annual growth of population 3% and the demand for healthcare services is growing over time. On average, the health expenditures recorded consistent annual growth rate of 7%. The total health expenditure increased from \$400 million in the year 2000 to \$1400 million in 2015; the latter accounted for 10.7 % of the country's Gross Domestic Product (GDP), of which, the public reimbursement schemes represent 62.5% (PCBS, 2016). Hospitals are the main providers of the country's health services and consume 42% of healthcare expenditures. Palestinian public hospital beds comprise 61.1% of the total 6006 hospital beds (PMoH, 2015b). The significant decline in donor support in recent years and the unique political situation of the Palestinians produced serious effects on the scope and quality of health services (WHO, 2016).

Because of the applied national health insurance schemes which cover most of the Palestinians. Hence, public hospitals are crowded and functioning at high bed occupancy rates (Kitaneh & Hamdan, 2012). To cater to the increasing health demand, the Palestinian Ministry of Health (PMoH) allocates about 40% of its budget to purchase hospital services from local and regional referral hospitals (PMoH, 2015a). According to the applied insurance schemes, health care seekers are asked to go to a public hospital first; then, they are either treated or transferred to a non-public referral hospital. The referral decision is made according to the availability of resources or the availability of the type of the services required based on the patient's acuity condition. Therefore, it is hoped that exploring a room for improvements will contribute to savings in the healthcare expenditure, reduce the volume of transferred patients, and reduce the financial burdens of purchased hospital services.

As hospitals make up a significant proportion of healthcare expenditure, they are a large source of potential savings. Gains in their efficiency may have a substantial contribution to the overall performance of the country's health care system (Hurley, 2009; Johnson & LEE, 2017). Our

research efforts to analyze the efficiency of the Palestinian public hospital and the associated driving factors represent a preconditioning phase for applying and controlling any promising reform (Fragkiadakis et al., 2016).

Data Envelopment Analysis (DEA) is an appropriate methodology for the analysis of public sector activities (Gouveia et al., 2016; Mitropoulos et al., 2013). Since the advent of DEA by Charnes et al. (1978), more than ten thousand studies were published and estimated the performance of different kinds of entities and production activities (Emrouznejad & Yang, 2017) including the healthcare sector (Liu, Lu, Lu, & Lin, 2013b). Due to the lack of data in developing countries, few empirical works applied DEA (Linh Pham, 2011). This work enhances the usefulness of using DEA method and DEA-based Malmquist Index (MI) by analyzing the efficiency of 11 public hospitals in West Bank from 2010 to 2015, in total, 66 observations were analyzed.

In the first step of our work, the year 2015 was analyzed to shape a base for potential improvements. Then, we applied DEA Based - Malmquist Index to demonstrate a 5-period evaluation of productivity change and examine both shifts in technology and gains in efficiency (Färe et al., 1992, 1994). Finally, to explore the determinants of inefficient performance, we applied Tobit regression model. The dependent variable was the vector of DEA scores of 66 observations, and the independent variables were contextual factors. Information from the model brings insights into the efficiency drivers of public hospital operations and facilitates the formulations of policies.

Considering the above, we address a DEA literature gap. There is no previous knowledge how efficient the Palestinian public hospitals are functioning or what factors drive their efficiency levels. In response to this need, our endeavor goes to achieve the following research objectives: (1) Evaluate how Palestinian public hospitals utilize resources while caring for their patients; (2) Analyze the year-specific changes in their performance from 2010 to 2015; and (3) explore environmental effects associated with the efficient use of hospital resources.

3.1.1 Conceptual model

To assess hospitals regarding their effective use of resources, researchers should include any resource used by a hospital, and the outputs should include all the amounts of services produced (Afzali, Moss, & Mahmood, 2009; Cook et al., 2014). Environmental (contextual) factors which could influence the efficiency of a hospital (e.g., government regulations), where such

factors are not traditional inputs are assumed not under the control of the manager can be accommodated in a DEA analysis (Coelli et al., 2005).

Within a set of comparable production units, like hospitals, the DEA method considers the multiple outputs and multiple inputs in practice and applies frontier analysis to estimate efficiency (Odeck & Alkadi, 2001). Those units exhibiting best practices would form the efficient frontier (Cook & Seiford, 2009b). DEA allows for ranking non-frontier hospitals directing management efforts for potential improvements.

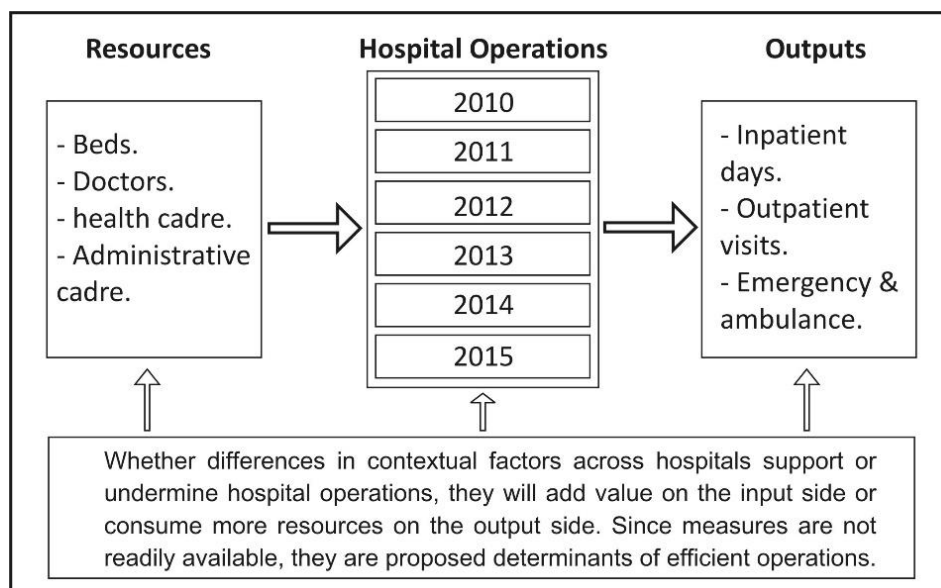


Figure 3. 1 Conceptualized production structure of hospitals

Figure 3.1 illustrates the proposed relationships between the essential elements of hospital operations; the inputs, the outputs, and the environmental factors. Environmental factors that support the production of services on the input side or touch the production of services on the output side should be included. More specifically, for example, the healthcare infrastructure either adds resources which could be included as input or requires resources to overcome poor environmental state which could be included as output. However, measures may not be easily available to include these effects within the input-output mix (Boussofiane et al., 1991). Therefore, finding out the relationship between these factors and the estimated efficiency levels adds practical insights into the hospital efficiency estimates. To elaborate further on the performance of hospitals, we conduct longitudinal analysis that provides information on how productivity in the Palestinian public hospitals had changed.

Our findings can provide valuable insights to hospital managers who make decisions on operational practices, and for policymakers at the country level who may influence the

operating environment of hospitals through regulations, national insurance schemes, and standards amongst other policy measures.

3.1.2. Empirical context

According to the Palestinian Central Bureau of Statistics (PCBS), by the end of the year 2016, the estimated population of the Palestinian Territories was 4.88 million of which 2.97 million are living in West Bank (WB), and 1.91 million are living in Gaza Strip. The male-female ratio is 50.8/49.2.

Health care services are provided in eleven administrative regions (Governorates) in West Bank. They are Jenin, Tubas, Tulkarm, Nablus, Qalqillya, Salfit, Ramallah, Jericho, Bethlehem, Hebron, and East Jerusalem. We use the terminology “public” to denote the organizations owned and managed by the Palestinian Ministry of Health (PMoH) and the terminology “others” for other providers. The PMoH is the main healthcare provider and bears the heaviest burden of health provision (PMoH, 2015a). The country’s total health expenditure was \$1400 million in 2015 which accounted for 10.7% of the GDP (PCBS, 2017).

The ongoing budget of the PMoH was about \$500 million; salaries were 47% of the budget. There are 80 hospitals in Palestine, 50 hospitals are in West Bank (60.1% of total beds), and 30 hospitals are in Gaza Strip (39.9% of the total beds), with a total number of 6,006 beds. 73% are general beds, 19% specialized beds, 3.1% rehabilitation beds and 4.9% maternity beds.

3.1.3 Literature review

The problem of measuring productive efficiency was best described, sixty years ago, by Farrell (1957). To solve the problem, Farrell introduced an activity analysis approach that combines the measurement of multiple inputs into a single measure of efficiency which he regarded as “technical efficiency.” Technical inefficiency is the amount of waste that can be eliminated without worsening any input or output. Building on Farrell’s ideas, Charnes et al. (1978) introduced a powerful nonparametric methodology to assess the relative efficiencies of multi-input and multi-output production units which had been titled Data Envelopment Analysis (Cook & Seiford, 2009a). These production units are denoted as decision-making units (DMUs) in the DEA literature. DEA methodology avoids the need for prices or prior assumptions of weights that reflect the relative importance of the different inputs and outputs to measure technical efficiency (Cooper, Seiford, & Zhu, 2011). Measurement can be extended to other types of economic efficiency when additional types of data are available. The DEA has become the researchers’ focus to find the best attainable productive practices.

Although parametric statistical/econometric techniques as stochastic frontier analysis (SFA) can be used to estimate efficiency in a healthcare context (Atilgan, 2016; Jacobs, 2001; Rosko, 1999).

The DEA approach has become the most chosen methodology for evaluating the provision of health care. There is an extensive body of literature examining the performance of healthcare sector at all levels. The first application of DEA in health care began with H. David Sherman's doctoral dissertation. He applied DEA to evaluate the performance of medical and surgical departments in 15 hospitals (Jon A Chilingirian & Sherman, 2011). The first published DEA work in healthcare context was in 1983 and investigated nursing services (Nunamaker, 1983). In 1984 the second published study investigated the medical and surgical departments in seven hospitals (Sherman, 1984).

Based on a review of 317 published studies on frontier measurement of the efficiency of the healthcare delivery from 1983 to 2006, Hollingsworth (2008) found that 75% of the works applied the DEA, and other DEA-based methods as Malmquist Index. Empirical applications of DEA included performance examinations of different healthcare markets ranging from primary health care level (Gouveia et al., 2016; Oikonomou et al., 2016) to the overall health care system and country level (Ozcan & Khushalani, 2017; Samut & Cafri, 2016). The practice behavior at provider group level was also examined (J A Chilingirian et al., 2002; Fiallos et al., 2015). Finally, the performance of home health care agencies (Valdmanis et al., 2017) and hospitals (Matranga et al., 2013).

Among the empirical studies using DEA, hospitals received the most research attention (Jon A Chilingirian & Sherman, 2011). The goals of hospital services are multiple and complex. Hospitals produce multiple outputs (e.g., inpatient care, surgeries, outpatient care, emergency) and absorb multiple inputs (e.g., clinical and non-clinical staff, beds, equipment, and supplies). Recent DEA studies extend the analysis to investigate variations in hospital performance over time and to identify contextual drivers of efficient practices (Ya Chen et al., 2017). Table 3.1 summarizes some studies applying the DEA models, Tobit regression, and Malmquist index.

To monitor performance changes over time, researchers combine DEA methodology and DEA-based Malmquist index analyses (Miguéis, Camanho, Bjørndal, & Bjørndal, 2012). When using Malmquist index and DEA, results help to analyze the impacts of health system reforms (van Ineveld et al., 2016). A recent study investigated the impact of economic downturn on hospital performance in Pennsylvania from 2005 to 2012; results showed that performance slightly

decreased due to economic downturn from pre-recession to post-recession (Ya Chen et al., 2017). A longitudinal study analyzed referral hospital in Uganda used five-year secondary panel data from 2009 to 2013 found that efficiency improved on average by 5%. Improvements were driven by technological changes rather than shifts in technical efficiency (P N Mujasi & Kirigia, 2016). Another study examined public hospitals in Greece over the period 2005-2009. Results showed declining performance that was attributed to a declining trend in best practice frontiers, while the levels of technical efficiency were stable (Fragkiadakis et al., 2016). Ozgen & Ozcan (2004) used seven-year longitudinal data to examine productivity changes in the market of dialysis facilities in the US; findings showed progress in technical efficiency and regress in technological efficiency. Finally, the efficiency of a sample of the Chinese hospitals was examined from 2004 to 2008, progress in productivity was attributed to technological shifts (Ng, 2011).

Second stage DEA is commonly used to assess the relationship between DEA efficiency scores and non-physical inputs or contextual factors. Because the DEA scores of the first stage represent censored data, the second stage of analysis applies Tobit regression (Hoff, 2007; Narci et al., 2015). Tobit regression applies the Maximum Likelihood Method to estimate the model's parameters (Schnedler, 2005). Chowdhury & Zelenyuk (2016) applied DEA and truncated regression model to explore the determinants of the hospital efficiency in Ontario/Canada. Their findings identified occupancy rate, outpatient-inpatient ratio, location, teaching status, and case-mix index as determinants of efficient practices. A study examined the hospitals in Ghana used DEA and Tobit regression, efficiency was determined by region and ownership (Jehu-Appiah et al., 2014). Finally, Samut & Cafri (2016) analyzed the health care systems in 29 OECD countries during 2000–2010 and applied Malmquist Index and Tobit regression procedures. The authors, identified education, income, and market factors as determinants of hospital efficiency.

Most DEA works were applied in the developed countries, mainly the US and Europe (O'Neill et al., 2008). However, few empirical studies were conducted in developing countries due to the scarcity of data. But recently, there are more frequent DEA studies. For example, hospitals in Vietnam (Linh Pham, 2011), referral hospitals in Uganda (Paschal N Mujasi, Asbu, & Puig-Junoy, 2016), general hospitals in Iran (Kalhor et al., 2016; Shahhoseini et al., 2011), hospitalals in Kenya (Kirigia et al., 2002), hospitals in the Sultanate of Oman (Ramanathan, 2005, 2006), emergency departments in Jordan (Al-Refaie et al., 2014), and public hospitals in South Africa

(E Zere, McIntyre, & Addison, 2001). Finally, many studies investigated in-depth the efficiency of the healthcare organizations in Turkey (Ersoy et al., 1997; Narıcı et al., 2015).

Aimed at Palestine, we conducted secondary research to find studies evaluating the performance of healthcare providers. No study was published. Moreover, the performance measurement systems are absent among healthcare organizations in Palestine. The existing Palestinian literature describes the transitional context and the complications within the country's health care system.

Hamdan & Defever, (2002) identified six determinants are driving the health care system; burden of health system problems, the pressure of international aiding agencies, the deteriorated economy, the geographical separation between West Bank and Gaza, unique social context, and ambiguous political future. Giacaman et al., (2009) reviewed the inadequate response of public healthcare to health problems and emphasized the need for improvements. The authors described the health system as a composite of fragmented services. Finally, Kitaneh & Hamdan (2012) described the working conditions of the Palestinian public hospitals as suffering from understaffing and frequent absence of supplies that cause patients to wait for a long time before getting served.

So far, interventions that enhance performance among the Palestinian public hospitals are straightforward needs. This work evaluates their efficiency, allocates potential savings, and identify the drivers of inefficient practices. Hopefully, findings will have favorable outcomes regarding hospital performance.

Table 3. 1 Selected recent DEA research with extensions in hospital efficiency analysis

Authors	Design	Model	(DMU)	Sample & data	Inputs	Outputs	Tobit predictors
Samut & Cafrı (2016)	Longitudinal	CCR-DEA + Tobit Input-oriented	Country	OECD countries 2010 - 2011	Beds, personnel, equipment	Discharge rate, infant survival rate	GDP, the life expectancy, public & private hospitals
Paschal N Mujasi <i>et al.</i> (2016)	Cross-sectional	CCR-DEA + Tobit Output oriented	Hospital	17 referral hospitals in Uganda	Beds, personnel	Inpatient days, outpatient visits	ALOS, BOR*, ownership, size
Ozgen & Ozcan (2004)	Longitudinal	CCR + Malmquist Input oriented	Dialysis (Renal units)	140 facilities 1994 - 2000	Personnel, machines, costs	Outpatient, home, training	
Chowdhury & Zelenyuk (2016)	Longitudinal	Output oriented DEA + Truncated regression	Hospital	113 Hospitals 2003 - 2006 Canada	Personnel, cost, equipment	Ambulatory services, case-mix	Size, location, teaching, BOR, equipment, out / inpatient ratio
Eyob Zere (2000)	Longitudinal	DEA + Malmquist Output oriented	Hospital	86 hospitals 1997- 1998 South Africa	Beds, Personnel, cost	Inpatient, outpatient,	
Kalhor <i>et al.</i> (2016)	Cross-sectional	DEA + Statistical significance input oriented	Hospital	54 Hospitals 2014 Iran	Beds, Personnel	Inpatient, ALOS, outpatient,	Size, teaching, type, ownership, qualifications
Fiallos, Patrick, Michalowski, & Farion (2015)	Cross-sectional	SBM-VRS DEA + Statistical test	Physician	20 pediatricians and seven groups of patients	Encounter time, Laboratory time, number of radiology requests	Adverse events, number of unscheduled returns	
Linh Pham (2011)	Longitudinal	Input oriented DEA + Malmquist	Hospitals	101 public hospitals 1998 – 2006 in Vietnam	Beds, personnel	Outpatient, inpatient, surgeries	
Narci <i>et al.</i> (2015)	Cross sectional	DEA + multivariate Tobit	Hospital	1103 hospital in Turkey 2010	Beds, personnel	Inpatient, surgeries outpatient, EM, daycare,	Objective and subjective competition.
Khushalani & Ozcan (2017)	Longitudinal	Dynamic Network DEA + Malmquist	Hospital and subdivisions	1259 hospitals, in the USA 2009 – 2013	Beds, doctors, expenses per bed	Adjusted case mix, outpatient, surgeries	
Jehu-Appiah <i>et al.</i> (2014)	Cross-sectional	VRS DEA + Tobit Output oriented	Hospital	128 hospitals, in Ghana 2005	Beds, personnel, expenditure	Inpatients, Tests, deliveries, outpatient	Ownership, region
Fragkiadakis <i>et al.</i> (2016) in Greece	Longitudinal	Input oriented DEA + Malmquist regression	Public hospital	87 hospitals, 2005 – 2009	Personnel, expenses	Inpatients, EM, surgeries, Lab tests.	Characteristics of public hospitals

ALOS, Average Length of Stay (for certain year) = total number of inpatient days/number of admissions. **BOR**, Bed Occupancy Rate = total inpatient days / (number of beds * 365)

3. 2 Methods

This work addresses the productive efficiency of the Palestinian public hospitals from 2010 to 2015. Like many other developing countries, there is a lack of data on performance. Therefore, we derive the relevant operational data from the publicly published annual reports by the Palestinian Ministry of Health (PMoH). To achieve our research objectives, we organized the analysis around three phases: (1) Using a six-year data of the Palestinian public hospitals, we employ the basic DEA-CCR² and the DEA-BCC³ models to analyze the overall efficiency, pure technical efficiency and scale efficiency⁴; (2) we apply DEA-based Malmquist Index to conduct longitudinal analysis and monitor year-specific variations of efficiency; (3) we apply Tobit regression model to explore the drivers of efficient practices. The dependent variable is the CCR scores of cross-sectional 66 observations.

In the following subsection, we first introduce the sample characteristics, then we provide the proposed production model and variables. After that, we explain the applied DEA-based models.

3.2.1 Sample and data

The study used data from 11 public hospitals operating in West Bank from 2010 to 2015 targeting a total of 66 observations. The sample excluded two public hospitals from the analysis. One psychiatric hospital does not meet the homogeneity assumption of DEA method. Another newly established hospital in 2014 was also excluded because efficiency judgment of a new hospital could be biased in the early stages of managerial experience. Hospitals in Gaza Strip were also excluded as accurate data is not available in the reports due to disputes between public authorities in West Bank and Gaza. We obtained ethical approval from the PMoH to carry out the research.

Out of the 1594 public hospital beds in West Bank, 180 beds are psychiatric beds operated by one hospital in Bethlehem. The other beds (1414 beds) are general hospital beds and operated by 12 public hospitals which represent the population of the study. They are geographically

² CCR model was developed by Charnes *et al.* (1978). Also known as constant returns to scale (CRS) model, it is the basic frontier model. The letters CCR stand for the initials of the developers' last names.

³ BCC model was developed by Banker *et al.* (1984). Also known as variable returns to scale (VRS) model. BCC extends the methodology of CCR as it has additional constraint that restricts the frontier to permit variable returns to scale. The letters BCC stand for the initials of the developers' last names.

⁴ The analysis of two models distinguishes three types of efficiencies (Boussofiane *et al.*, 1991; Cooper *et al.*, 2007). CCR model scores the overall technical and returns to scale efficiency. BCC model scores the pure technical efficiency. Thus, Scale efficiency (SE) = CCR score / BCC score.

distributed across ten governorates; one public hospital serves one governorate. Hebron and Nablus are two exceptions where two hospitals serve in each governorate. There are no public hospitals in East Jerusalem due to political issues.

3.2.2 Production model and variables

The investigated hospitals are all general hospitals; they are designed to provide primary and secondary health services, they don't provide tertiary health services. Considering this and their operational context, we included input-output measures that make a practical sense for the Palestinian public hospital settings. It is assumed that all these hospitals are centrally monitored and controlled by the Ministry of Health to keep on a certain level of quality. Hospital managers are responsible for meeting patients' needs efficiently and effectively within the governorate served by that working hospital.

Different input and output sets had been used in the literature to analyze the efficiency of hospitals (Hofmarcher et al., 2002; Narıcı et al., 2015). The basic principle, to identify variables, is to have a clear understanding of the "process" being evaluated among peer hospitals (Cook et al., 2014). We used output measures that represent the level of public health benefits achieved in respect of three functional areas; admissions, outpatient visits, and emergency services. Since the other activities within the hospital (laboratory tests, deliveries, surgical operations, radiology activities etc.) are highly correlated with the three measures, we did not include them in the set of outputs (Ozcan, 2008a).

The three main output measures are: (1) inpatient services as measured by the total number of annual care days rather than a number of cases to account for case-mix adjustment (Chowdhury et al., 2014); (2) outpatient services as measured by the total number of annual visits (Narıcı et al., 2015); and (3) the emergency services as measured by the total annual number of cases served without admission (Kawaguchi et al., 2014).

Inpatient days represent the total annual duration of patient admissions and the utilization of clinical and nonclinical inputs, such as nursing care, pharmaceutical items, paramedical support services, and administrative services. Outpatient visits represent the utilization of the outpatient clinics and the dedicated clinical and administrative resources to these clinics. The synergic practices between inpatient and outpatient units is a predictor of efficient managerial behavior to better allocation of input resources (Paschal N Mujasi et al., 2016).

Table 3. 2 Distribution of input-output measures, means and (standard deviations), N = 11

Year	Input measures				Output measures		
	Hospital beds (X1)	Doctors FTEs (X2)	Health FTEs (X3)	Administrative FTEs (X4)	Inpatient days (Y1)	Outpatient visits (Y2)	Emergency care (Y3)
2010	107 (20)	55 (8)	164 (28)	74 (9)	32152 (6667)	38111 (7702)	56082 (7452)
2011	106 (19)	46 (8)	170 (29)	75 (9)	32101 (6728)	35085 (7491)	56872 (7915)
2012	111 (21)	47 (7)	174 (29)	75 (8)	36015 (7914)	41305 (8430)	65094 (9461)
2013	119 (23)	44 (6)	179 (27)	75 (7)	37719 (8678)	40983 (8117)	66301 (11292)
2014	123 (25)	46 (6)	195 (32)	77 (8)	39908 (9837)	41737 (8652)	69016 (11284)
2015	125 (25)	49 (7)	194 (32)	74 (8)	42692 (10588)	46017 (8994)	68425 (10272)

FETs, Full-Time Employees. Health FTEs, as nurses, laboratory technicians, radiology technicians.

In Palestine, the emergency department and the ambulance services represent the utilization of a considerable amount of inputs in the public hospitals. The reasons behind are: (1) the hospital emergency departments become the first choice for patients seeking treatment when of the family practice model is absent; (2) the primary health care centers work only for six hours a day, and five days a week, they provide a minor role of emergency and ambulance services; and (3) all the applied insurance schemes ask insured people to go to a public emergency department first, to be financially covered if they need additional hospitalization costs later.

The input measures characterize the employed labor and capital. Labour input measures comprised three groups of personnel, the doctors, the full-time healthcare employees FTEs (Nurses, technicians para-medical departments), and the administrative FTEs (Ozgen & Ozcan, 2004). Capital input measure was represented by the number of hospital beds (Chowdhury & Zelenyuk, 2016). Table 3.2 displays some descriptive statistics of the input-output measures.

3.2.3 DEA models

This study addresses potential input savings and constructs input-oriented frontiers guided by the space of managers' control. Because public hospitals serve the public demand as given and

must manage their resources accordingly, therefore, they target input minimizing rather than output maximizing which recommends using the input-oriented DEA models. Further, their managers have more control over inputs than the outputs (Lindlbauer et al., 2016; Mogha et al., 2016; Ozcan, 2008b; Wang et al., 2015).

First, we applied a DEA-CCR model which assumes a Constant Returns to Scale (CRS) within hospital operations and doesn't account for the scale effects; then, we applied the DEA-BCC model which was developed in 1984 to satisfy scale effects in efficiency analysis. The CCR dual linear programming model to estimate relative efficiencies of 11 hospitals is written as:

$$\theta_o^* = \text{Min } \theta_o \quad (3.1)$$

Subject to,

$$\begin{aligned} \sum_{p=01}^{p=11} \lambda_p x_{ip} &\leq \theta x_{io} & i = 1,2,3,4 \\ \sum_{p=01}^{p=11} \lambda_p y_{rp} &\geq y_{ro} & r = 1,2,3 \\ \lambda_p &\geq 0 & p = 1,2, \dots, 11 \end{aligned}$$

Where:

θ_o = the efficiency score of hospital “0” under evaluation.

x_{ip} = the quantity of input “i” utilized by the “pth” hospital.

y_{rp} = the quantity of output “r” produced by the “pth” hospital.

λ = weights obtained from the dual version of the linear programming.

The radial distance to frontier provides a technical efficiency measure for hospitals under assessment. The DEA-BCC input-oriented model requires an additional set of convexity constraint for the dual linear programming algorithm (Equation 3.2), the sum of lambdas to be one and written as Equation 3.2:

$$\sum_{p=01}^{p=11} \lambda_p = 1.0 \quad (3.2)$$

The sum of lambdas yielded from the CCR model provides information whether the hospital is operating under increasing or decreasing returns to scale (Banker & Morey, 1986a; Banker & Thrall, 1992). While the CCR efficient hospitals are operating at the most productive scale size and the sum of lambdas is one, the inefficient hospitals are operating under Decreasing Returns to Scale (DRS) when $\sum \lambda > 1$ and may benefit from economies of scale. Other inefficient

hospitals are operating under Increasing Returns to Scale (IRS) when $\sum \lambda < 1$ and may suffer diseconomies of scale that may explain a state of weak control among large hospitals.

Since the BCC model always envelops the data more closely than the CCR model (input-oriented frontiers). Inefficient hospitals measure the shorter distance to the BCC frontier than the CCR frontier (Dyson et al., 2001). The analysis of the two models distinguishes three types of efficiencies that help managers to capture the components of inefficient operations (Boussofiane et al., 1991; Cooper et al., 2007). They are global technical efficiency (TE) as given by CCR score, pure technical efficiency (PTE) as given by the BCC score, and scale efficiency (SE) reflects the portion of inefficiency attributed to the given scale of operations.

$$CCR \text{ score} = BCC \text{ score} \times \text{Scale efficiency} \quad (3.3)$$

$$TE = PTE \times SE$$

Reproducing the graph of Banker *et al.*, (1984), Figure 3.2a illustrates the application of the CCR and BCC scores regarding the three components of efficiency related to the proposed production possibility set for the input-output mix (X, Y). Group of Hospitals “H1 to H6 and Hx” were used for demonstration purpose. The inefficiency component of hospital Hx as given by the ratio AB/AD is attributed to the scale of its operations. Moreover, it is distinguished from the pure technical inefficiency as given by the ratio AC/AD.

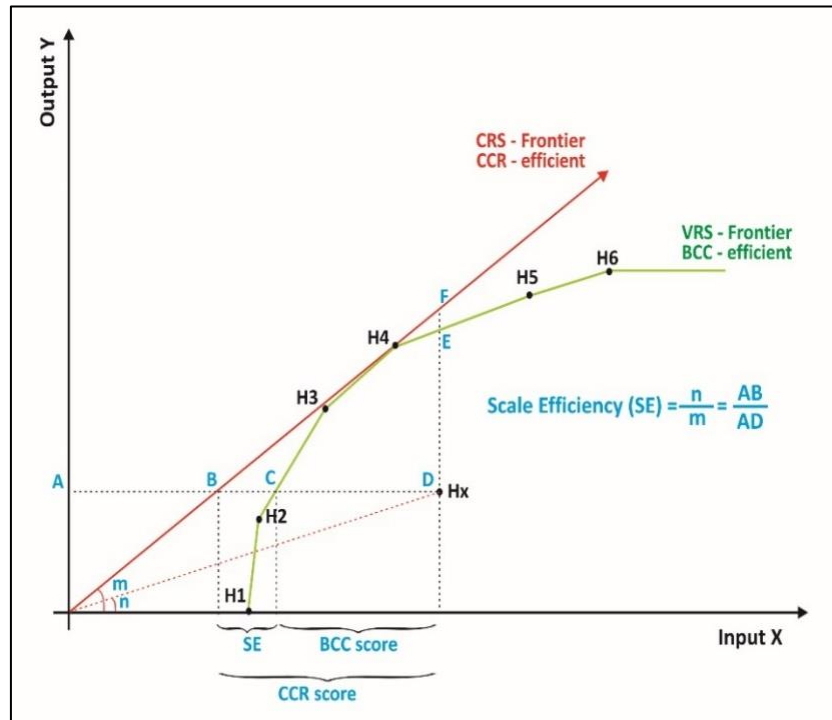


Figure 3. 2a. Illustration of scale efficiency derived from the CCR score and the BBC score.

3.2.4 Malmquist Index (MI) models

The Malmquist Index (MI) was developed by Malmquist (1953) as a quantity index for the use of analysis of consumption of inputs. Based on the notation of scaling of Malmquist (1953), Caves *et al.* (1982) developed a measure of productivity change (Caves *et al.*, 1982). Then Fare *et al.* (1992) proposed the nonparametric MI to estimate productivity changes between two time periods with a set of linear programming models (Färe *et al.*, 1992, 1994). Despite the argument that this approach could be equivalent to total factor productivity (TFP) index, particularly for multiple input-output technologies (Portela & Thanassoulis, 2006), the DEA-based Malmquist productivity index has proven itself as a good tool for measuring the productivity change of DMUs with a substantial body of applications in the literature (Yao Chen & Ali, 2004). Malmquist Index is a frontier analysis that measures the change in total factor productivity of a DMU between two periods and provides a chance to compare hospital performance by years. Further, the model allows for decomposing the MI into two components where more information can be derived from individual components (Ozcan, 2008a; Tone & Tsutsui, 2017), they are:

(1) Efficiency change (EC) component, for a given hospital, EC indicates how much a hospital succeeded to improve its efficiency between periods. It is termed in DEA literature as gains in efficiency or the catch-up effect.

(2) Shifts in frontier technology (TC) component, TC represents the effect of technology change or regulatory change that occurred between two periods.

Since public hospital managers have more prospects to reduce input resources than generating demand and should meet demand while minimizing costs, the input-based productivity index is recommended.

We analyze public hospital efficiency using the input-based distance function concept that was first introduced by Shepherd (1970). The function measures how much a firm's inputs can be proportionately reduced given the observed levels of outputs (Wheelock & Wilson, 1999). We use linear programming-based measures of technical efficiency (DEA) to estimate the distance functions. From the distance function estimates, we calculate the MI of productivity changes.

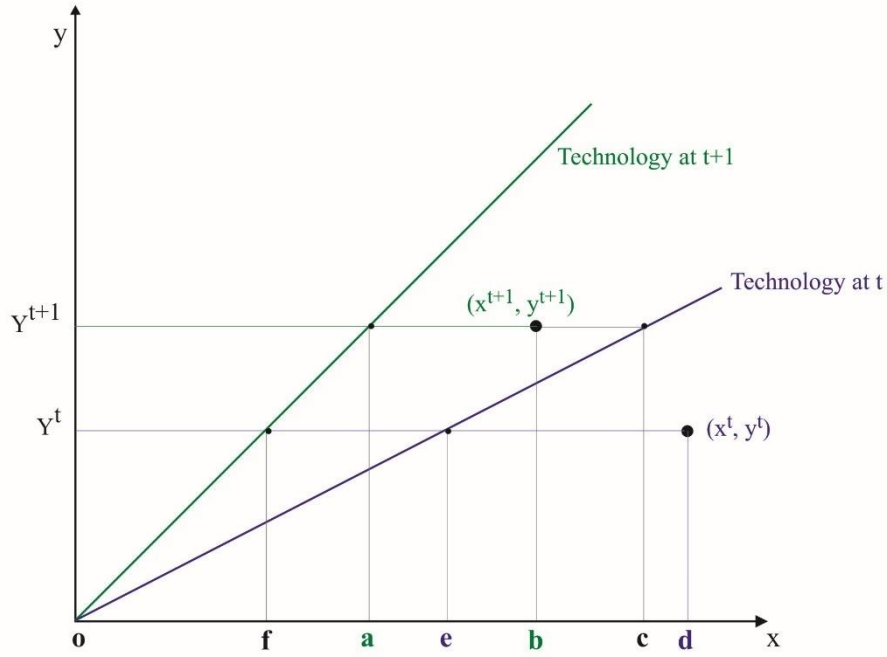


Figure 3. 3b. Illustration of the input-based Malmquist Productivity Index.

Reproduced from Färe et al., (1992).

Consider the simple setting in Figure 3.2b, in which a hospital produces a single output y^t from a single input x^t at time t , the productivity index of this hospital at time $t+1$, with t period treated as a base, is decomposed into two components (Färe et al., 1992):

$$M_i^{t+1}(Y^{t+1}, X^{t+1}, Y^t, X^t) = \text{Change in efficiency} \times \text{Change in technology} \quad (3.4)$$

$$\text{Change in efficiency (EC)} = \frac{D_i^{t+1}(X^{t+1}, Y^{t+1})}{D_i^t(X^t, Y^t)} \quad (3.5)$$

$$\text{Change in technology (TC)} = \left[\frac{D_i^t(X^t, Y^t)}{D_i^{t+1}(X^t, Y^t)} \frac{D_i^t(X^{t+1}, Y^{t+1})}{D_i^{t+1}(X^{t+1}, Y^{t+1})} \right]^{\frac{1}{2}} \quad (3.6)$$

Equation 3.5 represents the change in efficiency as the ratio of efficiency distance of observation (X^{t+1}, Y^{t+1}) with respect to technology $t+1$ in the numerator to the efficiency distance of (X^t, Y^t) with respect to technology t in the denominator. We may express this ratio as $\frac{ob/oa}{od/oe}$ (see Figure 3. 2b).

Equation 3.6 represented the change in technology (frontier shift) and expressed as the geometric mean of two frontier shift effects or the geometric mean of two Caves *et al.* (1982) Malmquist productivity indexes (Tone & Tsutsui, 2017), they are:

(a) The left-hand component inside the brackets is the frontier shift effect at the observation (X^t, Y^t) . The denominator of this side is the efficiency distance of observation (X^t, Y^t) with respect to technology $t+1$.

(b) The right-hand component inside the brackets is the frontier shift effect at the observation (X^{t+1}, Y^{t+1}) . The numerator of this side is the efficiency distance of (X^{t+1}, Y^{t+1}) with respect to technology t . Therefore, see Figure 3.2b, we may express the change in technology (TC) as $\left(\frac{of}{oe} \frac{oa}{oc}\right)^{\frac{1}{2}}$, and the change in efficiency of a hospital between two years can be seen as in Equation 3.7:

$$M_i^{t+1}(Y^{t+1}, X^{t+1}, Y^t, X^t) = \frac{ob/oa}{od/oe} \times \left(\frac{of}{oe} \frac{oa}{oc}\right)^{\frac{1}{2}} \quad (3.7)$$

The distance functions in Equations 4-a and 4-b represent the efficiency distance during t and $t+1$ periods respectively. Assuming (t) as the base period, Equations 4-c and 4-d represent the cross-period distance functions. In Equation 4-c the distance $D_i^{t+1}(X^t, Y^t)$ represents the efficiency distance using hospital at period (t) relative to the frontier technology at period $t + 1$, and in Equation 3-d, the distance $D_i^t(X^{t+1}, Y^{t+1})$ represents the efficiency distance using hospital at the period $(t+1)$ relative to the frontier technology at period (t) .

To calculate the distance functions given in the Equation 3.6, we used the fact that the input distance function is the reciprocal of Farrell's technical efficiency measure (i.e., the reciprocal of D is $1/D$) (Färe & Grosskopf, 2000). The reciprocal is the smallest ratio by which an input mix can be multiplied and still achieve a given level of output (Barros, 2005). We used Excel Solver to conduct solutions to the following four linear programming problems:

$$[D_i^t(X^t, Y^t)]^{-1} = \min \theta \quad (3.8)$$

S.T

$$\sum_{p=1}^{11} \lambda_p^t X_{ip}^t \leq \theta_o X_{io}^t \quad i = 1, 2, 3, 4$$

$$\sum_{p=1}^{11} \lambda_p^t Y_{rp}^t \leq Y_{ro}^t \quad r = 1, 2, 3$$

$$\lambda_p^t \geq 0 \quad p = 1, 2, \dots, 11$$

$$[D_i^{t+1}(X^{t+1}, Y^{t+1})]^{-1} = \min \theta \quad (3.9)$$

S.T

$$\begin{aligned} \sum_{p=1}^{11} \lambda_p^{t+1} X_{ip}^{t+1} &\leq \theta_o X_{io}^{t+1} & i = 1,2,3,4 \\ \sum_{p=1}^{11} \lambda_p^{t+1} Y_{rp}^{t+1} &\leq Y_{ro}^{t+1} & r = 1,2,3 \\ \lambda_p^{t+1} &\geq 0 & p = 1, 2, \dots, 11 \end{aligned}$$

$$[D_i^{t+1}(X^t, Y^t)]^{-1} = \min \theta \quad (3.10)$$

S.T

$$\begin{aligned} \sum_{p=1}^{11} \lambda_p^{t+1} X_{ip}^{t+1} &\leq \theta_o X_{io}^t & i = 1,2,3,4 \\ \sum_{p=1}^{11} \lambda_p^{t+1} Y_{rp}^{t+1} &\leq Y_{ro}^t & r = 1,2,3 \\ \lambda_p^{t+1} &\geq 0 & p = 1, 2, \dots, 11 \end{aligned}$$

$$[D_i^t(X^{t+1}, Y^{t+1})]^{-1} = \min \theta \quad (3.11)$$

S.T

$$\begin{aligned} \sum_{p=1}^{11} \lambda_p^t X_{ip}^t &\leq \theta_o X_{io}^{t+1} & i = 1,2,3,4 \\ \sum_{p=1}^{11} \lambda_p^t Y_{rp}^t &\leq Y_{ro}^{t+1} & r = 1,2,3 \\ \lambda_p^t &\geq 0 & p = 1, 2, \dots, 11 \end{aligned}$$

When the MI is computed by Equation 3.4 and employing the input-based model of productivity change, a number less than one will correspond to progress (Färe et al., 1994; Thanassoulis, Shiraz, & Maniadakis, 2015), *in the sense that lower input levels are needed to secure given output levels*. In Table 3.7, we show the reciprocal of the computed indexes so that a value >1 indicates progress from period t to period $t+1$, and $MI < 1$ indicates regress from t to $t+1$ period, while a value of one indicates no change. The latter conforms to standard interpretation in the productivity literature (Barros, 2005; Yao Chen & Ali, 2004; Färe et al., 1992).

3.2.5 Accounting for environmental factors: the Tobit Regression Model

The ability of a hospital to transform inputs into outputs is influenced by its managerial efficiency and external operating environment (Johnson & Kuosmanen, 2012). Therefore, relating the measures of inefficiency to the characteristics of operating environment provides a better understanding of efficiency differences and determines the key performance drivers across hospitals (Ray, 1991). The impact of environment on production was first considered by Charnes *et al.* (1981). The authors disentangled program efficiency from management efficiency by reference to empirical observations obtained from schools.

Fried *et al.* (1999) reviewed previous approaches to incorporating the external operating environment into a non-parametric measure of technical efficiency. Three categories classified the applied method in the DEA literature are:

(1) The frontier separation approach: can be implemented only for categorical factors and requires a priori selection of the most important contextual factor (Charnes *et al.*, 1981).

(2) The all-in-one approach: Single-stage DEA estimation of the effects of contextual factors was first developed by Banker & Morey (1986b). The procedure includes the external operating environment variables directly in the linear programming problem along with the traditional inputs and outputs. However, this approach requires that the external variable is classified as an input or an output in advance. Camanho *et al.* (2009) propose a model that distinguishes between the influence of internal nondiscretionary factors and external nondiscretionary factors to estimate inefficiency.

(3) The two-stage approach: The typical two-stage approach follows a first stage DEA estimation of efficiency based on inputs and outputs, then a second stage regression analysis seeking to explain variation in first stage efficiency scores concerning environmental factors. Some studies apply Ordinary Least Squares (OLS) regression to estimate the significant influence of contextual factors in the second stage; others use a Tobit regression model (Adler *et al.*, 2002). Ray (1988, 1991) was the first to apply the two-stage DEA model where the estimated efficiency scores in the first stage are regressed on contextual variables in the second stage.

Despite the large number of useful applications of the two-stage DEA method (Bravo-Ureta *et al.*, 2007; Jon A Chilingerian, 1995; Samut & Cafri, 2016), it has been criticized and different examinations of the statistical consistency of the method provided contrast conclusions that call for further testing (Johnson & Kuosmanen, 2012). Banker & Natarajan (2008) show by

simulation that the two-DEA estimator for the contextual variables is statistically consistent when OLS or Maximum Likelihood Estimator (MLE) is applied in the second stage. This requires the contextual factors to be independent of the input variables, but the contextual factors may be correlated with each other. Hoff (2007) concluded that Tobit regression is sufficient to represent the second stage DEA models when compared with alternative methods or with the OLS. McDonald (2009) came to a similar conclusion as Hoff, but he advocated not using Tobit regression.

Kieschnick & McCullough (2003) recommended using parametric regression rather than using quasi-MLE unless the sample size is large enough to justify the argument underlying the quasi-MLE. Simar & Wilson (2007) had sharply criticized the two-DEA method for lack of a coherent data generating process (DGP) and for the bias and serial correlation of the DEA efficiency estimates. They argue that the conventional methods of statistical inference are invalid in the second stage regression. Then, the authors propose the use of a bootstrap method to correct for the small sample bias and serial correlation of the DEA efficiency estimates. Later, Daraio, Daraio, Simar, & Wilson (2010) tested the assumptions required for two-stage estimation and rejected them in the non-parametric setting.

We follow Banker & Natarajan (2008) and employ Tobit regression in the second stage to evaluate the influence of environmental factors on productive efficiency of Palestinian hospitals. We regressed the CCR efficiency estimates against ten proposed factors (Table 3.3). These factors were derived in two steps. First, we extracted potential factors from the relevant literature which had been previously examined by other researchers such as the bed occupancy rate (BOR) and the average length of stay (ALOS). Second, factors represent some proposed market settings in Palestine such as the percentage of public hospital beds (PPHB) and the percentage of refugees living in every governorate (REFP).

The bed occupancy rate (BOR) is related to return to scale within hospital operations and capacity utilization, the higher the BOR, the higher constant return to scale and scale efficiency (Paschal N Mujasi et al., 2016). From economic point view, higher occupancy rate has a lower cost per case (Ferrier & Valdmanis, 1996). The ratio of outpatient visits to inpatient days (OPIPR) shows to what extent hospital managers make a better combination of the two services that could make better use of available resources. The average length of stay (ALOS) is the average days spent in a hospital from the time of admission to the time of discharge. It represents the intensity and efficiency by which individual patients are treated (Mitropoulos et al., 2013).

The ratio of administrative employees to health employees including doctors (ADHR) may affect the way of doing clinical and nonclinical processes during hospitalization, accordingly may influence efficiency (Kalhor et al., 2016). The size (SIZE) of the hospital and the applied processes to patient treatment may differ as for their size and affect the level of resource utilization; a large hospital may suffer diseconomies of scale (Gok & Sezen, 2013).

Although all the investigated hospitals are public and don't compete, it was felt that the market characteristics of each region may impact efficiency. The proposed factors influence patients' choices and may influence hospital efficiency. Due to differences in demographic and socioeconomic factors, we considered the location of the hospital (LOC) as a dummy variable to indicate whether the hospital is North to Jerusalem or South to Jerusalem where different social lifestyles apply.

Since the Palestinians' loss of their land and homes in 1948, there are refugee camps in West Bank cities; an additional demographic factor was thought to influence efficiency; The way how refugees are living and working may influence the efficiency of the working hospital in that governorate. Therefore, the percentage of refugees living in every governorate (REFP) was proposed to impact efficiency. The number of available hospital beds per 10000 citizens was considered, it represents the supply side of hospital services in a governorate (HBFP). Finally, two concentration indicators as a proxy for provider distribution are proposed to impact efficiency: (1) the available number of primary health centers per 10000 citizens in each governorate (PRC); and (2) the percentage of public hospital beds (PPHB) with respect to the overall providers' beds in a certain governorate (Samut & Cafri, 2016).

The regression model has a censored structure because the dependent variable yielded from DEA-CCR model is limited between zero and one, while the independent variables that correspond to one can be observed. Then, Tobit regression which takes the censored structure into account is suggested. The model supposes that there is a latent dependent variable Y_p^* , this unobserved variable linearly depends on the independent variables X_p via a set of parameters β s. There is a normally distributed error term ε_p to capture random influences on the relation. The observed value of the dependent variable Y_p (Equation 3.12) is defined to equal the "latent variable" whenever the latent variable is above zero, and to equal "zero" otherwise, where:

$$Y_p = Y_p^* \quad \text{if } Y_p^* > 0 \quad (3.12)$$

$$Y_p = 0 \quad \text{if } Y_p^* \leq 0$$

$$Y_p^* = \beta X_p + \varepsilon_p$$

Table 3. 3 Proposed predictors of inefficiency.

Variable	Definition	Measurement	Mean*	SD
BOR	Bed occupancy rate	The proportion of occupied beds in a year = Inpatient days / (number of beds * 365).	83.1%	1.65%
OPIPR	Outpatient – inpatient ratio	Total outpatient visits divided by total inpatient days.	1.23	0.06
ALOS	The average length of stay	Total inpatient days divided by the number of admissions.	2.18	0.05
ADHR	The ratio of administrative to health employees.	The number of administrative FTEs divided by the total health FTEs including doctors in each observed hospital.	0.36	0.01
SIZE	Hospital size (dummy)	(1) For large hospitals > 130 beds, (0) otherwise.	0.36	0.06
LOC	Hospital location (dummy)	(1) for North Governorate and (0) for South Governorate.	0.6	0.06
REFP	The proportion of refugees living in the governorate.	The percentage of refugees living in camps of all the governorate population where the observed hospital operates.	8%	0.8%
HPFP	Number of hospital beds per 10000 inhabitants	The number of all the available hospital beds per 10000 in the governorate where the public hospital operates.	12	0.711
PRC	The available primary care centers per 10000 inhabitants	The number of primary centers per 10000 inhabitants in the governorate where the public hospital operates.	2.7	0.1
PPHB	The percentage of public hospital beds.	The percentage of the available public hospital beds in a governorate to the total available number of beds.	59.3%	2.8%

**Mean and SD Values used six-year data of the predictors from 2010 to 2015.
Data Source: Palestinian health annual reports 2010 – 2015.*

The CCR-DEA scores are right censored data, following the literature, the efficiency scores are transformed to become left-censored data of inefficiency scores the used Equation 3.13 (Paschal N Mujasi et al., 2016; Narcı et al., 2015):

$$Inefficiency\ score = \left(\frac{1}{CCR\ DEA\ score} \right) - 1 \quad (3.13)$$

To estimate the β s, the Maximum Likelihood Estimation (MLE) method is used in the Tobit regression (Amemiya, 1973; Samut & Cafri, 2016). Regression coefficients are interpreted the same manner as the ordinary least-squares OLS regression. The only difference is the

interpretation of the factor signs. Specifically, negative sign means better efficiency and positive sign means more inefficiency (Narci *et al.*, 2015). The initially estimated general model (Equation 3.14) included all the proposed predictors:

$$\begin{aligned} Inefficiency = & \beta_0 + \beta_1 BOR + \beta_2 OPIPR + \beta_3 ALOS + \beta_4 ADHR + \beta_5 SIZE + \\ & \beta_6 LOC + \beta_7 REEP + \beta_8 HBFP + \beta_9 PRC + \beta_{10} PPHB \end{aligned} \quad (3.14)$$

3.3 Results and discussion

3.3.1 Descriptive Analysis

3.3.1.1 The sample characteristics

We analyzed the efficiency eleven public hospitals operating in West Bank from 2010 to 2015. They serve 1377 beds which make up 97.4% of the total public hospital beds in West Bank. Table 3.4 displays relevant working characteristics of the public healthcare market. It is worth noting the uneven spread of care providers across the governorates; (1) the distribution of public hospital beds per 10000 citizens varies largely between 7 beds and 27 beds; (2) the distribution of the primary health care centers per 10000 citizens varies across governorates from 1.84 centers to 4.08 centers; (3) the percentage of public hospital beds to the overall beds vary across governorates from 22% to 100%.

The uneven distribution of providers is a remnant of previous political phases and the contextual factors in which the public sector evolved in West Bank (Giacaman *et al.*, 2009). Estimations from the Tobit regression model in Section 3.3.5 is proposed to explain the associations of these variables with hospital efficiencies. Surprisingly, hospital P11 in Hebron governorate works at 120.4% occupancy rate. This hospital may show efficient scores, but it is reasonable to question the quality of care provided.

Table 3. 4 Selected characteristics of the operating public hospitals in West Bank (2015).

Variable	Definition	Measurement	Mean*	SD
BOR	Bed occupancy rate	The proportion of occupied beds in a year = Inpatient days / (number of beds * 365).	83.1%	1.65%
OPIPR	Outpatient – inpatient ratio	Total outpatient visits divided by total inpatient days.	1.23	0.06
ALOS	The average length of stay	Total inpatient days divided by the number of admissions.	2.18	0.05

ADHR	The ratio of administrative to health employees.	The number of administrative FTEs divided by the total health FTEs including doctors in each observed hospital.	0.36	0.01
SIZE	Hospital size (dummy)	(1) For large hospitals > 130 beds, (0) otherwise.	0.36	0.06
LOC	Hospital location (dummy)	(1) for North Governorate and (0) for South Governorate.	0.6	0.06
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HPFP	Number of hospital beds per 10000 inhabitants	The number of all the available hospital beds per 10000 in the governorate where the public hospital operates.	12	0.711
PRC	The available primary care centers per 10000 inhabitants	The number of primary centers per 10000 inhabitants in the governorate where the public hospital operates.	2.7	0.1
PPHB	The percentage of public hospital beds.	The percentage of the available public hospital beds in a governorate to the total available number of beds.	59.3%	2.8%

**Mean and SD Values used six-year data of the predictors from 2010 to 2015.
Data Source: Palestinian health annual reports 2010 – 2015.*

3.3.1.2 Input-output variables

Figure 3.3 illustrates year-specific variations in mean values of the outputs produced throughout six study years. Since the year 2012, there is a consistent increase in emergency services that contributed significantly to the variations in the provided hospital services. However, input levels had slightly increased during the study periods, growth in the average number of health FTEs (e.g., nurses, laboratory technicians, radiology technicians) is noticed in Figure 3.4.

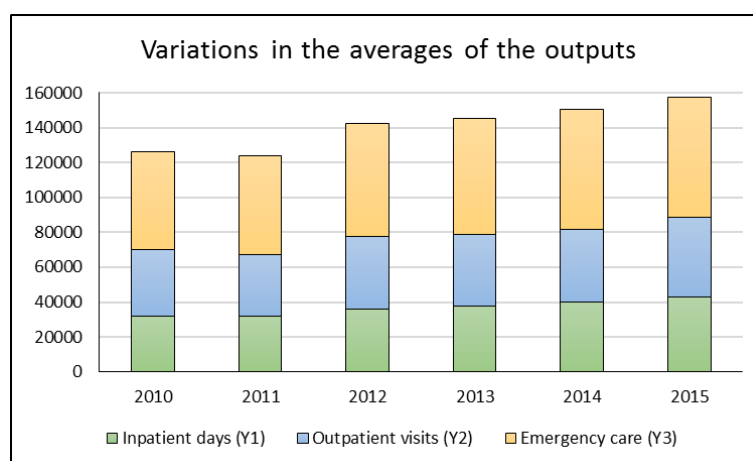


Figure 3. 4 Year-specific variations in the means of produced outputs.

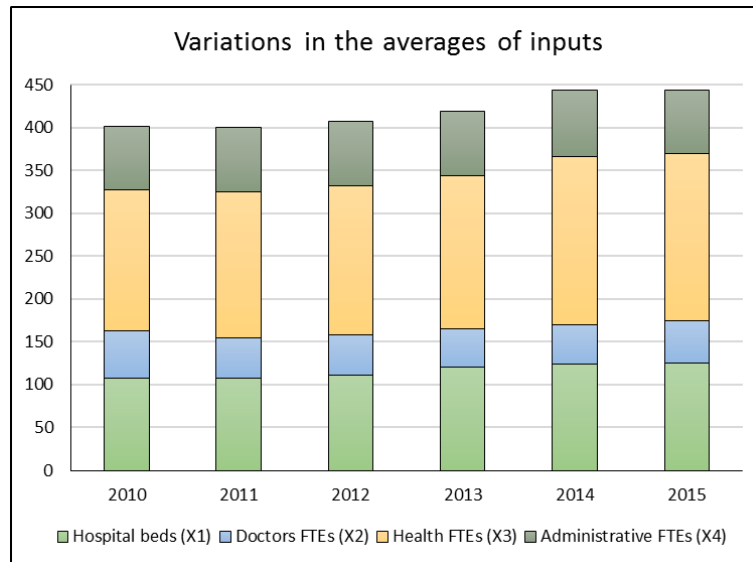


Figure 3. 5 Year-specific variations in the means of consumed inputs.

3.3.2 Hospital Efficiencies.

3.3.2.1 The year 2015

To make results more tangible for inefficient hospitals, we started analyzing the year 2015 to shape opportunities for potential improvements. The illustration of scale efficiency in Figure 3.5 helps for better understanding. Table 3.5 summarizes the individual efficiency scores for 11 hospitals in 2015. As estimated by the CCR model, under the Constant Returns to Scale (CRS) approach, average efficiency was 0.86; scores ranged from 67% to 100%. As a result, the Palestinian public hospitals have the potential to reduce 14% of their inputs while producing the same levels of services.

Three efficient hospitals P01, P04, and P011 constructed the best practices CCR frontier. These hospitals were efficient in the overall sense in both pure technical and scale efficiency. This, in turn, classifies P01, P04, and P011 as operating under CRS. Regarding other hospitals (Table 3.5), the sum of the CCR optimal lambda values classify each hospital as either operating under Increasing Returns to Scale (IRS) or Decreasing Returns to Scale (DRS) (see Table 3.5). If $\sum \lambda > 1$, then DRS prevail and if $\sum \lambda < 1$, then IRS prevail (Banker & Morey, 1986a; Banker & Thrall, 1992).

As estimated by the DEA-BCC model, under variable returns to scale approach, five hospitals P01, P02, P04, P10, and P11 were pure technically efficient. The others, P03, P05, P06, P07, P08, and P09 suffer technical inefficiency and can individually reduce their inputs by (1- BCC score) without reducing the levels of the provided outputs. Hospital P06 is scale efficient, and its inefficient performance is totally attributed to technical inefficiency as illustrated by the

BCC score 85% implying a potential savings of 15% of inputs producing the same level of outputs.

Scale efficiency measures show hospitals P01, P04, and P11 as efficient and working under constant returns to scale. Four hospitals P02, P03, P05, and P07 were operating under increasing returns to scale. Their average scale efficiency is 82.2% and could theoretically increase their size by 17.3 % to achieve optimal scale. Hospitals P08, P09, and P10 were operating under decreasing returns to scale implying that their service outputs increase by a smaller proportion compared to an increase in inputs. Their average scale efficiency is 91.4% and appears to be higher than the average for increasing returns to scale hospitals. Thus the effect on scale efficiency due to the size of the hospital is stronger on small hospitals than on large ones. Managers of large hospitals are weakly controlling their service operations. Better adaptation to new technologies will help them improve their scale efficiency (Ozcan, 2008b; Ozgen & Ozcan, 2004).

Table 3. 5 Efficiency results Efficient Reference Set 2015 (ERS).

Hospital	Beds	CCR (%)	Rank 1 - 11	BCC (%)	SE* (%)	$\Sigma \lambda$ CCR	Returns to Scale
P01	36	1	1	1	1	1	CRS
P02	50	0.67	11	1	0.67	0.53	IRS
P03	54	0.75	9	0.97	0.77	0.71	IRS
P04	55	1	1	1	1	1	CRS
P05	58	0.83	7	0.97	0.86	0.53	IRS
P06	117	0.85	6	0.85	1	1	CRS
P07	131	0.69	10	0.7	0.99	0.97	IRS
P08	163	0.92	4	0.95	0.97	1.22	DRS
P09	200	0.83	7	0.92	0.9	1.46	DRS
P10	238	0.87	5	1	0.87	2.06	DRS
P11	275	1	1	1	1	1	CRS
Average		0.86		0.94	0.91		

We decomposed efficiency components. It is worth noting five findings:

(1) There are different sources of inefficient performance, inefficient operations of P02 and P10 are attributed to scale effect while inefficient operations of P06 and P07 are attributed to pure technical effect. P02 and P10 represent a ministry problem while P06 and P07 represent a hospital management problem.

(2) Hospital P02 is 67% scale efficient while 100% pure technically efficient and was operating under increasing returns to scale suggesting an increase in its size to catch optimal production level.

(3) It is evident that all hospitals with more than 131 beds exhibit DRS, and hospitals with less than 131 beds exhibit IRS. It is the optimal productive size of hospital operations (Seiford & Zhu, 1999).

(4) Hospital P10 is 87% scale efficient while 100% pure technically efficient and was operating under decreasing returns to scale, a state of lack of control over resources. This result was expected because P10 is a hospital in Ramallah titled “The Medical Complex” resulted from the previous merging of three hospitals in the governorate, this may explain inefficiency and a certain level of managerial failure or lack of control.

(5) P07 and P02 were ranked in 10 and 11 positions respectively, more efforts should be focused on their performance improvement.

3.3.2.2 Year-specific analysis of efficiency

Table 3. 6 Year-specific Overall efficiency TE and pure technical efficiency PTE.

Hosp.	Beds	CCR scores (TE)						BCC scores (PTE)					
		2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
P01	36	1	1	1	1	1	1	1	1	1	1	1	1
P02	50	0.64	1	0.72	0.66	0.6	0.67	0.98	1	0.99	0.95	0.99	1
P03	54	0.53	0.6	0.72	0.72	0.67	0.75	0.84	0.81	0.95	0.92	0.9	0.97
P04	55	1	1	1	1	1	1	1	1	1	1	1	1
P05	58	0.93	0.99	0.78	0.91	0.81	0.83	1	1	0.94	1	0.95	0.97
P06	117	0.75	0.91	0.79	0.82	0.75	0.85	0.76	0.94	0.83	0.83	0.8	0.85
P07	131	0.84	0.8	0.89	0.86	0.69	0.69	1	0.95	0.93	0.87	0.73	0.7
P08	163	0.9	1	0.83	0.73	0.74	0.92	0.93	1	0.84	0.82	0.84	0.95
P09	200	0.69	0.82	0.79	0.87	0.86	0.83	0.75	0.83	0.79	0.94	0.88	0.92
P10	238	0.72	0.83	0.86	1	0.86	0.87	1	1	1	1	1	1
P11	275	1	1	1	1	1	1	1	1	1	1	1	1
Average %		81.8	90.5	85.3	87.0	81.6	85.5	93.3	95.7	93.4	93.9	91.7	94.2
On the frontier		3	5	3	4	3	3	6	7	4	5	4	5
Percentage %		27	46	27	36	27	27	55	64	36	46	36	46

Table 6 summarizes year-specific efficiency estimated by the DEA-CCR and the DEA-BCC models of 66 observations. The CCR scores represent the overall technical efficiency while BCC scores represent the pure technical efficiency. Figure 3.5 illustrates the mean year-specific

efficiency. The overall mean technical efficiency score over six years was 85.3%. That is, to become efficient, the public hospitals in Palestine could save 15% of their resources to produce the given level of the observed outputs. Savings will have a significant impact on hospital operations and on reducing the volume of purchased hospital services and save public money.

During 2011, hospitals show the best performance level as given by 90.5% average pure technical efficiency. The years 2010 and 2014 show relatively poor performance as given by the average efficiencies 81.8% and 81.6% respectively. Hospitals, in the general sense, gave the idea as improving their performance during the study period. More specifically, there was 4% increase in the average efficiency scores in 2015 compared with 2010.

During the whole study period, the average of the CCR efficiency scores was 85.29%, the average of the BCC efficiency scores was 93.7%, and the average scale efficiency was 91%.

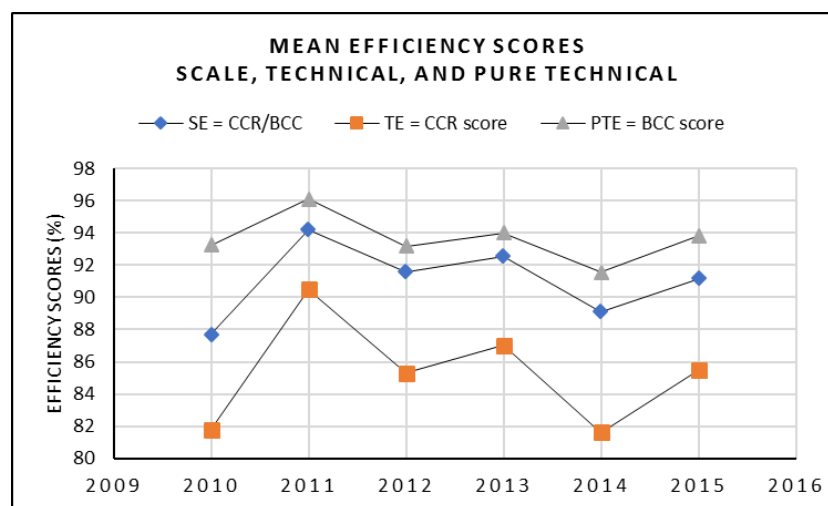


Figure 3. 6 Mean year specific efficiencies; Scale, Technical, and Pure Technical efficiencies.

3.3.3 Productivity change.

Table 3.7 summarizes the average values of Malmquist Index (MI) and its components technology (TC) and efficiency change (EC) for each pair of years during the entire period 2010-2015. Over the study period, the public hospital market saw a loss of productivity, given its average level 0.88 (Figure 3.6). Both EC and TC components exhibited a trend similar to the MI, that is a negative change in productivity was driven by technical efficiency change as well as technological regress (Ozgen & Ozcan, 2004).

Technical efficiency changes reported values close to one (close to no change status) and slightly positive values between 2011-2012 and between 2013-2014. With higher values of changes in technical efficiency component than the corresponding changes in technology (EC

values > TC values), the technological changes are the major source of regressive productivity. During the last period 2014-2015, MI = 0.75 both TC and EC (TC = 0.85, EC = 0.89) are influencing the most regressive productivity period. Appendix D shows the estimated four distance functions used to calculate the MI under input-based productivity index assumption.

Table 3. 7 Malmquist productivity index (MI) and its components EC and TC.

Period	2010-11	2011-12	2012-13	2013-14	2014-15
All the hospitals					
MI	0.83	0.95	0.80	0.91	0.75
EC	0.95	1.07	0.98	1.05	0.89
TC	0.87	0.89	0.82	0.88	0.85
The small hospitals < 130 beds					
MI	0.82	1.01	0.83	0.90	0.81
EC	0.96	1.07	0.98	1.01	0.92
TC	0.86	0.94	0.84	0.90	0.88
The large hospitals $\geq$ 130 beds					
MI	0.83	0.91	0.78	0.92	0.70
EC	0.94	1.06	0.98	1.08	0.86
TC	0.89	0.85	0.79	0.87	0.82
<i>(MI) Malmquist index, (EC) Efficiency change, (TC) Technology change.</i>					

It is useful to look at the results by small and large sub-groups regarding size which may provide insights into differences in productivity change and its components. The given productivity indexes in Table 3.7 is displayed in Figure 3.7 (for small hospitals) and Figure 3.8 (for large hospitals). We classified hospitals into small and large according to their scale behavior given previously in Table 3.5; we defined hospital with beds < 130 as small, and hospital with beds $\geq$ 130 as large. In Palestine, because Palestinian public health sector is a relatively small market, a hospital with 130 beds is perceived as a large hospital.

Unlike the whole sample behavior, for small hospitals, productivity showed one progress period 2011-12 as driven by EC = 1.07 rather than technological change (Figure 3.7). However, for large hospitals, the technical efficiency failed to bring total productivity to a progressive status and again the continuous loss of productivity of large hospital during the study period is witnessed (Figure 3.8). As a result, for the investigated hospitals, of any size the cause explaining the regress in productivity was its technology component. i.e., the size of public hospitals appeared to have no major role in their technical efficiencies but have a role in productivity and probably attributed to technology.

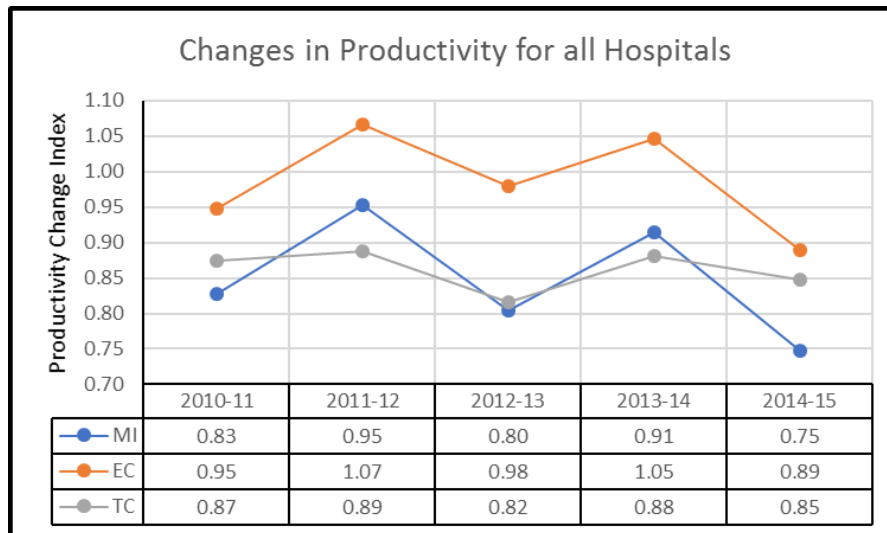


Figure 3. 7 Malmquist Index (MI), EC component, and TC component for all hospitals.

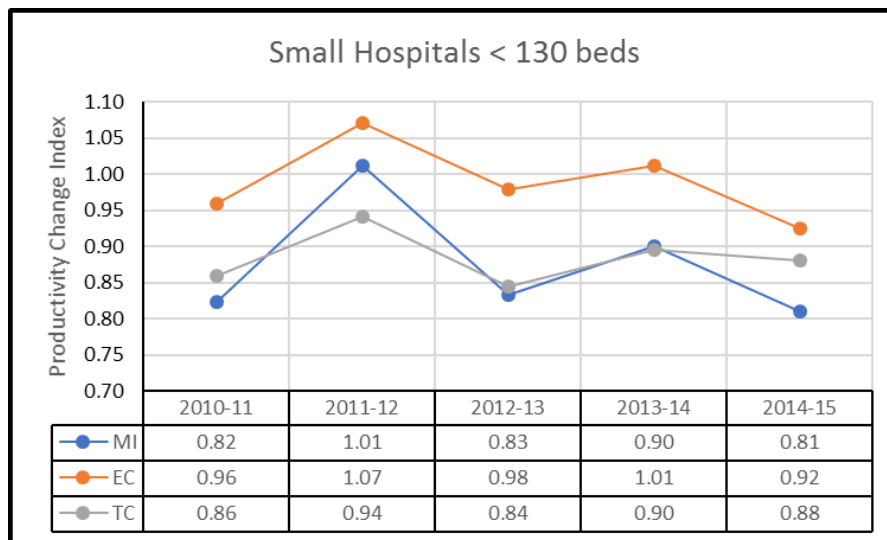


Figure 3. 8 Malmquist Index (MI), EC, and TC for small hospitals (less than 130 beds).

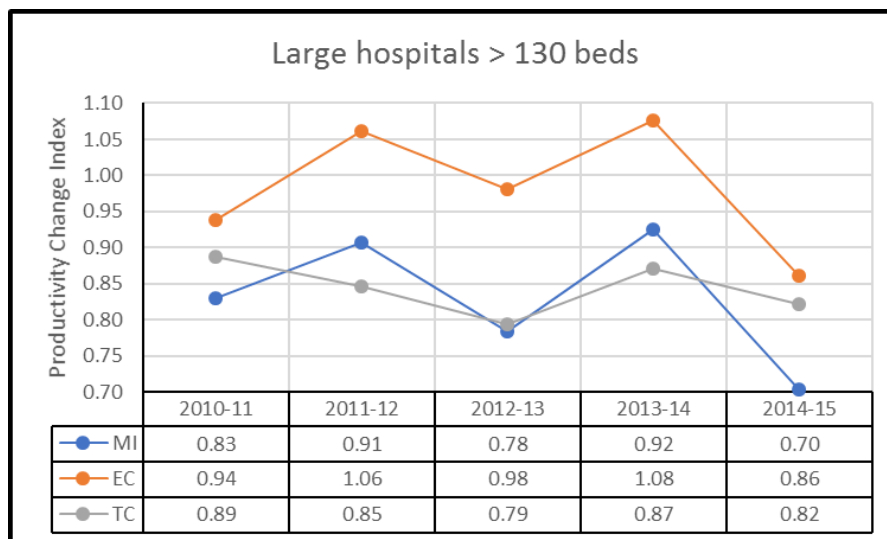


Figure 3. 9 Average Malmquist Index (MI), EC, and TC for large hospitals ≥ 130 beds.

3.3.5 The impact of environmental factors on efficiency

The selected Tobit model was earlier presented in this study Section 3.2.5 for explaining the observed hospital inefficiencies. Because we had a relatively small sample of 11 observation for every year, we followed the approach of Sarkis & Talluri (2002) to include the 66 observations from the years 2010 to 2015 in simultaneous CCR estimates (Appendix C). The resulting cross-sectional data is right-censored then transformed to left censored inefficiency scores (following the suggested transformation by Jon A Chilingirian (1995) as given by Equation 3.13). Appendix C exhibits the related discussion and the calculated outcomes. Then, we regressed the inefficiency scores against the proposed predictors in Table 3.4. To get more robust results, we tested six Tobit models using Stata 14 to examine the significance and to estimate the parameters. We started with four predictors to get a significant overall model, then included additional predictor in each model, model 6 showed four significant predictors. We run robust standard error procedure to avoid the heteroscedasticity; Table 3.8 presents the results of Tobit regressions.

The joint null hypothesis as $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$ is rejected at the 1% level of significance when given at least one non-zero parameter in all the models. The final empirical model including the significant predictors at 10% significance level was:

$$Inefficiency = \beta_0 + \beta_1 BOR + \beta_2 OPIPR + \beta_5 SIZE + \beta_9 PRC \quad (3.15)$$

Four predictors were significant in explaining hospital inefficiency in model 6. (1) the bed occupancy rate (BOR) at 1% significance level $p < 0.01$. (2) the outpatient visits to inpatient days ratio (OPIPR) at 1% significance level $p < 0.01$. (3) the hospital size (SIZE) at 10% significance level $p < 0.1$. (4) and the available number of primary health care per 10000 citizens (PRC) living in the served governorate at 1% significance level $p < 0.01$.

The coefficients of BOR and OPIPR are negative implying that increasing these predictors by one unit will lead a decrease in the predicted hospital inefficiency by 0.0129 and by 0.197 respectively, holding all other variables in the model constant. The higher the hospital BOR or OPIPR, the lower the predicted inefficiency score with a substantial effect of OPIPR, a change of one unit in OPIPR will decrease inefficiency level by 19.7%. Our result was expected and goes consistently with the previous evidence (Chowdhury & Zelenyuk, 2016; Paschal N Mujasi et al., 2016).

Table 3. 8 Results of six Tobit regression models.

Predictors	model (1)	model (2)	model (3)	model (4)	model (5)	model (6)
BOR	-0.0171*** (0.00209)	-0.0172*** (0.00203)	-0.0170*** (0.00213)	-0.0142*** (0.00221)	-0.0149*** (0.00160)	-0.0129*** (0.00229)
OPIPR	-0.218*** (0.0588)	-0.211*** (0.0690)	-0.219*** (0.0426)	-0.207*** (0.0380)	-0.204*** (0.0485)	-0.197*** (0.0387)
ALOS	0.00596 (0.0726)	0.00753 (0.0663)	0.00553 (0.0661)	-0.0302 (0.0469)	-0.0391 (0.0797)	-0.0626 (0.0808)
LOC	-0.0543* (0.0304)	-0.0526 (0.0365)	-0.0516 (0.0414)	-0.0345 (0.0387)	-0.0239 (0.0389)	-0.0117 (0.0381)
SIZE	0.0440 (0.0435)	0.0413 (0.0375)	0.0422 (0.0358)	0.0467 (0.0408)	0.0760* (0.0442)	0.0745* (0.0389)
ADHR		-0.0432 (0.284)				
PEFP			0.000385 (0.00280)			
PPHB				0.00267** (0.00134)		0.00212 (0.00163)
PRC					0.0633*** (0.0193)	0.0561*** (0.0216)
Constant	2.009*** (0.177)	2.019*** (0.161)	1.997*** (0.183)	1.558*** (0.276)	1.644*** (0.206)	1.327*** (0.297)
Observations	66	66	66	66	66	66
Sigma	0.107	0.107	0.107	0.103	0.1	0.075
Wald X ²	220.01	286.32	293.53	648.35	470.95	750.17
Prob. > X ²	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Pseudo R2	2.682	2.683	2.683	2.77	2.83	4.12
Log likelihood	38.14	38.15	38.15	40.15	41.45	55.47

Standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1

The coefficient of SIZE was positive implying that inefficiency and SIZE change in the same direction. Results indicate that predicted inefficiency for large hospitals is 0.0745 higher than for small hospital keeping all other predictors constant. As hospital capacity increases for more than 130 beds, hospital inefficiency is more likely to increase. Our results are inconsistent with previous evidence from Turkey (Atilgan, 2016) and Uganda (Paschal N Mujasi et al., 2016).

The coefficient of PRC was positive implying that increasing the number of available primary centers per 10000 by one unit in a governorate will lead an increase in the predicted inefficiency score by 1.327. The more available primary health care centers in the served region, the less efficient the hospital working there. This result may be explained as the more primary health

care centers; health seekers have more flexibility in choosing a provider and become less likely to go to a public hospital (Morrisey, 2001).

The percentage of available public beds to the all available beds in a governorate PPHB significantly explained the predicted hospital inefficiency score at 5% significance level (Model 4). The coefficient was positive implying the more percentage of public beds available the more inefficient, an increase of PPHB by one unit in a governorate will lead an increase in the predicted inefficiency score by 0.00267 keeping all other predictors constant. Assuming the demand is given to the public and controlled by the applied insurance policies, the more proportion of public hospital beds leave unoccupied beds as a holdup capacity. This competition predictor requires more in-depth investigation to get more robust results. The evidence is inconsistent regarding competition; a previous study showed no statistically significant relationship between competition and hospital efficiency (Narcı et al., 2015). Other studies showed a positive relationship between the number of private hospitals and hospital efficiency at the country level (Samut & Cafri, 2016).

Finally, Model 1 revealed a significant effect of hospital location (LOC) on hospital inefficiency at 10% significance level. The coefficient was negative implying that inefficiency and LOC change in the opposite direction. Keeping in mind that the dummy values 1 for North and 0 for South, shows that hospital in the north is less likely to be inefficient while keeping all other predictors constant. The differences in socio-economic characteristics create different health needs and different patient behaviors which in turn may explain the different influence of location on hospital efficiency; further research would be useful.

3.4 Conclusions and future research

Using data from 2010 through 2015, we assessed the technical efficiency of public hospitals in West Bank with the aim of identifying potential improvements. The research work has the privilege to present the first investigation of the productive efficiency, efficiency trends, and the determinants of inefficient performance at the hospital level in Palestine. Additionally, this work comes a reference study for future research within the distinct country conditions of the Occupied Palestinian Territories. The analysis was based on a set of variables that conform with nature of services in the Palestinian public hospitals being a general type of hospitalization. The output measures conceptualized the volume of benefits delivered to the public regarding inpatient, outpatient, and emergency services. The input measures considered the hospital size and personnel structure (capital and labor). Furthermore, this study took the basic data envelopment analysis (DEA) further by employing longitudinal data and using Malmquist

Index. Then in the second stage of analysis, the work incorporates the environmental factors that influence the inefficient performance of hospitals.

The main findings of this study are: (1) The potential savings of 14.5% of resource consumption without reducing the volume of the provided services. (2) During the years 2010 through 2015, despite the improvement in technical efficiency 4%, hospitals displayed regress in productivity attributed to regress in technology component of Malmquist Index. (3) The strong effect of outpatient-inpatient ratio on efficient performance. A one-unit increase in OPIPR will lead a decrease of 19.7% in the predicted inefficiency level, holding all other factors constant.

The first aim of this study was to evaluate the productive efficiency of the Palestinian public hospitals in West Bank. The empirical results show that during the year 2015, three hospitals were technically efficient in the overall sense (DEA-CCR), and they were more successful to transform the constrained inputs into hospital services. The relative efficiency of other hospitals ranged from 67% to 92%, and the average efficiency of all the observed hospitals was 85.5% and can save 14.5% of their resources. Therefore, findings show the need for revision of the criteria for making a referral decision to purchase hospital services should be reconsidered. The referral decisions, when based on measurement, will reduce expenditure on purchased hospitalization.

Further analysis of the DEA-CCR and the DEA-BCC scores allowed us to decompose the inefficient components of hospital operations into pure technical and scale efficiencies. Inefficient operations of P06 and P07 were attributed to managerial effects as given by the scale-free BCC efficiencies 85% and 70% respectively. While for hospitals P02 and P 10, the inefficient operations are attributed to scale effects in P02 and P10. Moreover, the year 2011 exhibited a best average level of performance, and the year 2014 exhibited the poorest average performance level. During the study period, the average scale efficiency as given 91% level had a larger effect on driving the given overall inefficiency than the average pure technical efficiency as given 93.7% level.

Therefore, findings show the need for revision of the resource allocation policies. The Hospitals working under increasing returns to scale can share additional workload to reach their optimal size of operations, considering this opportunity. Finally, the managers of inefficient hospitals can direct and quantify their efforts to benchmark best performer.

The second aim of this study was to analyze variations in productivity. We applied the input-oriented Malmquist productivity index and its two components, the shift in the frontier that

estimates technological change and the shift in efficiency that estimates management efforts to catch up best performers. It is evident from the results that, hospitals displayed regress in productivity attributed to continuous regress in technology. In Palestine, it is believed that emphasis on quantity preceded the quality in Palestinian hospitals (Hamdan & Saleem, 2013). Although international donors supported capacity building reforms and new technologies were installed in healthcare, our findings may explain the inappropriate adoption of new technologies (i.e., insufficient experience and knowledge or change resistance), which could limit the benefits to be acquired from new technology. Balanced efforts to get the "know how" skills will make up better benefits from the new technology (Ozgen & Ozcan, 2004).

The third aim of this study was to explore the determinants of inefficient performance among the Palestinian public hospitals. Tobit regression models identified six significant relations between working conditions and operational inefficiency levels. Bed occupancy rate has a negative impact on inefficiency levels because hospitals with higher occupancy rates will take advantage of full bed capacity, findings suggest setting a proper level of health personnel following bed occupancy rates will enhance efficiency (Fragkiadakis et al., 2016; Nyman & Bricker, 1989). Outpatient visits as a proportion of inpatient days had a negative impact on inefficiency (Paschal N Mujasi et al., 2016). Since outpatient services require less personnel, managing this ratio while considering for case mix will help managers make better use of resources.

The other three factors: (1) the size of the hospital; (2) the number of available primary care centers within the governorate; (3) and the percentage of the available public hospital beds in a governorate to the total available number of beds. These factors were positively related to inefficient performance. Setting the appropriate combination of health care providers in a particular region in Palestine is within the role of the Ministry of health. Evidence from Turkey revealed opposite effect of size on hospital performance (Atilgan, 2016). Capacity plans that consider the volume, type and ownership following population health needs will reduce the impact of the prevalent weak structure in country's hospital settings. Finally, hospital location in Northern governorates was negatively related to inefficiency. Previous evidence showed the impact of location on hospital efficiency due to demographic and socioeconomic differences (Matranga et al., 2013). Managing these factors will guide policy makers at the Ministry level for appropriate policies and regulations towards better efficient operations among the Palestinian public hospitals.

Although the study was the first to examine the productivity of Palestinian public hospitals, it has some important limitations. First, the study excluded hospitals working in Gaza and results can't be secured at the country level. Due to the relative nature of DEA, the exclusion of hospitals in Gaza could make our results overestimated. Second, due to lack of data, the study didn't include operating costs. Third, the small sample size makes the results very sensitive to measurement error. However other studies used small sample size, it is the reality when the examined group of DMUs is small (Tlotlego et al., 2010).

Finally, like many developing countries, because of the lack of data associated with qualitative information, the scope of our study was limited to examine decisions made by managers and ministry administrators in respect of the quantity and the distribution of resources.

Future research could extend the results of this study in many ways. Research may optimize the allocation of resources within the health care system and consider the clinical quality of services and patient satisfaction. Extending the analysis to cross-country comparisons with Arabic speaking countries that share similar socioeconomic context such as Jordan will be useful.

This study uncovered hospitals working at over occupancy rate ($> 100\%$), more specific, the largest hospital P11 with 275 beds. While this hospital displayed efficient performance, quality is questioned and requires more investigations to examine whether the adoption of policies of over occupation in some Palestinian hospitals leads to premature discharges or other medical complications.

Appendix C.

Inefficiency scores: values of the dependent variable in Tobit regression

To have a sufficient number of observations for Tobit Analysis we employed the DEA framework presented by Boussofiane et al. (1991). The method allows us to capture the actual variations of each hospital through simultaneous estimation of efficiency of all the 66 observations. Since DEA is a relative measurement method, a change in the efficiency score in the following year of the tested hospital does not necessarily mean a change in its own performance only; changes in the performance of the others may influence the relative position of that hospital. If we carry out an independent analysis for each year, we cannot certainly attribute the changes in the efficiency score of a focal hospital to actual performance change of that hospital. But, simultaneous inclusion of 66 observations in the model allows for addressing the variations of a hospital across two successive years with certainty (Sarkis & Talluri, 2002). This method strengthens the discriminatory power of DEA as sufficient number of DMUs are analyzed (Cook et al., 2014).

Table 3. 9 DEA-CCR scores: simultaneous estimations of 66 observations.

Hospital	CCR efficiency: Simultaneous estimation of 66 observation					
	2010	2011	2012	2013	2014	2015
P01	1	0.92	1	0.89	0.98	0.97
P02	0.57	0.66	0.67	0.57	0.58	0.64
P03	0.49	0.51	0.67	0.63	0.6	0.65
P04	0.97	0.93	0.99	1	1	0.98
P05	0.88	0.68	0.71	0.78	0.77	0.82
P06	0.62	0.63	0.69	0.72	0.69	0.69
P07	0.73	0.72	0.82	0.73	0.65	0.68
P08	0.75	0.78	0.77	0.65	0.71	0.78
P09	0.64	0.64	0.76	0.76	0.75	0.78
P10	0.64	0.74	0.8	0.88	0.79	0.84
P11	1	1	1	1	1	1
Average	0.75	0.75	0.81	0.78	0.77	0.80

Table 3. 10 Inefficiency scores of 66 observations (dependent variable values in Tobit Regression Model).

Hospital	Transformed inefficiency: Simultaneous estimation of 66 observation					
	2010	2011	2012	2013	2014	2015
P01	0.00	0.09	0.00	0.12	0.02	0.03
P02	0.75	0.52	0.49	0.75	0.72	0.56
P03	1.04	0.96	0.49	0.59	0.67	0.54
P04	0.03	0.08	0.01	0.00	0.00	0.02
P05	0.14	0.47	0.41	0.28	0.30	0.22
P06	0.61	0.59	0.45	0.39	0.45	0.45
P07	0.37	0.39	0.22	0.37	0.54	0.47
P08	0.33	0.28	0.30	0.54	0.41	0.28
P09	0.56	0.56	0.32	0.32	0.33	0.28
P10	0.56	0.35	0.25	0.14	0.27	0.19
P11	0.00	0.00	0.00	0.00	0.00	0.00

**Transformed inefficiency scores = $[(1/CCR \text{ efficiency}) - 1]$*

Appendix D.

Results of four distance functions used to calculate MI.

The four input-based distance results, calculations are based on Equations 3.8, 3.9, 3.10 and 3.11 for the following Tables 3.11, 3.12, 3.13, and 3.14 respectively.

Table 3. 11 Distances at period (t) relative to frontier technology at period (t).

Period Hosp.	2010 - 11		2011 - 12		2012 - 13		2013 - 14		2014 - 15	
	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D
P01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P02	0.67	1.49	0.6	1.67	0.66	1.52	0.72	1.39	1.00	1.00
P03	0.75	1.33	0.67	1.49	0.72	1.39	0.72	1.39	0.6	1.67
P04	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P05	0.83	1.20	0.81	1.23	0.91	1.10	0.78	1.28	0.99	1.01
P06	0.85	1.18	0.75	1.33	0.82	1.22	0.79	1.27	0.91	1.10
P07	0.69	1.45	0.69	1.45	0.86	1.16	0.89	1.12	0.8	1.25
P08	0.92	1.09	0.74	1.35	0.73	1.37	0.83	1.20	1.00	1.00
P09	0.83	1.20	0.86	1.16	0.87	1.15	0.79	1.27	0.82	1.22
P10	0.87	1.15	0.86	1.16	1.00	1.00	0.86	1.16	0.83	1.20
P11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 3. 12 Distances at the period (t+1) relative to the frontier at (t+1).

Period Hosp.	2010 - 11		2011 - 12		2012 - 13		2013 - 14		2014 - 15	
	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D
P01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P02	0.6	1.67	0.66	1.52	0.72	1.39	1	1.00	0.64	1.56
P03	0.67	1.49	0.72	1.39	0.72	1.39	0.6	1.67	0.53	1.89
P04	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P05	0.81	1.23	0.91	1.10	0.78	1.28	0.99	1.01	0.93	1.08
P06	0.75	1.33	0.82	1.22	0.79	1.27	0.91	1.10	0.75	1.33
P07	0.69	1.45	0.86	1.16	0.89	1.12	0.8	1.25	0.84	1.19
P08	0.74	1.35	0.73	1.37	0.83	1.20	1.00	1.00	0.9	1.11
P09	0.86	1.16	0.87	1.15	0.79	1.27	0.82	1.22	0.69	1.45
P10	0.86	1.16	1.00	1.00	0.86	1.16	0.83	1.20	0.72	1.39
P11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 3. 13 Distances at period (t) relative to frontier technology at (t+1).

Period Hosp.	2010 - 11		2011 - 12		2012 - 13		2013 - 14		2014 - 15	
	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D
P01	1.30	0.77	1.07	0.93	1.26	0.79	1.07	0.94	1.14	0.88
P02	0.64	1.57	1.13	0.89	0.77	1.29	0.60	1.66	0.60	1.67
P03	0.56	1.78	0.54	1.85	0.78	1.29	0.67	1.50	0.70	1.43
P04	1.06	0.95	0.98	1.02	1.01	0.99	1.13	0.88	1.49	0.67
P05	0.94	1.06	0.75	1.33	0.82	1.22	0.83	1.21	0.78	1.29
P06	0.74	1.35	0.72	1.39	0.79	1.26	0.78	1.28	0.82	1.22
P07	0.80	1.24	0.78	1.27	0.95	1.05	0.76	1.31	0.65	1.54
P08	0.95	1.05	0.84	1.19	0.87	1.15	0.67	1.50	0.79	1.27
P09	0.75	1.33	0.68	1.47	0.88	1.14	0.88	1.13	0.77	1.29
P10	0.72	1.38	0.80	1.25	0.93	1.08	0.97	1.03	0.92	1.09
P11	1.13	0.89	1.06	0.94	1.22	0.82	1.06	0.94	1.18	0.85

Table 3. 14 Distances at (t+1) relative to frontier technology at the (t).

Period Hosp.	2011 - 10		2012 - 11		2013 - 12		2014 - 13		2015 - 14	
	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D	D ⁻¹	D
P01	1.00	1.00	1.23	0.81	0.95	1.06	1.11	0.90	1.26	0.80
P02	1.28	0.78	0.74	1.35	0.62	1.62	0.67	1.50	0.66	1.52
P03	0.62	1.62	0.76	1.31	0.67	1.49	0.68	1.46	0.74	1.36
P04	1.14	0.87	1.76	0.57	1.28	0.78	1.11	0.90	1.06	0.94
P05	1.10	0.91	0.77	1.30	0.83	1.20	0.89	1.12	0.87	1.15
P06	0.98	1.02	1.00	1.00	0.84	1.19	0.78	1.28	0.76	1.32
P07	0.83	1.21	0.91	1.10	0.80	1.25	0.76	1.32	0.78	1.29
P08	1.02	0.98	1.04	0.96	0.78	1.28	0.82	1.21	0.80	1.24
P09	0.86	1.16	0.92	1.09	0.79	1.27	0.86	1.16	0.94	1.07
P10	0.83	1.21	0.95	1.06	1.02	0.98	0.89	1.12	0.90	1.11
P11	1.06	0.95	1.33	0.75	1.16	0.86	1.25	0.80	1.15	0.87

CHAPTER 4

Evaluating the Productive Efficiency of Public Hospitals in Jordan

ABSTRACT

Over the last five years, Jordan is committed to providing health care services for more than a million refugees coming from bordering countries and face increasing demand for the services of public hospitals. Their efficiency is a key success factor to manage the unique and complex context effectively. This research investigated the technical and scale efficiency of the Jordanian Public Hospitals. The study applied constant and variable return to scale input-oriented DEA models to rank hospitals and allocate the factors associated with inefficient operations. The work tested 27 public hospitals from 2010 to 2014, in total, 135 observations were examined concerning four input-measures and three output measures. The output measures characterize three functional areas; inpatient, outpatient, and ambulance and emergency departments. Further, decomposing the technical efficiency allowed considering for scale effects. Findings revealed that 25 observations out of 135 ones were efficient and constructed the efficient frontier. Eight hospitals in 2014 were on the efficient frontier but were weakly efficient, and all suffered slacks. Targets and reference sets were identified to guide improvements. Hospitals were sorted into five performance patterns; promising, declining, stable good, stable poor, and unstable. The number of physicians and outpatient services recorded high slacks. On average, 2013 scored the best performance. Scale analysis shows that a capacity of 160 beds is an optimal production size in Jordan. Inefficient and weakly efficient hospitals can target areas of opportunities for performance improvements. The efficiency of Public hospitals in Jordan was not investigated since 1992. The study was limited to public hospitals from 2010 to 2014.

Keywords: Performance; Hospitals; DEA; Developing Countries; Jordan.

4.1 Introduction

The operational environment in Jordan continues to be considerably affected by the security situation in Syria and the influx of the Syrian refugees into the country, as well as by the development in Iraq and Gaza in 2014 (UNHCR, 2016). While the number of inhabitants in Jordan was 9,531,712 in 2015, about 30% of them are not Jordanians, e.g., 1,300,000 are

Syrians (JMoH, 2015a). Moreover, due to regional political unsteadiness in the Middle East, there is an unpredictable movement of refugees which places greater demands on the country's infrastructure and health services (Lozi, 2013). According to the United Nations Refugee Agency (UNHCR), Jordan hosted more than a million refugees during 2015. Jordan has granted the Syrian refugees access to services like health and education. The Jordanian Ministry of Health is an operational partner with UNHCR to respond to the refugees' needs. Therefore, the Jordanian public hospitals expect more workloads and demand to cope with the government commitments toward the refugees; their efficiency becomes a key component of their role.

Data Envelopment Analysis (DEA) methodology is an effective method to evaluate the performance of organizational units like hospitals. DEA gained acceptance and became a universal tool in comparing productivity (Kaitelidou et al., 2016). It is widely used to evaluate hospital performance (Emrouznejad et al., 2008; Xu et al., 2015). This study estimates the technical and scale efficiencies of public hospitals in Jordan using DEA. While, advanced methods in operations research had been developed in healthcare applications (Xie & Lawley, 2015), however, DEA is relatively limited in the literature of the developing countries including Jordan (Shahhoseini et al., 2011). Most developing countries used simple ratio methods to measure efficiency (Villalobos-Cid et al., 2016). This work attempts to fill a gap in the developing countries literature by providing evidence from Jordan. Further, we decompose the factors of inefficiencies and analyze technical and scale efficiencies. We ranked the equally efficient hospitals, then we tested for weak efficiency and identified the benchmark hospitals. Section 4.3 introduces the results and the discussion of five stages of this work with the aim of reducing inefficiencies.

The Jordanian Ministry of Health (JMoH) owns and manages the public hospitals. Their 4693 beds supply 37.8% of the total capacity of hospital beds in Jordan (JMoH, 2015a). We consider each Jordanian public hospital in every year as a DMU over the period 2010-2014. We analyzed the data of 27 public hospitals; in total, we examined 135 DMUs. We included three functional areas of operations: the inpatient care, the outpatient visits and the emergency and ambulance services. Better utilization of the hospital resources will enhance the free opportunity to serve additional patients. It is hoped that findings capture the areas that merit more attention for improving performance.

The structure of this paper is as follows: In the following two subsections, we shall review relevant literature applying the DEA methodology and the literature in the developing countries. After that, we shall present the method and case-study description followed by the results. The

results and the discussion are combined for each stage of work. Finally, in Section 4.4 we conclude and summarize the findings, managerial implications, and the limitations of the study.

4.1.1 Relevant DEA Literature

The early work of Farrell (1957) to measure productive efficiency brought the development of a powerful methodology in 1978 to measure relative efficiency of peer production units called Data Envelopment Analysis (DEA) by Charnes et al. (1978). Thousands of published works had applied DEA to different organizational settings within different contexts. DEA is a non-parametric approach to estimate the relative efficiency of peer Decision-Making Units (DMUs) that have multiple inputs and outputs (Cook et al., 2014). It is a mathematical linear programming optimization method where inefficient hospitals can benchmark against the best performers.

When DEA is applied to hospitals, the hospital under evaluation is considered efficient if and only if it cannot improve some of its inputs or outputs without worsening some of its other inputs or outputs (Cooper, Seiford, & Zhu eds., 2011). Since 1978, DEA had been widely used to evaluate efficiencies in many areas, such as but not limited to, the banking industry (Johnes, Izzeldin, & Pappas, 2015), education organizations and institutions (Selim & Bursalioğlu, 2015), airline companies (Barros & Peypoch, 2009), environmental performance (Zhou, Poh, & Ang, 2016), and hospital operations (Prakash & Annapoorni, 2015). DEA literature investigates private and public settings (Paradi & Anadol, 2001). Table 4.1 shows some selected DEA-based case studies and the used input-output measures to evaluate hospitals' efficiencies.

DEA-based studies provide useful managerial insights about improving performance, and it is an excellent tool to improve service productivity (Sherman & Zhu, 2006). Application to healthcare and education blossomed in the early days of DEA. Sherman (1984) who was the first to use DEA to identify the inefficient hospitals. Based on the review of published work on DEA, the authors found that among the most popular application areas are health care and education organizations (Emrouznejad et al., 2008; Liu et al., 2013a). Hundreds of articles addressed hospital efficiency analysis, most of them applied DEA (Hollingsworth, 2008; O'Neill et al., 2008).

Recently, DEA studies tend to analyze the impact of health care intervention programs (Zeng et al., 2016), technology, settings, and the influence of the crisis on the efficiency of healthcare providers. A study revealed that the adoption of new technology had improved the technical efficiency but did not affect the scale efficiency in the ICUs systems in the Greek public

hospitals (Highfill & Ozcan, 2016; Tsekouras et al., 2010). DePuccio & Ozcan (2016) explored efficiency differences between two different settings to deliver medical care. The medical home and nonmedical home hospitals' settings, hospitals in the former model, were more efficient. Another study investigated the impact of the crisis on hospital sector, and the efficiency of Greek public hospitals applied the DEA to derive hospital efficiency (Kaitelidou et al., 2016). German hospitals were tested for the effect of accreditation on two quality programs; the study found a positive relation between one program of quality standards with efficiency and negative relation with the other program (Lindlbauer et al., 2016).

4.1.2 DEA studies are relatively limited in developing countries

The techniques used in frontier efficiency measurement of healthcare organizations are mainly based on DEA (Hollingsworth, 2008). Most of these DEA studies are conducted in Europe and the US. But fewer studies are also conducted in other countries. Examples of empirical DEA studies, outside Europe and the US, are witnessed in Canada (Chowdhury & Zelenyuk, 2016), in Japan (Kawaguchi et al., 2014), in China (Xu et al., 2015; Yang & Zeng, 2014), in Turkey (A. S. Ali, 2016), in Iran (Hajialiafzali et al., 2007), or in the Philippines (Li et al., 2016) amongst others. Based on the cross-national comparison of DEA-based hospital efficiency studies, O'Neill et al. (2008) analyzed 79 studies. The authors found that there are three groups of DEA research based on their country of origin: (1) 25 studies were conducted in Europe; (2) 48 studies were conducted in the US; (3) and six were conducted in other countries.

Regarding the developing countries, the lack of data and the weakness of reporting had restricted the knowledge and applications of DEA research (Mogha et al., 2016). A study discussed these barriers to measure productivity in hospitals and data scarcity in Iran when applying DEA and Malmquist Index (Nabilou et al., 2016). Few recent studies applied DEA in developing countries such as Younsi (2016) applied DEA to evaluate the technical and scale efficiencies of the public-sector hospitals in Tunis during 2010-2014; Kalhor et al. (2016) investigated the factors affecting the efficiency of 54 general hospitals in Iran; a study investigated the operations of hospitals in the Sultanate of Oman, the author applied DEA and Malmquist Index (MI) to analyze hospital operations during 1999-2000 (Ramanathan, 2005).

In Jordan, the efficiency of hospitals had been investigated once using DEA approach. Al-Shammari (1999) applied DEA to measure the productive efficiency of public hospitals in Jordan. The author analyzed 15 hospitals and used the data during the period 1991-1993. The employed DEA model estimated the relative efficiency scores and ranked the hospitals. Al-Shammari recommended changes required to save resources and improve managerial

efficiency. Sarkis & Talluri, (2002) extended Al-Shammari's work and addressed some issues and utilized an improved method to track the dynamics of performance across the three years data. The revised work treated each hospital in each year as an observation and then scored all the observations dependently and simultaneously (Boussofiane et al., 1991). They used the model developed by Andersen & Petersen (1993) to rank both efficient and inefficient hospitals across three years.

4.2 Methods

4.2.1 Public hospitals in Jordan

The Jordanian healthcare system comprises public, private, charitable and International sectors. The public sector involves (a) Jordanian Ministry of Health (JMoH), (b) Royal Medical Services, (c) Medical services in Public Universities and (d) Health Services in the ministries and government institutions. These service providers operate collaboratively with four council organizational bodies: The Higher Health Council, the Jordanian Medical Council, the Jordanian Nursing Council and Food and Drug Administration (JMoH, 2015b).

Out of 12,407 hospital beds distributed in 104 hospitals in Jordan, the JMoH owns and operates 31 public hospitals, which supply capacity of 4693 beds (37.8% of the total capacity), in addition to 1538 different primary health care centers. The budget in 2014 accounts for 8% of the Gross Domestic Product (GDP = \$36,338 million) as reported by the JMoH. We excluded four hospitals from our analysis because they do not comply with the homogeneity assumption of applying DEA. Three of them are Psychiatric hospitals, and one is an Obstetrics and Gynecology hospital; they produce different types of services that chart different performance measures.

4.2.2 Sample and DEA models

We investigated a sample of 27 hospitals that operate 4226 beds, 90% of the total 4693 public hospital beds. We extracted data from the five annual statistical reports published from 2010 to 2014 to derive the operational data. Till the time this work was initiated, the last publicly published report was for the year 2014 (JMoH, 2015b). The 27 public hospitals are homogeneous and share similar production profiles (Villalobos-Cid et al., 2016). They are consistent with the essential assumptions for applying DEA methodology (Dyson et al., 2001).

We followed the approach of Sarkis & Talluri (2002) to include the 135 observations from 2010 to 2014. Therefore, we have sufficient discriminatory power of DEA (Cook et al., 2014). The

extension method of Boussofiane et al. (1991) allowed us to capture variations in year-specific efficiency of each hospital by simultaneous assessment of all 135 observations. We also employ the super-efficiency model in DEA to rank efficient hospitals (Andersen & Petersen, 1993).

Traditionally, the input-oriented models are applied to hospital analysis and justified as hospitals serve public health care as given and must manage their resources accordingly (Lindlbauer et al., 2016). It is meaningful to assume that hospital managers have more control over inputs than the outputs. This work constructs an input-oriented frontier model for attainable performance improvements guided by the space of managers' control (Wang et al., 2015). We applied the input-oriented DEA-CCR model under Constant Return to Scale (CRS) operations (Mogha et al., 2016). Then we apply DEA-BCC model under Variable Returns to Scale (VRS) operations. The two models allowed us to decompose efficiency into the scale and pure technical efficiencies (Cooper et al., 2007).

4.2.3 Input-output measures

Dyson et al. (2001) discussed many procedural issues when using the DEA method and suggested many protocols that deliver robust analysis: (1) state of homogeneity among the DMUs; (2) the number of inputs and outputs when compared to the number of DMUs; (3) the Clear purpose of the DEA exercise; (4) the importance of orientation. A high number of observations serve the sufficient degree of freedom and discriminatory power of DEA. Golany & Roll (1989) suggested a rule of thumb that the number of DMUs; at least, twice the number of inputs and outputs. Cook et al. (2014) argued that the clear purpose of the DEA exercise helps to define the type of inputs and outputs to be used to fit a clear understanding of the “process” being examined.

The applied input-output measures in this study characterize three functional areas in hospital settings. We used, in our analysis, four input measures are: (1) x_1 , the number of beds; (2) x_2 , the number of full-time working physicians; (3) x_3 , the number of healthcare personnel; including pharmacists, nurses, laboratory technicians, radiology technicians and others; and (4) x_4 , the number of administrative employees. The output measures represent the level of public benefits achieved concerning the three selected functional areas. Enlightened by the procedural work of Golany & Roll (1989) and the given literature in Table 4.1. The three main output measures are (1) y_1 , inpatient days as measured by the total number of annual care days rather than the number of cases to account for case-mix adjustment (Chowdhury et al., 2014). (2) y_2 , outpatient services as measured by the total number of annual visits; and (3) y_3 , the ambulance and emergency services as measured by the total annual number of cases served (Kawaguchi et

al., 2014). Since the other activities within the hospital (such as laboratory tests, deliveries, surgical operations, radiology activities) are highly correlated with the three measures, we did not include them in the set of outputs (Ozcan, 2008b). Table 4.2 presents the relevant descriptive statistics of 135 observations.

Table 4. 1 Input-output measures of selected empirical DEA studies.

Authors and Case Study	Method / Model	Input-measures	Output-measures
(Li <i>et al.</i> , 2016) Public Hospitals in the Philippines	DEA-based mathematical model for evaluating the performance	- Added exogenous environmental factors	- Included desired and undesired outputs
(Mogha <i>et al.</i> , 2016) 36 public sector hospitals of Uttarakhand / India	Input oriented CCR DEA	- Beds. - Doctors. - Paramedical Staff.	- Inpatient days. - Outpatient visits. - Major and minor surgeries.
(Prakash & Annapoorni, 2015) Public hospitals in Tamil Nadu	DEA; variable return to scale, output-oriented frontier.	- Beds - Surgeons. - Nurses.	- Outpatient - Total deliveries - Major Surgeries.
(Viola & Benvenuto, 2014) Public Hospitals in South-East Italy	CCR model, input-oriented	- Doctors - Health care staff - Non-medical employees. - Number of beds	- The number of adjusted ordinary releases - The number of care days.
(Ozcan, 2008a) Non-Federal acute hospitals in Virginia	Quality-adjusted DEA. Quality is an additional output measure in the second DEA stage.	- Hospital beds. - Operational expenses. - Total assets. - Total Staff.	- Adjusted Discharges. - Total outpatient visits.
(Kawaguchi <i>et al.</i> , 2014) Japanese Municipal Hospitals.	Network DEA, Divisions, and all hospital assessments.	- Beds - Doctors. - Nurses. - Administrative.	- Inpatients. - Outpatients. - Emergency.
(Chowdhury <i>et al.</i> , 2014) Ontario Hospitals Canada.	Malmquist Productivity Index (MPI), (DEA)	- Staff Hours - Beds Hours - Medical Supply cost - Non-medical supply cost. - Equipment cost.	- Inpatients. - Outpatients. - Case-mix care days
(Leleu <i>et al.</i> , 2012) ICUs and Hospitals in Florida.	Modified DEA	- Staff (FTE). - Nurses (FTE). - Beds. - expenses	- Inpatients days. - Case-mix index
(De Nicola <i>et al.</i> , 2012) Italian Public Hospitals	Bootstrapped DEA.	- physicians. - Nurses. - Beds.	- Ordinarily discharged patients. - Adjusted case- mix.

Table 4. 2 Inputs – Outputs: Descriptive Statistics N = 135 observations.

Measure	Min.	Max.	Mean	Std.
Input measures				
Number of beds (X1)	17	1101	150	178
Physicians (X2)	20	642	97	117
Health Cadre (X3)	43	1687	331	282
Administrative Cadre (X4)	13	329	84	59
Output measures				
Inpatient days (Y1)	800	268807	35397	47292
Outpatient visits (Y2)	8976	644809	114090	116367
EM and Ambulance (Y3)	0.0	596735	83375	82881

Our method comprises five stages. (1) Assess the existing position of the hospitals (what is the rank of each hospital within a range 1-135?). (2) Study efficiency variations over time. (3) Determine directions to improve performance (which hospitals to benchmark?). (4) Determine the potential input reduction and output increase (what are the target values of inputs and outputs?). (5) Analyze the effects of size of operations (what is the scale efficiency of the hospitals?). The following section reports the model, results, and the discussion of each stage. We used Solver algorithm to carry out the linear programming optimization.

4.3 Results and discussion

4.3.1. Stage 1: Efficiency scores, CRS model, input-oriented frontier

4.3.1.1 Results

We analyzed the 135 observations in 135 linear programming optimization iterations, the symbols h_{01} to h_{135} denote DMUs. The number of observations is sufficient to minimize the distortion of the empirical DEA outcomes (Cook et al., 2014; O'Neill et al., 2008). We applied the dual CRS model (Charnes et al., 1978). Equation 4.1 shows the mathematical format:

Table 4.3 displays the results. The 25 efficient observations are on the efficient frontier and domain the other inefficient 110 observations.

The radial distance to the constant returns frontier provides a technical efficiency measure for hospitals under assessment. Given the evaluation periods 2010-2014, h_k , represents one of the 135 observations, and x_{ik} and y_{rk} are the i^{th} input and r^{th} output of h_k hospital respectively. Running the model will estimate 135 values of relative efficiency scores (θ^*). The estimated

optimal value of θ is $\theta^* \leq 1.0$ represents efficiency score of the hospital under evaluation. If $\theta^* = 1.0$ the hospital is on the frontier and cannot reduce its input proportionally when $\theta^* < 1.0$ then the hospital is dominated by the frontier and able to reduce all its inputs proportionally by $(1.0 - \theta^*)$ to become efficient.

Table 4. 3 Relative efficiency scores from 2010 to 2014.

DMU _s	Jordanian Public Hospitals 2014	Beds	2010	2011	2012	2013	2014
		2014	Efficiency Scores from 2010 to 2014				
h ₀₁	AL-Basheer	1101	1.00*	0.91	1.00	0.93	0.96
h ₀₂	Prince Hamza	433	0.66	0.77	0.83	0.81	0.85
h ₀₃	AL-Zarqa	221	1.00	0.89	0.97	1.00	0.90
h ₀₄	Princess Basma	202	1.00	0.96	1.00	1.00	1.00
h ₀₅	Prince Faisal Bin AL-Hussein	178	1.00	0.96	1.00	0.98	1.00
h ₀₆	Jarash	159	0.86	0.84	0.68	0.59	0.76
h ₀₇	AL-Hussein / Salt	152	0.82	0.60	0.77	0.65	0.71
h ₀₈	Dr. Jameel Al-Totanji	140	0.81	0.87	0.88	0.81	0.90
h ₀₉	Ma'an	131	1.00	0.95	0.89	0.81	1.00
h ₁₀	AL-Iman	130	0.91	0.75	0.82	0.69	0.86
h ₁₁	AL-Karak	124	0.60	0.62	0.79	0.72	0.58
h ₁₂	AL-Nadeem	120	0.73	0.73	1.00	0.80	1.00
h ₁₃	Prince AL-Hussein Bin Abdullah	118	0.12	0.71	0.73	0.61	0.78
h ₁₄	Princess Rahma	112	1.00	1.00	1.00	1.00	1.00
h ₁₅	AL-Ramtha	110	0.67	0.74	0.90	0.72	1.00
h ₁₆	Princess Badea'	98	0.93	0.83	0.87	0.93	0.95
h ₁₇	Princess Raya	94	0.74	0.83	0.71	0.66	0.81
h ₁₈	Ghor AL-Safi	82	0.84	0.85	0.88	0.89	0.93
h ₁₉	Mua'th Bin Jabal	75	0.87	0.75	0.85	0.76	0.92
h ₂₀	Queen Rania AL-Abdullah	72	0.59	0.60	0.51	0.56	0.48
h ₂₁	AL-Mafraq	70	0.84	0.87	0.90	0.95	1.00
h ₂₂	AL-Yarmouk	67	0.89	0.87	0.93	0.80	1.00
h ₂₃	AL-Shuneh (South)	60	0.76	0.49	0.54	0.52	0.52
h ₂₄	Abu - Obaidah	60	0.96	0.95	1.00	0.98	0.83
h ₂₅	Princess Eiman\ ma'di	58	0.80	0.80	0.89	0.72	0.87
h ₂₆	Princess Salma	38	0.62	0.61	0.63	0.50	0.61
h ₂₇	AL-Rueshid	21	1.00	0.92	0.80	0.69	0.44

*Efficient hospitals are indicated in boldface.

$$\theta_k^* = \text{Min } \theta_k \quad (4.1)$$

S.T

$$\sum_{h=01}^{h=135} \lambda_h x_{ih} \leq \theta x_{ik} \quad i = 1,2,3,4$$

$$\sum_{h=01}^{h=135} \lambda_h y_{rh} \geq y_{rk} \quad r = 1,2,3$$

$$\lambda_h \geq 0 \quad h = 1,2, \dots, 135$$

Including 135 observations simultaneously to the model allows for addressing the variations of a hospital across two successive years with certainty (Sarkis & Talluri, 2002). Since DEA estimates relative efficiency, a change in the efficiency score in the following year of a tested hospital does not necessarily mean a change in its own performance only; changes in the performance of the others may influence the relative position of that hospital. If we carry out an independent analysis for each year, we cannot certainly attribute the changes in the efficiency score of a focal hospital to actual performance change of that hospital.

4.3.1.2 Discussion and implications

Managers initially need to define their actual position concerning other performers to improve their processes. Table 4.3 shows the annual efficiency scores and sheds light on many interesting managerial implications. Efficiency variations categorize the hospitals into five different patterns.

Group 1: Promising trend; hospitals h02, h08, h12, h15, h18, h21 and h22. Although the magnitude of improvement was different across the hospitals, h02 showed a slow rate of improvement but, hospitals h12 and h15 changed from 0.73 and 0.67 in 2010 to very efficient (1.0) in 2014. Furthermore, h21 and h22 went from 0.84 and 0.89 in 2010 to very efficient in 2014. These hospitals frequently appear in the efficient reference sets as benchmark hospitals Table 4.5. This group of hospitals shows a good level of efficient management practices and need to keep on their courses. Their policies and decisions demonstrated a right direction of improvements during the last five years.

Group 2: Declining trend; hospitals h07, h23, h24, and h27 show a continuous decrease in their scores. Managers may allocate some regular non-value-added practices among their hospitals to avoid the propagation of deficiencies. Performance includes a downward trend foreshadowing worse performance and needs corrective actions. Hospital h27 moved from 1.0

position in 2010 to 0.44 in 2014; it seems that decision makers decided in 2012 to cancel some services (emergency and ambulance services). This decision does not cope with necessary changes associated with the inputs side, a decision made in 2012 needs reconsideration.

Group 3: Good and stable performance; hospitals h01, h03, h04, h05, h09, h14, h16, h19, and h25 showed a high level of performance (higher than 0.9) over the five years. Except for h19 and h25, these hospitals are common in their size as large organizations; they operate 41% of the total capacity. Although their inefficiency scores low proportions, though they need more management control actions since these small portions present large absolute deviations in their input and output quantities. Their inefficiency state may be attributed to scale inefficiency and diseconomies of scale. Despite the continuous efficient scores of hospital h14 operations, it ranks 16, 32, 44, 40 and 57 over the five years respectively. The lagging position of h14 is attributed to slacks.

Group 4: Poor and stable performance; hospitals h11, h13, h20 and h26 show low and stable levels of performance, on average, they score 0.5 and need closer management attention. Strategic restructuring and process re-engineering could be suitable methods for this chronic state. Hospital h13 showed step improvement from 0.12 in 2010 to 0.71 in 2011 then moved consistently; this hospital started working in 2010 which may explain this inconsistent jump in efficiency.

Group 5: Unstable performance; hospitals h06, h10, and h17 show fluctuating behavior. It seems that operations managers do not implement a strategic plan. Regular evaluation reports may help managers to discover the causes behind unstable performance between every two successive years.

4.3.2 Stage 2: Ranking the efficient hospitals

4.3.2.1 Results

In DEA literature, unlike the conventional DEA models, the super-efficiency model in DEA excludes the hospital under evaluation from its reference set. Therefore, the model allows for efficiency estimates to score greater than 1.0 (Tone, 2017). The super-efficiency model had been proposed either to rank the efficient DMUs (Andersen & Petersen, 1993) or to identify outliers (Banker & Gifford, 1988). Equation 4.2 shows the formulation of the applied model.

$$\theta_k^* = \text{Min } \theta_k \quad (4.2)$$

S.T

$$\sum_{h=01}^{h=135} \lambda_h x_{ih} \leq \theta x_{io} \quad h \neq k, i = 1, 2, 3, 4$$

$$\sum_{h=01}^{h=135} \lambda_h y_{rh} \geq y_{ro} \quad h \neq k, r = 1, 2, 3$$

$$\lambda_h \geq 0 \quad h = 1, 2, \dots, 135$$

Table 4. 4 Complete Ranking of 135 observations.

DMU	2010	2011	2012	2013	2014
h01	9	35	1	19	17
h02	99	59	58	61	48
h03	3	31	33	12	29
h04	24	82	39	21	71
h05	10	26	8	15	13
h06	72	100	90	114	68
h07	55	113	94	111	102
h08	67	50	54	77	30
h09	4	79	56	91	76
h10	60	106	51	95	69
h11	112	108	118	119	117
h12	109	89	28	88	5
h13	135	101	74	115	63
h14	16	32	44	40	57
h15	107	70	43	93	7
h16	18	64	105	49	47
h17	86	97	98	104	84
h18	103	128	52	73	41
h19	34	123	38	66	22
h20	122	110	127	120	132
h21	80	65	25	96	11
h22	36	46	20	83	14
h23	78	133	126	129	125
h24	42	27	2	75	45
h25	85	81	62	92	37
h26	124	121	131	130	116
h27	6	23	53	87	134
Mean	62.8	77.7	60.4	80.6	58.6

Andersen & Petersen (1993) method had been criticized with many drawbacks to rank efficient unit. First, regarding the objective function value as a rank score for all the units ignoring the fact that each unit has its weights (Adler *et al.*, 2002). Second, the specialized DMUs may have an excessively high ranking (Torgersen *et al.*, 1996), Sueyoshi (1999) suggested specific bounds on weights to avoid this problem. Third, the problem of infeasibility issue in super-efficiency model (Rhrall, 1996). Banker & Chang (2006) found that the Andersen and Petersen method does not rank efficient units satisfactorily in their simulation study. Finally, despite the popularity of this method to rank efficient units in the DEA applications, there is a lack of

evidence on whether the super-efficiency model differentiates the efficient units (Banker, Chang, & Zheng, 2017).

Following the work of Andersen & Petersen (1993), the super-efficiency model provides a principal ranking for both efficient and inefficient hospitals (Sarkis & Talluri, 2002). Table 4.4 illustrates the ranking of 135 observation. The year-specific means indicate the overall annual performance of the market of public hospitals. At the hospital level, individual managers may benefit from their relative position each year moving horizontally within Table 4.4. Further, the Jordanian Ministry of Health may benefit from the year-specific means of performance of all the public hospitals by moving vertically within the Table.

The estimates of the super-efficiency model (shown in Table 4.4) support the results of the first stage of this study (Section 4.3.1). Hence, we assume that the employed method (to some extent) helped us to achieve our research objective of holistic ranking. Hospital h05 has the best sum of five ranks of 72; this reflects the good stable scores of year-specific efficiencies (1.0, 0.96, 1.0, 0.98, and 1.0). The result is consistent with high-efficiency scores given in Table 4.3. On the other hand, the poor performance of h26 (0.62, 0.61, 0.63, 0.5, and 0.61) reflects the most lagging position (sum of five ranks of 622). Hospital h12 shows a promising trend over the five years except for the failure in 2013; its managers can review for changes made in 2013 to avoid future failures.

4.3.2.2 Discussion and implications

The holistic ranking of 135 observations goes in-depth to rank the efficient hospitals which allow for more objective comparison. Table 4.4 displays the results. It is evident that the best performer among 135 observations is hospital h01 in 2012. On average, the hospital operations in 2013 occupy the best performance position as shown by the mean ranks. Managers may review practices and policies in 2013 to develop an improvement plan. The year 2012 scored the lowest mean efficiency levels.

The best hospitals, when compared to others within the same year, are h03, h27, h01, h03 and h12 during 2010 to 2014 respectively, while the worst performers are h13, h23, h26, h26 and h27 during 2010 to 2014. Particularly h23 and h26 are in extreme positions; hospital h26 appears twice as the worst in two successive years. Hospital h05 shows the best average performance (sum of five ranks 72) over the five years while the best performer h01 in 2012 shows a sum of 81 over the five years. Again, hospital h12 reveals the best position in 2014 as

ranked five. Hospital h13 in 2010, h23 in 2011, h26 in 2012, h26 in 2013 and h27 in 2014 are the worst five performers.

4.3.3 Stage 3: Global benchmarking, Efficient Reference Set (ERS)

4.3.3.1 Results

Each inefficient hospital tracks an Efficient Reference Set (ERS) to catch up the efficient frontier. This set directs the improvement efforts and constructs the composite hospital (virtual) as weighted by the values of their lambdas. The inefficient hospital attempts to become like the composite hospital; that is the convex combination of actual inputs and outputs of reference set hospitals.

Table 4. 5 Efficient Reference Sets (ERSs) for 19 inefficient hospitals in 2014.

	2010	2011	2012	2013	2014	$\sum \lambda$
h01	h ₀₉ (1.894)		h ₀₁ (0.5)		h ₁₂ (2.299)	4.69
h02	h ₀₃ (0.679) h ₀₅ (0.261) h ₀₉ (0.703) h ₁₄ (0.304)					1.95
h03			h ₀₄ (0.130)h ₂₄ (0.197)	h ₀₃ (0.315) h ₀₄ (0.222)	h ₁₂ (0.336)	1.2
h06			h ₁₂ (0.498)h ₂₄ (0.204)		h ₁₂ (0.330)	1.03
h07	h ₀₄ (0.138)		h ₀₄ (0.150)		h ₁₂ (0.35) h ₁₄ (0.048) h ₂₁ (0.044)	0.73
h08	h ₀₅ (0.305)	h ₁₄ (0.187)			h ₁₂ (0.492)	0.98
h10			h ₁₂ (0.66)		h ₁₅ (0.169)	0.9
h11			h ₀₄ (0.084)	h ₀₄ (0.176)	h ₁₄ (0.139) h ₂₁ (0.49)	0.45
h13					h ₁₂ (0.207)h ₁₅ (0.608)	0.81
h16	h ₀₉ (0.264)				h ₁₄ (0.487)	0.75
h17			h ₁₂ (0.022)h ₂₄ (0.118)		h ₁₂ (0.505)	0.64
h18	h ₀₁ (0.033)	h ₁₄ (0.052)			h ₁₂ (0.379)	0.46
h19	h ₀₃ (0.011) h ₂₇ (0.411)		h ₁₂ (0.194) h ₂₄ (0.422)			1.04
h20					h ₁₂ (0.255)h ₂₁ (0.053)	0.31
h23	h ₂₇ (0.204)		h ₀₅ (0.067) h ₁₂ (0.043) h ₂₄ (0.764)		h ₁₂ (0.037)	0.52
h24	h ₀₃ (0.051)		h ₂₄ (0.746)			0.80
h25					h ₁₂ (0.248)h ₁₅ (0.169) h ₂₁ (0.033)	0.45
h26	h ₀₄ (0.033)h ₂₇ (0.157)		h ₂₄ (0.055)		h ₁₂ (0.049)h ₂₁ (0.079)	0.37
h27	h ₀₃ (0.02)		h ₂₄ (0.072)			0.09

The Global Efficient Reference Sets (ERSs) endeavor to create the benchmark combinations from the best performers within 135 observations. The 19 inefficient hospitals in 2014 attempt to improve their management practices according to the related ERSs and lambda values. Table

(5) displays the results. As expected, h12 frequently appears as a reference hospital in 2014 and consistent with evaluations in Table 4.3, where h12 showed a promising trend, and in the Table 4.4 hospital h12 is ranked as the best performer in 2014.

The Lambda (λ_h) is the weight associated with the hospital (h) obtained by the dual linear programming solution shown in Equation 4.1. However, the benchmark is global because the reference set includes managerial behaviors of hospitals within the study period.

4.3.3.2 Discussion and implications

The measured wastes through five years inspire a wide range of improvement actions to bridge these gaps. It is reasonable to show the ERSs for the inefficient hospitals in 2014 where managerial improvement actions are valid to take place and enhance performance. Table 4.5 shows a list of efficient reference sets (ERSs); each set provides information about the improvements required by the inefficient hospital to become efficient. For instance, hospital h16 in 2014 will use a combination of two hospitals h09 in 2010 and h14 in 2014 to become efficient. The associated values of lambdas (next to the reference hospital in Table 4.5) h09 (0.264) and h14 (0.487) respectively measure the reference hospital's share into the combination. Then, the target inputs and outputs for hospital h16 are 26.4% of h09 measures in 2010 plus 48.7% of h14 measures in 2014. To avoid duplication, we provided these details of h16 as an example, and then we apply an alternative method in Section 4.3.4 to calculate the input-output targets for the hospital.

It is evident that the hospital h12 is the most frequent reference hospital. Hospitals in 2011 and 2013 rarely appear as reference subsets, and only hospital h14 acts as a reference in 2011. Going back to Table 4.3 helps us understanding the results. Table 4.3 shows 7.0 efficient hospitals in 2010, only 1.0 efficient hospital h14 in 2011 (as expected), 6.0 efficient hospitals in 2012, then 3.0 efficient hospitals in 2013 and 8.0 hospitals in 2014; this explains the share of each year to construct the reference sets.

The sum of lambdas in the last column of Table 4.5 shows the scale effects of operations of each hospital in 2014 (Banker & Thrall, 1992). While efficient units exhibit a constant return to scale, the inefficient hospitals exhibit Decreasing Return to Scale (DRS) when $\sum \lambda > 1$ and may benefit from economies of scale. Others, exhibit Increasing Return to Scale (IRS) when $\sum \lambda < 1$ and may suffer diseconomies of scale; a state of weak control on activities. It is evident that all hospitals with 159 beds h06 and more exhibit DRS, and hospitals with less than 152 beds exhibit IRS. It is the optimal productive size of hospital operations. Section 4.3.5 introduces the scale efficiency analysis.

4.3.4 Stage 4: slacks and target measures

4.3.4.1 Results

The basic DEA-CCR and DEA-BCC models estimate technical efficiency by a radial measure (or the optimal efficiency score θ^*). This radial efficiency represents the proportional input reduction possible for an observed DMU while staying in the production possibility set (Torgersen et al., 1996). Saying it another way, $\theta^* < 1$ means that all inputs can be simultaneously reduced keeping the same proportion (mix) in which they are utilized. Then $(1.0 - \theta^*)$ is the maximum proportionate reduction allowed by the production possibility set (when input-oriented models are applied) (Cooper et al., 2007).

Due to their radial nature, these models have shortcomings as they do not account for non-zero slacks (Pastor et al., 1999). Because slacks represent a substantial amount of inefficiency in DMU's performance, they must be considered in the standard linear programming formulation of DEA (Morita et al., 2005). Therefore, the observed DMU is considered fully efficient (or "strongly efficient"), if and only if, it has $\theta^*=1.0$ and all slacks equal to zero. When both conditions apply, the DMU is known as efficient in the sense of Pareto-Koopmans (Charnes et al., 1985). However, if the radial efficiency score of a DMU (hospital) is $\theta^*=1.0$ and, at least, one of the slacks is not zero, the hospital is only radially efficient, also known as efficient in Farrell's sense. The latter case is known as "weakly efficient" DMU in the DEA literature and can reduce at least one or more of its inputs or increase at least one or more of its outputs to become strongly efficient (Zhu, 2014).

The existing DEA literature investigates finding a scalar measure based on the slacks when estimating inefficient performance. Many authors defined inefficiency based on slacks and proposed many formulae. Among them, Tone (2001) introduced what is known as Slack Based Measure of efficiency (SBM) with an additive (non-directional) structure. This measure removes input and output slacks through addition and subtraction from their respective inequalities. Later, Färe & Grosskopf (2010) introduced SBM of efficiency based on directional distance functions.

In this study, to calculate the input-excesses and output-shortfalls based on the existence of input-output slacks, then to assign targets for every hospital, we follow a two-phase procedure:

(1) We calculate the optimal efficiency θ^* as given by the DEA-CCR scores, results are previously included in subsection 4.3.1 and shown in Table 4.3. The estimated values of θ^* will

be used to calculate the proportional input reduction, for DMU_o, the target input measures ($\hat{X}_{io}$) will be given by Equation 4.3:

$$\hat{X}_{io} = \theta^* x_{io} - S_{io}^- \quad i = 1, 2, 3, 4 \quad (4.3)$$

Where “ S_i^- ” denotes the slack values associated with the “ i^{th} ” input as given by solving the formula (4.4).

(2) We follow the work of Torgersen et al. (1996) to calculate the input-output slacks by employing the Equations given in the linear programming problem 4.4.

$$\text{Maximize } \left\{ \sum_{i=1}^{i=4} S_i^- + \sum_{r=1}^3 S_r^+ \right\} \quad (4.4)$$

S.T

$$\sum_{h=01}^{h=135} \lambda_h x_{ih} + S_{ih}^- = \theta^* x_{io} \quad i = 1, 2, 3, 4$$

$$\sum_{h=01}^{h=135} \lambda_h y_{rh} - S_{rh}^+ = y_{ro} \quad r = 1, 2, 3$$

$$\lambda_h \geq 0 \quad h = 1, 2, \dots, 135$$

Where “ S_i^- ” and “ S_r^+ ” denote the slack values associated with the “ i^{th} ” input and “ r^{th} ” output of hospital “ h ” respectively. The negative and positive signs indicate the reductions or increments applied to the actual input-output values. Table 4.6 shows the results in ratios of the actual measures.

However, the output shortfalls include only the component of the slacks as augmentation required to the actual outputs. The target output measures ($\hat{Y}_{io}$) will be given by Equation 4.5.

$$\hat{Y}_{io} = y_{ro} + S_{ro}^+ \quad r = 1, 2, 3 \quad (4.5)$$

The differences (Δ s) between the projected input-output targets and the observed (actual) input-output quantities are the spaces for possible improvement (the input-excesses and output-shortfalls). Table 4.7 shows the ratios of input targets, input surpluses, output targets and output shortages as a percentage of actual values.

4.3.4.2 Discussion and implications

Both input and output slacks are factors that contribute to deficiencies, and once determined they will help managers improve their competitive position. It is important for managers to determine the target values, to measure against targets and control their improvement progress. Good operations management allows for expanding output levels (the quantities of output slacks) by employing the surplus resources (the quantities of input slacks added to the proportional reduction of inputs). Many hospitals may benefit from this matching policy such as hospitals h02, h18, h19, h20, h21, and h24.

Table 4. 6 Input-Output slack percentages in the year 2014.

	Actual Inputs				Actual outputs			Input slack %				Output slack %		
	X1	X2	X3	X4	Y1	Y2	Y3	S1 ⁻	S2 ⁻	S3 ⁻	S4 ⁻	S1 ⁺	S2 ⁺	S3 ⁺
h01	1101	558	1664	329	268807	564280	596735	5%	3%	-	-	-	21%	-
h02	433	251	648	236	100353	177457	196040	-	-	-	20%	-	81%	-
h03	221	208	644	131	60315	290435	107252	-	34%	5%	-	-	-	-
h04	202	260	632	158	67957	275521	146011	-	33%	-	-	-	19%	80%
h05	178	71	349	73	44469	186665	159193	19%	-	-	-	-	0%	1%
h06	159	65	387	92	26796	123445	127548	12%	-	2%	-	-	0%	-
h07	152	173	429	104	34600	156096	109590	-	36%	-	-	7%	27%	-
h08	140	124	316	83	38842	104871	123104	-	23%	-	-	-	-	21%
h09	131	39	349	50	31693	64711	54960	34%	-	41%	22%	-	-	-
h10	130	54	286	86	21663	98265	129321	4%	-	5%	18%	-	74%	30%
h11	124	140	451	112	24071	103284	41667	-	20%	-	-	-	-	-
h12	120	53	272	46	35748	128240	132000	-	-	-	-	33%	19%	68%
h13	118	60	286	67	19931	52573	126466	-	-	-	-	-	-	-
h14	112	52	294	82	38608	35897	84364	10%	-	1%	-	2%	303%	-
h15	110	55	266	70	21931	86373	163131	-	7%	-	9%	-	11%	-
h16	98	39	200	69	27838	29599	30862	10%	-	3%	31%	-	-	-
h17	94	38	250	60	19732	81211	75412	-	-	1%	4%	-	-	23%
h18	82	44	209	32	23137	41658	56373	-	16%	10%	-	13%	4%	16%
h19	75	36	155	65	11333	88358	61753	-	-	-	31%	-	24%	-
h20	72	36	181	34	10301	34111	39546	-	4%	2%	-	-	-	-
h21	70	44	320	63	22136	101354	110089	-	17%	30%	-	25%	119%	30%
h22	67	46	226	51	13427	98443	89689	-	14%	-	-	-	-	-
h23	60	34	153	46	7862	48349	33789	-	-	-	-	-	-	-
h24	60	36	171	53	8941	105154	24087	-	-	-	-	47%	46%	71%
h25	58	34	176	29	8090	49736	63927	-	-	16%	-	65%	-	27%
h26	38	32	125	41	6711	37943	28975	-	6%	-	-	-	-	-
h27	21	24	46	18	1472	14890	0	-	18%	-	13%	55%	-	*

* Hospital h27 produced zero of the output Y3, the ratio is not applicable; its slack value is 6203 cases.

Tables 4.6 and 4.7 show the slacks associated with each input-output measure of each observed hospital during 2014. The year 2014 was analyzed to shape opportunities for improvement. Although eight hospitals were scored as efficient, it is remarkable that all the efficient hospitals h04, h05, h09, h12, h14, h15, h21 and h22 are weakly efficient. Managers of efficient hospitals still have unfinished work to do and reduce their slacks to zero.

Table 4. 7 Input-Output Targets for the year 2014: potential savings in percentages.

	Estimated Input Targets %				Output Targets%			Input Surpluses %				Output Shortages%		
	$\hat{X}_1$	$\hat{X}_2$	$\hat{X}_3$	$\hat{X}_4$	$\hat{Y}_1$	$\hat{Y}_2$	$\hat{Y}_3$	ΔX_1	ΔX_2	ΔX_3	ΔX_4	ΔY_1	ΔY_2	ΔY_3
h01	91	93	96	96	100	121	100	-9	-7	-4	-4	-	21	-
h02	85	85	85	66	100	181	100	-15	-15	-15	-34	-	81	-
h03	90	56	85	90	100	100	100	-10	-44	-15	-10	-	-	-
h04	100	67	100	100	100	119	180	-	-33	-	-	-	19	80
h05	81	100	100	100	100	100	101	-19	-	-	-	-	-	1
h06	64	76	74	76	100	100	100	-36	-24	-26	-24	-	-	-
h07	71	36	71	71	107	127	100	-29	-64	-29	-29	7	27	-
h08	90	67	90	90	100	100	121	-10	-33	-10	-10	-	-	21
h09	66	100	59	78	100	100	100	-34	-	-41	-22	-	-	-
h10	83	86	81	69	100	174	130	-17	-14	-19	-31	-	74	30
h11	58	38	58	58	100	100	100	-42	-62	-42	-42	-	-	-
h12	100	100	100	100	133	119	168	-	-	-	-	33	19	68
h13	78	78	78	78	100	100	100	-22	-22	-22	-22	0	0	-
h14	90	100	99	100	102	403	100	-10	-	-1	-	2	303	-
h15	100	93	100	91	100	111	100	-	-7	-	-9	-	11	-
h16	85	95	92	64	100	100	100	-15	-5	-8	-36	-	0	-
h17	81	81	81	77	100	100	123	-19	-19	-19	-23	-	0	23
h18	93	77	84	93	113	104	116	-7	-23	-16	-7	13	4	16
h19	92	92	92	60	100	124	100	-8	-8	-8	-40	-	24	-
h20	48	43	46	48	100	100	100	-52	-57	-54	-52	-	-	-
h21	100	83	70	100	125	219	130	-	-17	-30	-	25	119	30
h22	100	86	100	100	100	100	100	-	-14	-	-	-	-	-
h23	52	52	52	52	100	100	100	-48	-48	-48	-48	-	-	-
h24	83	83	83	83	147	146	171	-17	-17	-17	-17	47	46	71
h25	87	87	71	87	165	100	127	-13	-13	-29	-13	65	-	27
h26	61	55	61	61	100	100	100	-39	-45	-39	-39	-	-	-
h27	44	26	44	31	155	100	**	-56	-74	-56	-69	55	-	**

** Hospital h27 produced zero of the output Y3 the ratio is not applicable; the ΔY_3 is 6203 emergency cases.

Hospital h09 is weakly efficient and suffers relatively high personnel slacks, it warns weak employment policies and may need revision. Hospitals h12, h18, h21 and h24 suffer slacks in

all the three outputs and have a chance to improve their efficiency scores by increasing their outputs. Hospital h15 suffers a large value of 303 % slack in the outpatient services; it can benefit from relevant resources in inpatient departments. However, h14 suffers low levels of slacks of less than 10%.

Decision makers and hospital managers get many beneficial insights from the target and slack results. Although hospital h01 ranks (1) in 2010, it ranks 17th in 2014 as explained by deficits in the outpatient services by 21 (about 117,000 visits). The lagging position of h27 in 2014 reflects high deviations in all the input-output measures; the distribution of loads and resources in h27 is questionable. Table 4.7 shows relatively high deviations in the measures of employees (e.g., hospitals h07, h10, h11, and h13). Hospital h04 has almost twice the required number of physicians, and hospital h11 employs additional 87 physicians, 191 health professionals, and 47 administrative employees are beyond its personnel requirements. This state reflects some weaknesses in employment plans, policies or implementation and indicates the need for corrective actions by the ministry officials.

4.3.5 Stage 5: VRS Model: technical, pure technical and scale inefficiencies

4.3.5.1 Results

It is important for the hospital managers to determine their relative efficiency and to identify the factors that contribute to the inefficient behavior in their organizations. In the previous sections, we applied a CRS frontier. We did not consider the scale effects of hospital operations whether they are too small (economies of scale effect) or too large (diseconomies of scale effect). In this section, we apply the VRS frontier; the DEA-BCC model was developed to satisfy scale effects in efficiency analysis (Banker et al., 1984). The following alternative evaluations of efficiency help managers to capture the components of inefficient operations (Ozcan, 2008a).

Since the VRS models always envelop the data more closely than the CRS models (input oriented frontiers), and inefficient DMUs measure the shorter distance to the VRS frontier and scores higher efficiency levels (Dyson et al., 2001). Therefore, the sequential analysis of CRS and VRS models distinguish three types of efficiencies. Table 4.8 summarizes the calculations and Equation 4.6 shows this decomposition analysis (Cooper et al., 2007):

- Global technical efficiency (TE) as measured by distance to CRS frontiers.
- Pure technical efficiency (PTE) as measured by the distance to VRS frontiers. It demonstrates the cause of inefficient operations.

- Scale efficiency (SE): reflects the portion of inefficiency caused by the given scale of operations.

$$TE = PTE \times SE \quad (4.6)$$

Table 4. 8 Scale Efficiency (SE) Scores 2010-2014

	2010			2011			2012			2013			2014		
	$\theta 1^*$	$\theta 2^*$	SE	$\theta 1^*$	$\theta 2^*$	SE	$\theta 1^*$	$\theta 2^*$	SE	$\theta 1^*$	$\theta 2^*$	SE	$\theta 1^*$	$\theta 2^*$	SE
h01	1.00	1.00	1.00	0.91	0.94	0.97	1.00	1.00	1.00	0.93	1.00	0.93	0.96	1.00	0.96
h02	0.66	0.67	0.97	0.77	0.81	0.95	0.83	0.86	0.97	0.81	0.86	0.94	0.85	0.89	0.96
h03	1.00	1.00	1.00	0.89	0.90	0.98	0.97	0.97	1.00	1.00	1.00	1.00	0.90	0.90	1.00
h04	1.00	1.00	1.00	0.96	0.98	0.98	1.0	1.0	1.00	1.0	1.0	1.00	1.0	1.0	1.0
h05	1.0	1.0	1.00	0.96	0.97	0.99	1.0	1.0	1.00	0.98	0.98	0.99	1.0	1.0	1.0
h06	0.86	0.87	0.99	0.84	0.84	1.00	0.68	0.68	1.00	0.59	0.61	0.98	0.76	0.77	0.99
h07	0.82	0.83	0.99	0.60	0.62	0.97	0.77	0.79	0.98	0.65	0.67	0.97	0.71	0.72	0.99
h08	0.81	0.82	0.99	0.87	0.87	1.00	0.88	0.89	1.00	0.81	0.82	0.98	0.90	0.90	1.0
h09	1.00	1.00	1.00	0.95	0.98	0.97	0.89	0.91	0.98	0.81	0.85	0.95	1.0	1.0	1.0
h10	0.91	0.93	0.98	0.75	0.78	0.96	0.82	0.83	0.98	0.69	0.73	0.95	0.86	0.88	0.98
h11	0.60	0.63	0.95	0.62	0.65	0.96	0.79	0.84	0.94	0.72	0.78	0.93	0.58	0.61	0.95
h12	0.73	0.75	0.97	0.73	0.74	0.99	1.00	1.00	1.00	0.80	0.81	0.98	1.0	1.0	1.00
h13	0.12	0.46	0.27	0.71	0.83	0.86	0.73	0.73	1.00	0.61	0.63	0.96	0.78	0.80	0.97
h14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
h15	0.67	0.71	0.94	0.74	0.83	0.88	0.90	0.91	1.00	0.72	0.75	0.96	1.00	1.00	1.00
h16	0.93	0.98	0.95	0.83	0.93	0.89	0.87	0.95	0.92	0.93	0.96	0.97	0.95	1.0	0.95
h17	0.74	0.83	0.89	0.83	0.93	0.89	0.71	0.82	0.86	0.66	0.78	0.85	0.81	0.91	0.89
h18	0.84	0.94	0.90	0.85	0.97	0.88	0.88	1.0	0.88	0.89	0.96	0.92	0.93	1.0	0.93
h19	0.87	1.0	0.87	0.75	0.82	0.91	0.85	0.86	0.99	0.76	0.84	0.91	0.92	0.92	1.00
h20	0.59	0.80	0.73	0.60	0.94	0.64	0.51	0.81	0.63	0.56	0.84	0.66	0.48	0.79	0.60
h21	0.84	0.87	0.96	0.87	0.92	0.94	0.90	0.92	0.98	0.95	0.97	0.98	1.0	1.0	1.00
h22	0.89	0.90	0.99	0.87	0.88	1.00	0.93	0.93	0.99	0.80	0.86	0.92	1.0	1.0	1.00
h23	0.76	0.96	0.79	0.49	0.75	0.65	0.54	0.80	0.68	0.52	0.73	0.71	0.52	0.72	0.72
h24	0.96	0.98	0.98	0.95	0.96	0.99	1.0	1.0	1.0	0.98	0.98	1.00	0.83	0.84	0.99
h25	0.80	0.92	0.87	0.80	0.86	0.93	0.89	0.89	0.99	0.72	0.89	0.81	0.87	1.0	0.87
h26	0.62	0.86	0.72	0.61	0.77	0.79	0.63	0.79	0.80	0.50	0.77	0.65	0.61	0.78	0.79
h27	1.0	1.0	1.00	0.92	1.0	0.92	0.80	1.0	0.80	0.69	1.0	0.69	0.44	1.0	0.44

$\theta 1^*$: The CRS Efficiency Score (Global Technical).

$\theta 2^*$: The VRS Efficiency Score (Pure Technical).

$SE = \theta 1^* / \theta 2^*$: Scale Efficiency Score

We applied the VRS input-oriented DEA model which requires an additional set of convexity constraint for the linear programming algorithm shown in the formulation (1.0), the sum of λ s to be one.

$$\sum_{h=1}^{h=135} \lambda_h = 1.0 \quad (4.7)$$

As expected, the VRS efficiency scores are higher than that of the CRS. The VRS frontier model assigns 36.0 efficient hospitals while the CRS frontier model assigns 25.0 efficient hospitals out of 135 observations. The remaining 110 hospitals' SEs score less than unity and equal their TE scores. Alternatively, they are efficient in pure technical perspective. These hospitals are: h01 in 2013 and 2014, h16 in 2014, h18 in 2012 and 2014, h19 in 2010, h25 in 2014 and h27 in the years 2011, 2012, 2013, and 2014. The CRS inefficiency scores of these hospitals are completely attributed to scale inefficiency as revealed by their shifts to catch the VRS frontier.

4.3.5.2 Discussion and implications

Forces of diseconomies of scale affect the operational efficiency of hospital h01, h01 is the largest hospital in the sample with 1101 beds. The manager of hospital h01 can monitor the outpatient services and review the control procedures to avoid the side effect of their large-size operations. The forces of the economies of scale affect the operational efficiency of the other ten hospitals. During 2014, hospital managers of h16, h18, h25, and h27 may have the chance to restructure their operations and deliver more services.

The SE of all the other hospitals (99 observations) score less than one, and their scale of operation contributes to their TE (CRS-score). Table 4.8 shows the detailed scores. Attention to manage the slacks will improve SE and the TE. Hospitals h27 in 2014 shows the worst SE scores. In conformance with our previous discussion; h27 needs an in-depth revision of their operations.

The SE is the interest of the Ministry of Health to achieve uniform distribution of health resources and workloads. However, the PTE is a hospital's manager interest. Table 4.8 shows that the global technical inefficiency, as measured by the CRS model in the first stage of our work, is attributed to scale inefficiency in 11 hospitals. Both the ministry officials and the managers may benefit from this analysis and act for improvements.

4.4 Conclusions and future research

Among few studies in the developing countries, we applied DEA to evaluate both technical and scale efficiencies of the Jordanian public hospitals. Findings show that their managers have unfinished work to carry on and may benefit from the results to improve their operations. We followed an analytic methodology of five stages to conceptualize a productivity improvement plan: scoring efficiency; a complete ranking of hospitals; benchmarking sets; deviations from target measures; and scale inefficiencies. We got consistent results through the five stages of analysis.

This paper has attempted to gain managerial insights from operational data of 27 public hospitals in Jordan from 2010 to 2014. We analyzed the CRS and VRS frontiers using Data Envelopment Analysis (DEA) methodology. Jordan is a key healthcare provider in the Middle East. The unstable security situation in the bordering countries bears additional amount of work on the Jordanian healthcare system. Efficiency improvement and slack-reduction will help hospitals respond to a possible surge in demand and mitigate the unfavorable effects of work overloads. For example, managing the slacks in outpatient visits of h01 and h02 offers additional hundreds of thousands of outpatients' visits, and the slacks in emergency services of h04, h12 and h21 serve additional thousands of trauma cases, such benefits may be passed on to the Syrian Refugees within available capacity.

The year 2013 showed the best annual average performance and shared in three efficient hospitals. However, the year 2014 shared in eight efficient hospitals to construct the efficient frontier. All of eight hospitals are weakly efficient. That is, all the 27 public hospitals have the chance to enhance their efficiency. Their managers may benefit from our results to improve their operations.

This work identifies opportunities for performance improvements, and it is not an improvement end. Public hospitals have the chance to serve additional patients without absorbing more resources in Jordan and can contribute effectively to the national objective of the public health sector. Our results are limited to the public hospitals; further research is required to include the private and the teaching hospitals to generalize findings at the country level.

CHAPTER 5

Compliance of Palestinian Hospital Doctors with PCC Behaviors

ABSTRACT

Objective: This study investigates how Palestinian doctors self-evaluate their ability on Patient-Centered Care (PCC) and identifies contextual factors that may affect their views.

Methods: A sample of 369 Palestinian hospital doctors completed the Provider-Patient Relationship Questionnaire (PPRQ). Doctors were asked to report their attitudes towards the importance of four PCC components in a context-free manner. The answers were explored through statistical analysis.

Results: A considerable percentage of Palestinian doctors are unfamiliar with PCC (55%) but perceive their actions as following the PCC principles. 48.8% of doctors considered the exchange of information with patients most important in comparison with the other PCC components. Clustering identified three groups of doctors regarding their views on the importance of PCC, 32.4% of doctors reported good perceptions, 47.5% moderate, and 20.1% poor. Older, married, and specialist doctors and those having previous knowledge about PCC are more likely classified in the “good” cluster. Doctors in private hospitals reported better attitudes towards PCC. The empathic relationship component scored low levels among Palestinian doctors. The level of job interest, nurses’ cooperation, and the tendency of patients to hide information are positively associated with PCC. The doctor’s formal style is negatively associated.

Conclusion: We identified the doctor profile that best fits PCC: specialists, older, married and familiar with PCC and highlighted knowledge gaps among doctors in public and private hospitals in respect to their views on PCC.

Practical implications: Enhancing knowledge management of PCC among doctors in hospitals is recommended. Decision makers should invest in the determined contextual predictors to improve provider-patient relationship

Keywords: PCC behaviors; Doctors; Palestinian Hospitals; Developing countries.

5.1 Introduction

Patient-Centered Care (PCC) is perceived as the right thing to do (Epstein & Street, 2011). PCC had long been acknowledged as an appropriate attribute and needed aspiration of high-quality health care systems (Greene et al., 2016). The Institute of Medicine considered the approach as one of the six essentials of the quality of care in the 21st century (Berghout et al., 2015; Rathert et al., 2013). It involves the awareness of each patient as a unique and respectful individual and addresses the better understanding of his own feelings, preferences, and views about the disease and treatment (Gremigni et al., 2016). The guiding philosophy of PCC promotes treatment adherence and supports patients to follow treatment recommendations (Robinson et al., 2008). Patients will be engaged more actively in their treatment and even more likely to adopt the suggested behavioral changes (Michie et al., 2003). Further, a common understanding of the patient's condition will help the doctor getting the relevant information and execute the best possible clinical strategy (Oates et al., 2000). Accordingly, Patients are more likely to receive the maximum achievable benefits (Donabedian, 2002; Manary et al., 2013).

This study addresses a PCC knowledge gap among Palestinian doctors. It focuses on four PCC processes: (1) exchange of information; (2) individualization (patient's agenda); (3) empathic behaviors; and (4) patient involvement (Shared Decision Making) (Gremigni et al., 2016). This paper examines three structural sets of factors which may impact effective medical interview: (1) doctor-related factors; (2) patient-related factors; and (3) hospital-related factors (Di Blasi et al., 2001; Donabedian, 2002). Hospital factors include hospital setting whether it is public or private, administrative support, workload conditions, nursing support, job satisfaction and job interest (Cushing, 2015). The doctors' related factors include education, experience, training, gender, familiarity with PCC, and doctor's style (Hall & Roter, 2002; M'hamdi, van Voorst, Pinxten, Hilhorst, & Steegers, 2017; Perron, Sommer, Louis-Simonet, & Nendaz, 2015). Patients related factors include the level of health literacy and patient's tendency to hide relevant information due to felt social consequences (Osborne et al., 2016). Findings may help policymakers, educators, and care providers capturing the areas that merit collaborative institutional efforts for enhancing the knowledge and practice of PCC behaviors.

5.1.1 The case of Palestine

Behind the daily life of the Palestinians lies a unique set of factors that drive their behaviors and contributes to their performance. Palestinians are stressed by an environment characterized by worsening economic situations, restrictions on movement (Mataria et al., 2009), and the gap between the reality of occupation and the yet to be the State of Palestine. The healthcare system

is politically framed to serve the previous commitments and liberation promises by the public authorities rather than socioeconomically designed. Politics underlie the applied health insurance schemes; policies disregard the best use of the limited resources principles, this would help politicians supporting their fragile political legitimacy (Bloom et al., 2008). Further, the newly established medical schools and medical institutions are struggling to manage this environment. Hospitals suffer from the lack of proper structure, and public hospitals suffer from understaffing, shortages of supplies, and high rates of bed occupancy (Kitaneh & Hamdan, 2012).

The doctors are not living apart from this environment; they are challenged to keep on professional practices in both public and private hospitals. In the public hospitals, they are overloaded with work due to the applied health insurance schemes, the schemes cover most of the population and increase the burden on the limited public services (Rashed & Hamdan, 2015). Perhaps gauging the growing problems in the public hospitals, the Palestinian Ministry of Health (PMoH) allocated more than 35% of its budget to purchase health services from the private hospitals (PMoH, 2015a). While these allocations seem to have had a favorable impact on better access, but, quality is compromised, and the PMoH is unable to pay the receivables for the private hospitals which increased the financial burden on the private administration. Their managers suffer financial deficit to pay salaries on a regular basis, and their doctors are less induced to do any more than what is minimally required.

Hospitals in Palestine provide a geographical coverage of primary and secondary health services. The eighty operating hospitals comprise four ownership forms: public hospitals, the United Nations Relief and Works Agency (UNRWA) hospitals, not-for-profit private hospitals (NGOs) and private for-profit hospitals. Hospitals are either public or private, stated differently. The estimated population of Palestine is 4,682,467 in 2014. Of whom 2.8 million live in eleven governorates in West Bank including East Jerusalem. Eighty hospitals operate 6006 beds, 62% of them are public, owned and managed by the PMoH in West Bank and Gaza Strip. 2449 hospital beds in Gaza. Fifty hospitals operate in West Bank 3557 beds, fourteen of them 40% of total beds are public. In 2015, the male-female ratio was 51/49, and 40% of the population is aged below 14 years (PMoH, 2015a).

We conducted secondary research to find studies on health education, health professionals, or doctor-patient relationship in Palestine. We found few published studies; no study addressed the medical interview. A study showed that (84%) of health professionals reported exposure to violence in the Palestinian public hospitals (Kitaneh & Hamdan, 2012). Recent research

examined the medical students' attitudes towards the freedom of movements between different hospitals and the barriers to doing their clinical courses (Shahawy & Diamond, 2016). A study applied the Safety Attitudes Questionnaire developed by the Agency for Healthcare Research and Quality (AHRQ) to measure the safety culture in the Palestinian Neonatal Intensive Care Units (Hamdan, 2013). Attitudes among physicians and nurses to report medical errors have also been studied (Rashed & Hamdan, 2015), the researchers found that among the main barriers to reporting medical errors in Palestine; the lack of proper structure and the fear of physicians' competence to be questioned. Finally, attitudes towards hand hygiene knowledge and practices among physicians and nurses (Mu'taz et al., 2016) and the attitudes of Palestinian physicians toward wife abuse (Haj-Yahia, 2013).

5.1.2 Research problem

All medical education and accreditation frameworks included interpersonal skills as one of the main competencies of a qualified doctor (Frank et al., 2010). Doctors approach their patients and the problems they present differently during the medical interview. This is because of differences in their experience levels, cultural education backgrounds, personalities, and differences in their views of professional behaviors. Their behaviors are influenced by the conceptual models which their knowledge and practice are organized (Engel, 1980). They are also influenced by the context of the institutions and the administrative organizations they work for (Di Blasi et al., 2001; M'hamdi et al., 2017; Paternotte, 2015). However, the management of interpersonal skills is best learned and developed in authentic professional working context (van den Eertwegh et al., 2015), PCC behaviors of the Palestinian doctors are not explored yet.

In Palestine, the applied governmental health insurance schemes which cover most of the population had placed greater demand on the public health services and hospital occupancy rates (Kitaneh & Hamdan, 2012). The public sector is moving from service-centered approach to patient-centered approach in care provision (WHO, 2015). The new strategy goes in hand with the adoption of a family practice model for primary health care. Evidence proved the effectiveness of PCC for better outcomes in family medicine, and PCC practices support family medicine models (Fenton et al., 2016; McCracken et al., 1983; Oates et al., 2000). Because PCC is an essential attribute of the high-quality health care system, and because quality should be of greater concern, this study addresses two major research objectives:

- (1) Assess the compliance with PCC behaviors among the Palestinian doctors.
- (2) Explore influences associated with compliance with PCC processes.

5.1.3 Conceptual framework

The inseparable biological, psychological and social patient concerns come together in the biopsychosocial medical model. The PCC methodology operationalizes the biopsychosocial perspective into the relevant course of actions and tasks to deliver the best possible patient care (Smith et al., 2013). Engel (1977) the initiator of the biopsychosocial model, extended the doctor's responsibility to account for the weighted contribution of the psychological and social factors as well as for the biological (somatic) factors connected to the patient's dysphoria and dysfunction. Engel also included to his arguments the shared decision and patient's responsibility to cooperate in his own health (Engel, 1980).

Donabedian (1966) model to approaching the assessment of the quality of care "structure - process - outcomes" has gained widespread acceptance. This model holds that "good structure increases the likelihood of good process, and the good process increases the likelihood of good outcome." He confirms the prior knowledge of the linkages between structure and process, and between process and outcome before a quality assessment can be undertaken. Structure denotes the attributes of the care settings which could be a major determining factor of the quality that the health care system can offer. Process denotes the patient's activities and the practitioner's activities. The practitioner's activities comprise two performance elements: the technical and the management of interpersonal relations "how skillful care had been executed" (Donabedian, 2002).

Based on both models and guided by Epstein and Street work "*Patient-Centered Care is a quality of personal, professional, and organizational relationships ...*" (Epstein & Street, 2011), we framed our conceptual perspective. Figure 5.1 presents the hypothetical relationships between structural attributes and PCC performance across hospital settings. The four PCC processes of interest are mapped with the doctor and hospital-related factors. Whereas, the patients' inputs cannot be ignored (Saultz & Saultz, 2017), the two patient-related variables represent the hypothesized patient-related factors that may influence the PCC performance. Assessment of outcomes and patient education are out of the scope of this study (the dashed part of Figure 5.1).

5.1.4 Two propositions

Interpersonal differences between doctors include differences in job titles (specialists, residents, or GPs), experience, gender, marital status, University of education, previous training, familiarity with PCC, and their style to approach their patients. Some doctors received training

communication skills, and some have previous knowledge of the PCC concept while other doctors don't. In Palestine, the Medical Schools and the Medical Board institutions are relatively youth. It is not uncommon that most of the experienced doctors got their education outside Palestine and pursued different curriculums, while the less experienced doctors had the chance to study either in local universities or abroad. Female doctors are more often less experienced and more often locally educated. It is reasonable to link this variability of their backgrounds with different behaviors to approach their hospital patients (Engel, 1989).

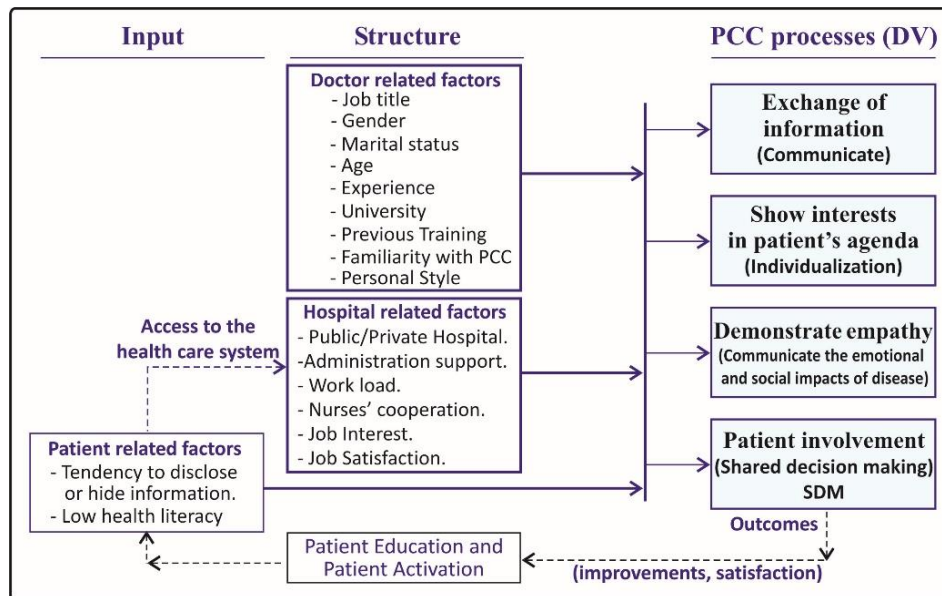


Figure 5. 1 Hypothetical links between structural attributes and PCC performance.

Palestinian public hospitals suffer high occupancy rates (Kitaneh & Hamdan, 2012). Some of the departments in public hospitals operate at 140% occupancy rates (PMoH, 2015). Accordingly, the working environment varies between public and private settings of the hospitals. Factors within the have impacts on doctors' performance (Kitson et al., 2013). When the doctors are supported by the hospital administration and other health professionals, when they have enough time to interact with the patient, when they find their job as interesting, or when they are satisfied, all will support better compliance with PCC behaviors. Thus, it is reasonable to think that doctors often adapt to less psychosocial interactions with patients trying to prioritize the biomedical aspects.

The variety of patients treated in hospitals, their level of health literacy and their tendency to hide relevant information may influence the doctor's perceptions and accordingly his behaviors. It is not uncommon in the developing countries that patients may adopt socio-cultural constraints and conceal information. Patient-related factors should be considered as inputs in the analysis to be true PCC study (Andaleeb, 2001). The perception on the doctor's side about

his patients can't be ignored (Saultz & Saultz, 2017) and become attendant during the medical interview. Because of these trends and because it is felt that quality was sacrificed in the Palestinian hospitals against stressing the quantity of care, this paper sets out to examine the PCC behaviors in the hospitals of Palestine. Two propositions are explored:

- Palestinian doctors comply differently with PCC behaviors due to interpersonal differences between them.
- Doctors perceive the working environment differently in the hospital they work for and have different views about patients' informative behaviors; these perceptions have impacts on the way they approach their patients' psychosocial needs.

5.2 Relevant Literature

5.2.1 PCC behaviors and medical care outcomes

PCC had been identified as a major objective of high-quality health care (Gremigni et al., 2016). There is a common recognition that informative and compassionate interaction between providers and patients is essential for better quality of care (Bylund, 2016; Robinson et al., 2008; Teutsch, 2003). Almost all the studies found a positive relationship between PCC implementation and patient satisfaction and well-being (Rathert et al., 2013). Patient Centeredness, Patient-Centered Care, and Patient-Centered Communication are used interchangeably in the literature (Epstein et al., 2005). The principles of PCC date back to the ancient Greek Medical School. In 1927, Peabody suggested that the practice of medicine in its broadest sense includes the whole relationship between doctor and his patient (Eveleigh et al., 2012). Similar concepts to PCC have arisen in the last five decades as, deeper diagnosis of Balint, client-centered therapy of Rogers, total-person approach to patient problems, disease versus-patient centered medical practices, and the biopsychosocial model of Engel (Oates et al., 2000).

The PCC approach recognizes the faith that healing involves knowing the patient as a person while accurately diagnosing his illness (Epstein, 2000). It focuses on the individual's specific health care needs by addressing the patient's emotions effectively (Reynolds, 2009), and giving him the opportunity to provide input into and participate in their care (Epstein et al., 2005). Moreover, the doctor's supportive attitudes towards the individual needs of the patients will promote their participation in medical care and improve health outcomes (Flickinger et al., 2016). From a clinical practice perspective, the PCC supports patient involvement in the decision-making and considers a patient-doctor relationship as one that incorporates the patient

views and preferences in the care process. Then, the patient is promoted to participate effectively in his own care for better outcomes (Greene et al., 2016; Oates et al., 2000).

Implementing the PCC approach promotes the values of effective care, shared decision-making, and patient education (Robinson et al., 2008). Advocators of the PCC approach focused on the effectiveness of patient-provider relationship as an integral to other quality factors (Greene et al., 2016). There is ample evidence that PCC behaviors lead to better health outcomes in different ways. Improved patient satisfaction, enhanced behavior change, building trust, patient adherence, improved patient activation and more active patient self-management (Beck et al., 2002; Fuertes et al., 2016; Hibbard, 2016; Joyce et al., 2010; Kim et al., 2004; Perron et al., 2015; Reynolds, 2009; Street et al., 2009). PCC was also associated with increased care efficiency, fewer diagnostic tests, and fewer referrals (Fenton et al., 2016). Evidence from developing countries shows that quality and efficiency problems are pervasive in health care (Andaleeb, 2001; Sultan & Crispim, 2016).

From the patient perspective, a review study of quality dimensions has identified ten dimensions across the reviewed studies. The most frequent three dimensions are an exchange of information, shared decision-making, and the healthcare access (Mohammed et al., 2016). The Picker Institute/Commonwealth Fund operationalized the PCC from a patient perspective regarding eight dimensions include responsiveness to patients' values and preferences, information, emotional support, coordination and integration, access, physical comfort, continuity, and involvement of family (Richardson et al., 2001). Patients in the developing countries consider communication as a quality dimension and contribute significantly to patient satisfaction (Andaleeb, 2001).

5.2.2 The slow implementation in practice of PCC and the biopsychosocial model

Doctors are challenged to keep on the nature and values of the medicine's commitment to their patients in the face of external forces; changes in technology, changes in market forces and variations in medical delivery and performs (Project, 2002). The growth in medical care sciences enhanced health care outcomes but have inadvertently distanced physician from their patients (Barry & Edgman-Levitan, 2012). The AHRQ reported that only around 45% to 62% of the patient encounters "always" used the PCC approach (E. Kelley et al., 2005). The slow implementation of PCC is attributed to barrier factors as the resistance to change the traditional patterns of interactions, and the perceptions of increased time and cost among the providers (Robinson et al., 2008). Moreover, the time constraint and environmental factors in hospital settings challenge the doctor to interact effectively with patients (Cushing, 2015; Lane, 2014;

Perron et al., 2015; van den Eertwegh et al., 2015). Finally, the conflicting views of healthcare professionals on professional responsibility affect implementing PCC (Berghout et al., 2015; M'hamdi et al., 2017).

Despite the persistent patients' wants for better communication from their doctors (Duffy et al., 2004; Mohammed et al., 2016) and the establishment of the benefits of PCC. Conversely, the biopsychosocial model does not show integration implemented with the daily medical care activities (Lane, 2014). It is common that medical professionals give less attention to the environmental and interpersonal factors than the biomedical factors which they regard as less important (Donabedian, 1980; Lane, 2014). Therefore, competent healthcare systems are obligated to bridge the differences between the biomedical and psychosocial perspectives; The AHRQ reported that only around 45% to 62% of the patient encounters "always" used the PCC approach (Kelley et al., 2005).

5.2.3 PCC behaviors and professionalism

Professional behaviors are mandated by the Health Profession Council of United Kingdom (Cornett, 2006). The American Accreditation Council for Graduate Medical students and the American Board of Specialties jointly considered the interpersonal and communication skills as one of six competencies for doctors (Makoul et al., 2007). Identifying the relative priority of the different components of quality of care depends on where we are in the system of care and on what the nature and extent of our responsibilities are? Donabedian illustrated this vision in a sketch as a set of successive concentric semi-circles, at the core of which the patient-practitioner interactions are located (Donabedian, 2002).

Professionalism is a belief system about how best to organize and deliver health care services and to bring for both the individuals and the organizations (Wynia et al., 2014). In the last three decades, professionalism advocates emphasized the emotional aspects, empathy, and compassion for quality health care (Yagil & Shnapper-Cohen, 2016). What the doctor considers proper professional responsibilities will influence his attitudes towards the patient and his clinical behaviors (Engel, 1989). The therapeutic attitude is a cornerstone of professionalism, and PCC is a technique that establishes a therapeutic alliance between care provider and patient (Rathert et al., 2013).

The professionalism frameworks promote positive attitudes of the physicians. Professionalism is a multifaceted approach to standards and is demonstrated by attitudes, knowledge, and behaviors (Cornett, 2006). The first step to adopting PCC behaviors is to ensure that physicians

and other professionals support the underlying rationale behind PCC approach (Elwyn et al., 2012). It is hypothesized that positive attitudes on the doctor's side will serve prized care on the patient side and will demonstrate effective relationships with patients (Flickinger et al., 2016).

The nature of doctor-patient relationship comprises both emotional and informational components (Barigozzi et al., 2014). PCC behaviors promote communicating both effectually. In hospital settings, the resulting bedside behaviors of the doctor reflects his point views towards the individual psychosocial needs of his patients. Surveys had shown that high patient ratings of quality of care and satisfaction are associated with doctors empathic behaviors (Mueller, 2015).

Finally, quality improvement is an integral part of professional self-regulation by both doctors and other hospital professionals. The biopsychosocial model reflects the basics of the PCC approach; individualization of the patient and the patient involvement in care processes (Robinson et al., 2008). Given the positive impacts of PCC on medical care quality, efforts to explore doctors' readiness to implement the principles of the approach become more significant.

5.3 Methods and materials

The descriptive design using a self-evaluation survey method was a framework for this cross-sectional research. Self-evaluation has been identified as a key aspect of medical professionalism (Symons et al., 2009). It provides insights into the doctor's thoughts, feelings, and emotions towards the patient-provider relationship (Perron et al., 2015), further, it promotes professional behaviors (Gremigni et al., 2016). The assessment of attitudes often uses questionnaires and self-report data (Glock & Kovacs, 2013). Moreover, the indirect multi-item method, where a group of items represents a PCC construct, provides the opportunity for participants to review different aspects of the investigated domain (Ajzen, 2005).

The self-evaluation method is common in the literature to explore doctors' behaviors in the workplace domains, such as but not limited to assessing the attitudes of nurses and physicians to cooperate with each other (Amsalu et al., 2014), the physicians attitudes towards patient and family-centered care (Nguyen et al., 2015), family physician attitudes to manage obesity (Epling et al., 2011), patient safety culture in Palestinian public hospitals (Hamdan & Saleem, 2013), the influence of the Palestinian physician attitudes towards wife abuse and their

willingness to justify wife beating (Haj-Yahia, 2013), and physician attitudes towards knowledge transfer and sharing in the Sultanate of Oman (Jabr, 2007).

5.3.1 Questionnaire design

The questionnaire was divided into four sections: the demographic characteristics of doctors, measures of 16 PCC behaviors, measures of 8 structural attributes, and the Socially Desirable Response Set (SDRS) to test for participants' propensity to give socially desirable answers (Hays et al., 1989).

The sixteen behavioral items represent four PCC constructs (Gremigni et al., 2016). First, exchange of information such as listening to the patient, asking questions, giving clear information and using quiet tone. Second, individualization such as showing interests in the patient's feelings, wants, expectations, and knowledge. Third, empathic behaviors to build trust such as understanding patient's emotions, conveying confidence and understanding the impact of disease on patient's situation. Fourth, patient involvement such as engaging the patient in informed and collaborative shared decision-making (SDM). We used a five-point Likert scale to score the level of performance and ranging from "not at all important" to "totally important," responses were coded from "1" to "5" respectively (Table 5.2).

Then, we interviewed two Palestinian doctors to explore factors that may influence implementing PCC practices. Initial eleven potential barriers were developed. The statements scored the level of perception about the existence of each barrier in the hospital. Our initiative was guided by literature (Borkowski, 2015; Fagerlind et al., 2013; Perron et al., 2015; Schwartz et al., 2010).

We used this preliminary version and conducted a pilot study that comprised ten participants. One behavioral item was modified to suit the social context, and three irrelevant items were eliminated, in the result, (8) potential barriers were studied (Table 5.3). The patient-related factors were discussed and confirmed as they influence the interviewing process, as preferences to exchange and manage information may vary among patients (Grady et al., 2016). The final version of the questionnaire is included in Appendix E.

5.3.2 Participants and sample characteristics

In October and November 2016, we collected data from public and private hospitals in the West Bank and East Jerusalem. The printed version of the self-administered questionnaire targeted all the full-time hospital employed doctors in the West Bank and East Jerusalem (N = 1418). We obtained ethical approval from the Palestinian Ministry of Health to carry out the research.

Doctors participated on a voluntary basis. Doctors were asked to remember recent few medical interviews and how they interacted with their patients, a brief introduction about the topic was also explained to each participant.

Of the (590) distributed surveys, (373) were returned 63%. We excluded four disqualified surveys and analyzed the data of (369) respondents. The demographic characteristics (Table 5.1) included gender (74% males), job title (37.7% specialists, 37.4% residents, and 24.9% GPs), age (39.2 % were more than 35 years old), experience (59.1% have experience of fewer than 5 years), hospital setting (49.1 % work in public hospitals), place of bachelor education (37.1% studied in local universities), training (71.4% got training in communication), and finally, their familiarity with PCC (55% are unfamiliar with PCC).

Table 5. 1 Sample characteristics N = 369.

Characteristic	Counts (%)	Characteristic	Counts (%)
Profession		Age	
Specialist doctor	139 (37.7)	≤ 35 years	222 (60.20)
Resident doctor	138 (37.4)	> 35 years	147 (39.2)
General doctor	92 (24.9)	Experience	
Hospital Department		≤ five years	218 (59.1)
Surgery	71 (19.2)	> five years	150 (40.7)
Internal Medicine	52 (14.1)	University of Bachelor	
Obstetrics & Gynecology	34 (9.20)	Inside Palestine.	137 (37.1)
Pediatrics	69 (18.7)	Outside Palestine.	229 (62.9)
Anesthesia	08 (2.20)	Communication Training	
Emergency	07 (1.90)	Never got training	102 (27.6)
Radiology	14 (3.80)	Got training	262 (71.4)
Other departments	114 (30.9)	Knowledge about PCC	
Gender		Don't know about PCC	203 (55)
Male	276 (74.8)	Knows about PCC	162 (45)
Female	93 (25.2)	Hospital settings	
Marital Status		Public	181 (49.1)
Unmarried	143 (38.8)	Private	188 (50.9)
Married	226 (61.20)	Total	369 (100)

5.3.3 Data analysis

Several data analysis techniques were used. Data were analyzed at 95% confidence interval ($\alpha = 0.05$) using the SPSS 23. Descriptive statistics, cluster analysis, Chi-square analysis, multivariate analyses of MANOVA and canonical correlation techniques.

5.3.3.1 Scores of PCC items and constructs

Doctors reported more frequently “most important” or “totally important” to score the “exchange of information” construct (48.8%), while the least frequently reported was the “empathy” construct (26.4%). In General, Palestinian doctors scored low levels of compliance with PCC behaviors. Table 5.2 shows the descriptive statistics. Each PCC construct was assessed for reliability using Cronbach’s Alpha. The coefficients were $\alpha = 0.79$, 0.82, 0.75, and 0.8 respectively (Nunally & Bernstein, 1978).

Table 5. 2 Descriptive statistics of PCC items and constructs.

Constructs and survey items (Cronbach’s $\alpha = 0.911$)	N	M	SD
Exchange of information (Cronbach’s $\alpha = 0.789$)	365	4.00	0.76
Provide clear information to the patient.	369	3.95	1.01
Turn to the patient in a calm and quiet tone	369	3.86	0.95
Show respect to the patient as a person rather than a case.	368	4.15	0.98
Pay attention to what the patient says.	366	4.04	0.94
Individualization (Cronbach’s $\alpha = 0.816$)	357	3.60	0.78
Show interest in what the patient feels about his status.	366	3.81	0.92
Show interest in what the patient knows about his disease/prognosis.	365	3.62	1.02
Show interest in what the patient wants from care.	366	3.58	0.98
Show interest in what the patient expects from care in this hospital.	365	3.42	0.97
Empathy (Cronbach’s $\alpha = 0.747$)	360	3.59	0.77
Understand the emotions that the patient may have.	366	3.68	0.94
Check how illness affects the patient’s daily life activities.	368	3.70	0.97
The doctor acts as putting himself in the “patient’s place”.	366	3.24	1.12
Inspire confidence and security when touching the patient or being nearby.	365	3.75	1.04
Patient involvement (Cronbach’s $\alpha = 0.796$)	364	3.61	0.78
Give the patient enough time to ask and talk about his disease.	368	3.67	0.96
Ask the patient questions that allow him to express his point view.	367	3.53	0.98
Encourage him and transmit optimism.	368	3.85	0.96
Offer the patient opportunity to discuss and share decision-making.	368	3.40	1.05
1 = not at all important (minimum score), 5 = mostly important (maximum score).			

5.3.3.2 Clustering the Respondents using their reported PCC scores

We conducted cluster analysis to find the underlying structural relationships among the doctors. The two-step clustering (hierarchical then K-mean cluster analyses) formed three groups of doctors (Figure 5.2). The final centers of the clusters illustrated three different levels of PCC behaviors. (1) Good (N = 111); (2) Poor (N = 69); and (3) Fare (N = 163).

Further, discriminant analysis of the outcomes was conducted. Two canonical discriminant functions significantly predicted the cluster outcomes, Wilks' Lambda = 0.158, $p < 0.01$. Function 1 explained 97.6% of the variance between clusters; the canonical correlation coefficient was 0.908. The standardized canonical discriminant function coefficients assigned high weights (> 0.2) to seven PCC subjects which were significant in differentiating the clusters (Table 5.3).

Table 5. 3 Final cluster centers of the seven differentiating PCC subjects.

PCC behavior*	Coefficient	Final Cluster Centers		
		Good	Poor	Moderate
Provide clear information to the patient	0.339	5	3	4
Show respect to the patient as a person rather than a case	0.262	5	3	4
Show interest in what the patient knows about his disease/prognosis	0.228	4	3	4
Show interest in what the patient expects from care in this hospital	0.230	4	3	3
Understand the emotions that the patient may have	0.235	5	3	4
Give the patient enough time to ask and talk about his disease	0.2	4	3	4
Offer the patient opportunity to discuss and share decision-making	0.21	4	3	3
* 1 = not at all important, 5 = totally important.				

Respondents' characteristics were cross-tabulated by the three clusters (2 x 3 model). The data was analyzed using a chi-square test of independence to look for an overall significance of the relationship between the respondent's characteristics and the behavioral cluster she belongs to (Table 5.4). The standardized residuals (the difference between observed and expected) values of (> 1.196 or < -1.196) were used to find which attribute has the most contribution to the significant relationship.

Job title, age, marital status, hospital, and familiarity with PCC were significantly associated to which cluster the doctor was located. The specialists, the older, the married, the doctors in private hospitals, and familiar doctors with PCC were more frequently in the good behavioral

cluster. The lack of familiarity with PCC and lack of previous training contributed most to poor PCC practices among doctors who were neither familiar with PCC nor trained. However, gender, experience, University of a bachelor degree, or previous training had no significant effect ($p > 0.05$) on which PCC cluster the doctor was located.

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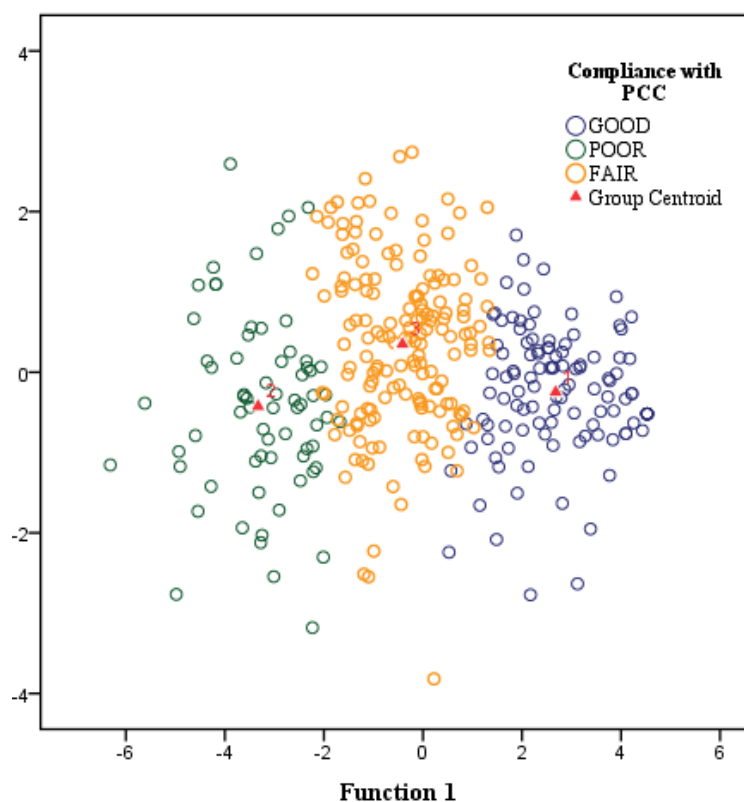


Figure 5. 2 Three groups of doctors based on differences in PCC behaviors.

The third section of the questionnaire scores the doctors' views about factors that may mitigate the effectiveness of medical interview. The projected eight working condition attributes were measured on a five-point Likert scale ranging from "totally disagree" to "totally agree" and coded from one to five respectively (Table 5.5).

Table 5. 4 Descriptive associations between respondents' characteristics and PC clusters.

		N	PCC Behavioral Clusters			X ²	Sig. p	Most Contribution Standardized Residual
			Good %	Poor %	Moderate %			
Job title	Specialist	129	41.9	18.6	39.5	9.53	0.049	Specialist X Good = 1.9
	Resident	127	26.8	25.5	60.4			
	GP	087	26.4	18.4	55.2			
Gender	Male	258	33.7	17.4	48.8	4.67	0.097	
	Female	085	28.2	28.2	43.5			
Age	≤ 35 years	204	26.5	21.6	52.0	8.01	0.018	> 35 years X Good = 1.8
	> 35 years	139	41.0	18.0	41.0			
Marital Status	Single	133	24.1	21.8	54.1	6.39	0.031	Single X Mod. = 1.1 Married X Good = 1.3
	Married	210	37.6	19.0	43.3			
Hospital	Public	165	24.8	23.6	51.5	8.57	0.014	Residuals are < 1.1
	Private	178	39.3	16.9	43.8			
Experience	≤ 5 years	200	28.5	20.5	51.5	3.54	0.17	
	> 5 years	142	38.0	19.0	43.0			
Bachelor	Local	129	30.2	20.9	48.8	0.59	0.74	
	Abroad	211	34.1	19.0	46.9			
Training	Untrained	094	30.9	26.6	42.6	3.92	0.14	
	Trained	245	33.1	17.1	49.8			
Familiar PCC	Unfamiliar	185	28.1	25.4	46.5	8.02	0.018	Unfamiliar X Poor = 1.6
	Familiar	154	37.0	13.6	49.4			

5.3.3.3 Scores of Contextual attributes

Table 5. 5 Scores and descriptive statistics contextual factors.

Contextual barrier*	N	Mean	SD
Hospital culture does not support effective medical interview.	367	3.07	1.10
I am overloaded, and I don't have enough time for a good interview.	368	3.24	1.11
Nurses cooperate positively.	364	2.78	0.99
I feel satisfied with my work in this hospital (N).	362	2.69	0.99
I find my job as interesting (N).	367	2.11	0.93
I prefer to be formal rather than warm and friendly.	369	2.83	1.14
Patients tend to give less information due to social consequences.	366	3.48	0.94
Most patients are not aware of their health status or their disease.	365	3.44	1.07
* (1) = strongly disagree, (5) = strongly agree.			
N, negatively worded item.			

5.4 Results

Multivariate techniques were applied because they allow for simultaneous comparisons among the variable sets to limit the probability of committing type I error in the study (Sherry & Henson, 2005). The approach also provides congruence between the explanatory nature of the study and the consideration of multiple possible causes of multiple effects. The scores of each four items that represent a certain PCC construct (Table 5.2) were averaged and became a mean index for that PCC construct. The new four PCC scores were (1) the exchange of information, (2) individualization, (3) empathy, (4) patient involvement. They represent the combined dependent variables (DVs) of the study through the subsequent carried out statistical analyses. Descriptive statistics appear in (Table 5.6). Pearson correlation between the four variables was substantial for all pairs. Empathy construct was the most strongly correlated with patient involvement and exchange of information ($r = 0.67$), while patient involvement was the least strongly correlated ($r = 0.5$) with the exchange of information construct. The following subsections test the hypotheses and analyze the associations between the different structural attributes and the PCC. We start with the effects of doctor-related factors, then the organization related factors, and finally the patient-related factors on the PCC behaviors.

Table 5. 6 Descriptive statistics of four PCC mean indexes.

PCC Construct	N	Min.	Max.	Mean	SD
- Exchange of Information	365	1.00	5.00	4.00	0.76
-Individualization	357	1.25	5.00	3.62	0.78
-Empathy	360	1.25	5.00	3.59	0.77
-Patient Involvement	364	1.25	5.00	3.61	0.78
Valid N	343				

5.4.1 The effect of doctor-related factors on PCC behaviors

We carried out a multivariate analysis of variance tests MANOVA to detect whether the combined dependent variables (DVs) differ across groups of participants based on their demographic factors. The combined DVs represent the four PCC constructs of interest. Post hoc tests detected differences between subjects and tested for the effects of each group of respondents on each PCC construct (DV). Box's M test indicated that the assumption of equality of covariance matrices was met $p > 0.05$. Levene's test showed that the assumption of equality of error variance was met $p > 0.05$, equality of error variance of DVs across groups was accepted supported (Table 5.7).

Table 5. 7 MANOVA, the associations between the categorical factors and the PCC.

Groups		Wilk's Λ	Test	Partial η^2	In favor of
Specialists, residents, GPs	Combined DVs	0.964	F (8,674) = 1.58, p = 0.127	0.018	--
	-Exchange of Information		F (2,343) = 1.99, p = 0.139	0.012	--
	- Individualization		F (2,343) = 4.630, p = 0.01*	0.027	Specialists
	- Empathy		F (2,343) = 1.930, p = 0.14	0.011	--
	- Involvement		F (2,343) = 2.231, p = 0.10	0.013	--
Male, female doctors	Combined DVs	0.959	F (4,338) = 3.65, p = 0.006	0.041	males
	-Exchange of Information		F (1,343) = 0.30, p = 0.578	0.001	--
	- Individualization		F (1,343) = 4.97, p = 0.026	0.014	Males
	- Empathy		F (1,343) = 0.080, p = 0.77	0.000	--
	- Involvement		F (1,343) = 7.28, p = 0.007	0.021	Males
Married, unmarried	Combined DVs	0.971	F (4,338) = 2.50, p = 0.042	0.029	Married
	-Exchange of Information		F (1,343) = 0.80, p = 0.372	0.002	--
	- Individualization		F (1,343) = 5.70, p = 0.017	0.017	Married
	- Empathy		F (1,343) = 5.48, p = 0.020	0.016	Married
	- Involvement		F (1,343) = 7.89, p = 0.005	0.023	Married
Experience > 5, ≤ 5 years	Combined DVs	0.965	F (4,337) = 3.08, p = 0.016	0.035	Experienced
	-Exchange of Information		F (1,341) = 0.20, p = 0.653	0.001	--
	- Individualization		F (1,341) = 7.90, p = 0.005	0.023	Experienced
	- Empathy		F (1,341) = 1.68, p = 0.195	0.005	--
	- Involvement		F (1,341) = 6.01, p = 0.015	0.017	Experienced
Local education, not.	Combined DVs	0.989	F (4,335) = 0.950, p = 0.43	0.011	--
	-Exchange of Information		F (1,338) = 0.34, p = 0.558	0.001	--
	- Individualization		F (1,341) = 0.67, p = 0.414	0.002	--
	- Empathy		F (1,341) = 0.07, p = 0.796	0.000	--
	- Involvement		F (1,341) = 2.50, p = 0.112	0.007	--
Trained, untrained	Combined DVs	0.979	F (4,334) = 1.80, p = 0.127	0.021	--
	-Exchange of Information		F (1,337) = 0.16, p = 0.694	0.000	--
	- Individualization		F (1,337) = 1.75, p = 0.178	0.005	--
	- Empathy		F (1,337) = 5.25, p = 0.023	0.015	Trained
	- Involvement		F (1,337) = 4.33, p = 0.038	0.013	Trained
Familiarity with (PCC)	Combined DVs	0.968	F (4,334) = 2.75, p = 0.028	0.032	Familiar
	-Exchange of Information		F (1,337) = 2.39, p = 0.125	0.007	--
	- Individualization		F (1,337) = 7.27, p = 0.007	0.021	Familiar
	- Empathy		F (1,337) = 4.67, p = 0.031	0.014	Familiar
	- Involvement		F (1,337) = 9.98, p = 0.002	0.029	Familiar
Public, private hospital	Combined DVs	0.968	F (4,338) = 2.75, p = 0.028	0.037	Private
	-Exchange of Information		F (1,343) = 11.8, p = 0.034	0.034	Private
	- Individualization		F (1,343) = 6.09, p = 0.014	0.018	Private
	- Empathy		F (1,343) = 3.49, p = 0.063	0.010	--
	- Involvement		F (1,343) = 6.18, p = 0.013	0.018	Private

*Significant effects are indicated in boldface

Results show that the combined dependent variables (DV) were not significantly different, in the general sense, across the three job titles (specialists, residents, and general doctors, $P > 0.05$). However, the main effect of job title on individualization construct was significant ($F(2,343) = 4.630$, $p = 0.01$), the effect size of job title was 0.027. Scheffe's multiple comparisons

indicate that there is a significant difference in individualization performance ($p = 0.018$) between specialists and residents in favor of specialists.

Male doctors were more compliant with PCC behaviors than female doctors. The combined DVs were significantly different across gender groups (Wilk's Lambda = 0.959, $F(4,338) = 3.65$, $p = 0.006$), the effect size was 0.041. The main effect of gender on individualization construct was significant ($F(1,343) = 4.97$, $p = 0.026$), the effect size was 0.014. The main effect of gender on patient involvement construct was significant ($F(1,343) = 7.28$, $p = 0.007$), the effect size was 0.021.

Married doctors outperformed unmarried doctors concerning PCC behaviors. The combined DVs were significantly different between married and unmarried doctors (Wilk's Lambda = 0.971, $F(4,338) = 2.50$, $p = 0.042$). The effect size was 0.029. The main effect of marital status on individualization, empathy, and patient involvement constructs was significant. The effect size was 0.017, 0.016, and 0.023 respectively.

Doctors with more than five years of experience in a hospital outperformed the less-experienced doctors. The combined DVs were significantly different across the two groups (Wilk's Lambda = 0.965, $F(4,335) = 3.08$, $p = 0.016$). The effect size was 0.035. The main effect of experience on individualization construct was significant ($F(1,341) = 7.9$, $p = 0.005$). The effect size was 0.023. The main effect of experience on patient involvement construct was significant ($F(1,343) = 6.01$, $p = 0.015$), the effect size was 0.017.

Results showed no significant differences between doctors' behaviors based on the place of study whether they educated in the Palestinian medical schools or elsewhere. Likewise, results showed that previous training on communication skills had no significant effect, in the general sense, on the combined DVs ($P > 0.05$). However, the main effect of training on empathic construct was significant ($F(1,337) = 5.25$, $p = 0.023$), the effect size of training was 0.015. The main effect of training on patient involvement construct was also significant ($F(1,337) = 4.33$, $p = 0.038$), the effect size of training was 0.013.

Familiar doctors with PCC outperformed doctors who were not familiar with PCC. The combined DVs were significantly different across the two groups (Wilk's Lambda = 0.968, $F(4,334) = 2.75$, $p = 0.028$). The effect size was 0.032. The main effect of familiarity with PCC on individualization behaviors was significant ($F(1,337) = 7.27$, $p = 0.007$). The effect size was 0.021. The main effect of experience on empathic behaviors was significant ($F(1,337) = 4.67$,

$p = 0.031$), the effect size was 0.014. The main effect of experience on patient involvement behaviors was significant ($F(1,337) = 9.98, p = 0.002$), the effect size was 0.029 (Table 5.6).

PCC behaviors were significantly associated with the adopted personal style of the doctors. Doctors who adopted a formal style rather than a warm, friendly style were negatively correlated with PCC behaviors. The four PCC constructs were significantly negatively correlated ($p < 0.001$). Pearson coefficients were - 0.2, - 0.24, - 0.20, - 0.19 respectively. The relation between doctor's style and hospital department was tested. Differences in personal style were significant between different hospital departments [$F(8,356) = 2.037, p = 0.041$]. Gynecologists ($M = 3.06, SD = 1.21$) reported the highest mean scores to act formally with patients, while, Pediatricians ($M = 2.4, SD = 1.03$) on average reported the highest mean scores to act friendly with their patients.

5.4.2 The effects of hospital factors and patient factors on PCC behaviors

Doctors in private hospitals outperformed doctors in the public hospitals (Table 5.6). The combined DVs were significantly different across the two groups (Wilk's Lambda = 0.968, $F(4,338) = 2.75, p = 0.02$). The effect size was 0.037. The main effect of hospital setting on the exchange of information behaviors was significant ($F(1,343) = 11.8, p = 0.034$). The effect size was 0.034. The main effect of hospital setting on individualization behaviors was significant ($F(1,343) = 6.09, p = 0.014$), the effect size was 0.018. The main effect of hospital setting on patient involvement behaviors was significant ($F(1,343) = 6.18, p = 0.013$), the effect size was 0.018 (Table 5.6). But there was no significant effect of hospital setting on empathic behaviors ($p = 0.063$).

We conducted a canonical correlation analysis (CCA) using the eight potential barriers as a predictor variable set (Table 5.5) of the four PCC indexes as the criterion variable set (Table 5.2). The purpose was to answer the study question whether doctors' working conditions are predictive of certain PCC behaviors by evaluating the multivariate relationship between the two variable sets. The predictor variable set included eight variables, of which two variables were patient-related, and the other six were hospital related variables. The dependent variable set included the four PCC processes of interest.

The analysis yielded four functions with squared canonical correlations (R_c^2) of .213, .047, .011 and .009 respectively. Collectively, the full CCA model ($N = 331$) was statistically significant, with a Wilk's λ of (0.73), $F(32, 1178) = 3.21, p < 0.001$ and explained ($1 - \lambda = 27\%$) of shared variance between the two variable sets. Thus, the r^2 type effect size was 0.27 (Sherry & Henson,

2005). The dimension reduction analysis allowed for hierarchal tests for significance and revealed that the full CCA model (Functions 1 to 4) was statistically significant $F(32, 1178) = 3.2, p < 0.001$. Functions 2 to 4, 3 to 4, and function four tests did not explain statistically significant amount ($p > 0.05$) of shared variance between the variable sets. We considered the effect of function 1 to identify the contributing variable as it captured most of the shared variance and not to interpret the effect of other functions as they only explained less than 5% of the variance.

Table 5.8 presents the standardized canonical function coefficients and structure coefficients for Function 1. Structure coefficients are used to decide what variables are contributing to this relationship. Looking at the coefficients, all the PCC constructs contributed as supported by the large squared structure coefficients (r_s^2), which represents the shared variance between the observed PCC scores and the variate created from the observed variable's set.

However, four predictor variables job interest, doctor's style, nurses' cooperation, and patient's tendency to hide information were the primary contributors to the predictor variate. The doctor's style predictor was negatively related to all the PCC processes which support the theoretically expected relation; the more formal the doctor interviews his patients, the less he adopts PCC behaviors. The other predictors were positively related.

Table 5. 8 The standardized canonical function coefficients.

Criterion Variables (DV's)	Function 1		
	Coef.	r_s	r_s^2 (%)
Exchange of information	- 0.454	- 0.851	72.4
Individualization	- 0.107	- 0.778	60.5
Empathy	- 0.215	- 0.819	67.1
Shared decision	- 0.413	- 0.855	78.3
Predictor Variables (IV's)			
Administration support.	- 0.040	+ 0.182	3.30
Workload.	+ 0.040	+ 0.172	3.00
Nurses' cooperation.	- 0.349	- 0.475	22.5
Level of job satisfaction	+ 0.087	- 0.358	12.8
Level of job Interest.	- 0.729	- 0.696	48.4
Doctor's formal style.	+ 0.574	+ 0.530	28.1
Patients tend hide information.	- 0.266	- 0.169	2.90
Low level of health literacy.	+ 0.148	+ 0.050	0.25

The results of the regression bivariate analysis supported the analysis of standardized canonical function coefficients. Beta weights reflected the relative contribution of each predictor to the PCC constructs (Sherry & Henson, 2005). The causal relationship was significant to all the four predictors (with high canonical function coefficients) with all the four PCC constructs. Two exceptions involve no significance, the Patient's tendency to hide information with individualization construct and the nurses' cooperation with the exchange of information construct (Table 5.9).

Table 5. 9 Regression analysis and causality relationships.

Significant Predictor Variables	Exchange Information		Individualization		Empathy		Involvement	
	β	p	β	p	β	p	β	p
Level of job interest	0.34	< 0.001	0.24	< 0.001	0.21	< 0.001	0.27	< 0.001
Doctor's formal style	- 0.23	< 0.001	- 0.25	< 0.001	- 0.22	< 0.001	- 0.21	< 0.001
Nurses' cooperation	0.06	0.252	0.13	0.02	0.18	0.001	0.19	0.001
Patient's tendency to hide information	0.12	0.026	0.05	0.33	0.11	0.047	0.10	0.080

5.5 Discussion and conclusions

While attention to improving the quality of services provided in Palestinian hospitals are growing, the problems of the health care delivery system are reported with increasing frequency in the public media. This work is the first research to investigate the consultation between doctor and patient among Palestinian doctors. The study explored factors that contribute to doctors' performance. The influence of patient-related factors had also been considered. In the general sense, PCC performance was significantly different between doctors in private and doctors in public hospitals in favor of doctors in private hospitals. Doctors in public hospitals were more frequently in poor and moderate performance groups (23.6 % and 51.5 % respectively). Evidence from other studies supported results as the state of public services in Palestine includes understaffing and overcrowded hospitals, and professionals work in crisis-mode (Hamdan & Saleem, 2013; Kitaneh & Hamdan, 2012). Others found that, in developing countries, private hospitals are induced to provide better services than public ones (Andaleeb, 2000). The remarkable finding was the prevalence of unfamiliarity with PCC (55 % of the Palestinian doctors never knew about Patient-Centered Care).

5.5.1 Compliance with PCC behaviors

The first research objective of this study was to assess the doctors' compliance with PCC behaviors. Palestinian doctors reported less frequent implementation than the published levels of implementing PCC. On average, 48.8% considered the exchange of information with patients as "most important" or "totally important," and only 27% of doctors considered the other three PCC behaviors as most or totally important. Previous evidence reported low levels of implementing PCC. The AHRQ reported that only around 45% to 62% of the patient encounters "always" used the PCC approach in developed countries (E. Kelley et al., 2005; Schwartz et al., 2010). There is a lack of knowledge about PCC, (55 %) of the Palestinian doctors were unfamiliar with PCC concept. These results were observed by others (M'hamdi et al., 2017). It is not uncommon in developing countries that the patients' voice is ignored by care provider (Andaleeb, 2001).

Three groups of doctors based on their PCC performance highlighted the behavioral patterns (1) the good (2) the poor, and (3) the moderate compliance with PCC. Doctors were significantly differentiated by seven behaviors to be allocated to the groups. They are providing clear information, showing respect to the patient as a person, showing interests in patient's knowledge and expectations, understanding patient's emotions, giving him time to ask and offering him the opportunity to share decisions. Doctors in the good performance group were more frequently specialists, aged (> 35 years), married, familiar with PCC, and working in private hospitals. This study did not investigate the motives behind good PCC performance; it may be hypothesized that good performance reflects self-developed social skills and individual commitment to professionalism that meet the patients' psychosocial expectations. Meanwhile, a remarkable result indicated that the lack of training or lack of familiarity with PCC was statistically associated with poor PCC performance.

The youth two medical schools in West Bank created a better chance for females to benefit joining the profession of medicine. The number of female doctors is increasing remarkably in the last ten years (Treister-Goltzman & Peleg, 2016). Even so, the gender gap is still common in the Palestinian hospitals (25% females). In developed countries, the gender gaps in the profession of medicine are not closed (Kuhlmann et al., 2017). The cultural context in Palestine supports studying at local universities rather than traveling abroad for females. Results show that only 14% of the female doctors are experienced with more than five years, and only 18% of females studied abroad. This explains the high male proportion of experienced doctors (90.4%), the high male proportion of doctors who studied abroad (92.5%), and the high male

proportion of doctors at public hospitals (72%). Gender was significantly associated with a medical specialty, females are more likely to be gynecologists, and male doctors are more likely to be surgeons or internists, no significant gender differences between counts of pediatricians. Previous studies indicated similar preferences (Ng-Sueng et al., 2016).

5.5.2 Association between doctor-related factors and PCC behaviors

Doctor related factors (job title, gender, marital status, experience, etc.) were not significantly associated with exchange information behaviors. One exception is the doctor's style. Doctors who adopted formal style during the medical interview were less likely to exchange information with patients than doctors approaching their patients in a warm and friendly style. Further, doctor's formal style was negatively related to all other PCC behaviors, individualization, empathy, and patient involvement. Literature suggests consistent finding is that doctors with warm and friendly style to be more effective in emotional and cognitive care (Di Blasi *et al.*, 2001). Differences in individualization behaviors were significant based on gender groups in favor of male doctors. Previous evidence showed significant differences between doctors in practice behaviors based on gender (Bertakis, 2009). Experienced groups outperformed the less-experienced doctors, familiarity groups with PCC in favor of previous knowledge about PCC, and marital status groups in favor of married doctors (Table 5.6).

Findings show that empathic behaviors are significantly influenced by marital status, training, and familiarity with PCC in favor of married, trained and familiar with PCC doctors respectively. Empathic behaviors represent the doctor's ability to respond to and improve his patient's emotional state (Kim *et al.*, 2004). Empathy impacts health quality, previous evidence supports the link between the doctor's empathy and clinical outcomes (Hojat, 2016). Palestinian doctors may advance their information interaction to serve better empathic partnership with patients. Patient involvement behaviors were associated with gender, marital status, experience, training, and familiarity with PCC. PCC behaviors regarding gender and marital status differences were in favor of male doctors and married doctors respectively. A study showed that Patients are more satisfied with male doctors than female doctors (Duberstein et al., 2007), further evidence showed the patients talk differently to male and female doctors (Hall & Roter, 2002). The outperformance of male doctors may be attributed to the moderating effect of the high percentage of experienced male doctors. Married doctors reported high scores at three PCC constructs: individualization, empathy, and shared decision making. Again, social leanings and cultural norms in the developing countries context explain the differences regarding social status (Kalra et al., 2013). Married people are hypothesized according to Eastern cultural norms

as more responsible and more caring than single people, they learn from their own social experience and act accordingly.

Despite the intuitional precedence of the four PCC processes; start the medical interview with the exchange of information and end with shared decisions, there was no pattern of associations between the doctor-related factors and the sequence of the PCC processes. Further, training was not significantly associated with PCC performance. As supported by the previous conclusion (subsection 5.4.1), the absence of a consistent course of actions may be attributed to the lack of effective training. Effective training should assist doctors to become more informative, empathic and mindful of moving their role as characterized by the authority to one that has the goals of the partnership, solidarity, and collaboration (Epstein & Street, 2011). Previous evidence showed significant differences between doctors based on personal differences or patient differences (Bertakis, 2009; Duberstein et al., 2007; Hall & Roter, 2002; Kalra et al., 2013).

5.5.3 Association between the hospital and patient-related factors and PCC behaviors

The second research objective of this study was to explore the working conditions that are predictive of certain PCC behaviors. The preliminary model of canonical correlation analysis discussed in this study provides insights to both hospital managers and policy makers who might use the results to improve implementing PCC behaviors. Improving PCC performance will enhance service quality in the hospital environment in Palestine. The model identified four significant predictable factors as perceived by the doctors have significant effects on the four PCC processes of interest (Table 5.8). This is important because doctors' perceptions have behavioral implications on their PCC behaviors. Investments to manage these factors will have positive influences on patients as they will receive better care of the often-neglected psychosocial dimensions of hospital services. The four predictors were job interest, doctor's formal style, nurse cooperation, and patient's tendency to disclose relevant information due to social consequences.

Since all the four predictors had a significant impact on the PCC processes, managers might base PCC enhancement strategies on the parameters of the model. The standardized β s provide straightforward answers to the targeted improvements. Addressing the job interest issue ($\beta = 0.34$ SD) will deliver the greatest improvement in the behaviors associated with the exchange of information behaviors. To formulate a strategy of four items to improve empathic behaviors by 1 SD, it requires an increase of 0.21 SD of job interest, an increase of 0.18SD of nurse collaboration, and an increase of perception among doctors that patients may hide relevant

information due to social consequences of 0.11SD. In addition to decreasing the level of formality in doctor's style by 0.18 SD.

The third research objective of this study was to explore the patient-related influences on doctor's PCC behaviors. Two perceptions of the doctors were investigated. First, the low-level of health literacy in the patient's side did not show significant impact on doctor-patient interaction. While low health literacy leads to an insufficient level of awareness to understand and use information which promotes and maintain good health (Osborne et al., 2016), surprisingly, the perception of low levels of health literacy had no significant influence on the doctor's PCC behaviors. Additional research is needed to investigate health literacy phenomenon in Palestine. Second, the perception of patients' tendency to hide relevant information due to felt social consequences had promoted doctors to more PCC interactions, increased exchange of information ($\beta = 0.12$), increased empathic behaviors ($\beta = 0.11$), and increased patient involvement ($\beta = 0.10$). Doctors who perceived this tendency reacted positively to improve patient engagement. Efforts can be devoted to training both doctors and nurses to recognize the value of PCC behaviors and to activate patients to disclose relevant information to achieve the best possible benefits for them. PCC is a quality of organizational, personal, and professional relationship (Epstein & Street, 2011). Evidence showed that nearly all educational and training interventions had improved interpersonal skills among doctors (Perron et al., 2015).

5.5.4 Limitations and future research

Because of the preliminary nature of this study, the results ought to be viewed as an overall assessment of the PCC behaviors of Palestinian doctors. Results shed lights on gaps in PCC behaviors between public and private hospitals. Future research is required to investigate in-depth each factor behind the poor performance of PCC behaviors in the public hospital. Moreover, investigations between medical specialties and type of illness in terms of PCC behaviors will introduce better understanding. Multivariate analysis showed no differences between trained and untrained doctors and it is worthy for further investigations. However, this result is inconsistent with previous evidence (Perron et al., 2015). Training assists doctors to become more informative, empathic and mindful of moving their role as characterized by the authority to one that has the goals of the partnership, solidarity, and collaboration (Epstein & Street, 2011). The study generates the question the effectiveness of training. Further research may also investigate patients' perceptions and views to identify their informative and PCC needs within the Palestinian context.

5.5.5 Conclusion

While the research literature focused on how to implement PCC, this study investigated the vital components of the health care system that underpin effective PCC behaviors. This study introduced a prior knowledge about personal, professional and organizational aspects and their relationships across hospitals (Figure 5.1). It is of significance as it comes at a time when the Palestinian Ministry of Health is adopting a family practice model. Results highlighted performance gaps between public and private hospitals, managers of public hospitals can benchmark the private hospitals. Results also suggested both groups have room for improving their doctors' interpersonal skills. Hospital managers might base PCC enhancement strategies on the parameters of the canonical correlation model and pay more attention for managing the identified predictors of PCC behaviors.

5.5.6 Practice implications

Since it is believed that emphasis on quantity preceded the quality in Palestinian hospitals (Hamdan & Saleem, 2013), this work brought to attention the weaknesses of an essential component of quality of care. Results highlighted room for enhancing the PCC behaviors among doctors and identified four drivers for improvement, in the country's hospitals. Doctors are requested to accomplish higher scores in PCC behaviors, this will help the public authorities to effectively adopt the family practice model as a strategy to manage the overcrowded state of work of the Palestinian hospitals.

Appendix E.

The final version of the employed survey of PCC behaviors.

Survey: The Compliance of Palestinian Hospital Doctors with PCC Behaviors

Dear doctor:

This survey applies to all doctors working in any Palestinian Hospital. It is a part of a doctorate thesis (Ph.D.) in Business Administration at the University of Minho - Portugal. The study explores the physicians' perspective to implement four aspects of Patient-Centered Care (PCC). On average, answering the questionnaire consumes 7-8 minutes. I do appreciate and acknowledge your cooperation to fill it transparently. The privacy of the collected data is highly respected and applies for academic purposes only.

Please consider the following in mind:

- 1- Submit one response only.
- 2- Patients included in discussion are not in severe urgent cases or patients with chronic disease.
- 3- Pediatricians apply interviews with families.
- 4- Think about your last interviews with patients during this week.

Part One: Demographic and social variables,

Please circle the statement that fits your job and personal attribute:

Job Title	☐ Specialist	☐ Resident	☐ General
Department (Specialty)	☐ Surgery	☐ Inter. Med.	☐ Obs. & Gyn.
	☐ Pediatrics	☐ Anesthesia	☐ Emergency
	☐ Radiology	☐ Others	
Gender	☐ Male	☐ Female	
Age	☐ ≤35 years	☐ > 35 years	
Marital Status	☐ Single	☐ Married	☐ Others
Hospital Setting you are in	☐ Governmental	☐ Non-governmental.	
Years of experience in the hospital.	☐ less than or equals five years	☐ More than five years	
University of Bachelor Education	☐ Inside Palestine	☐ Outside Palestine	
Previous training/ communication with the patient	☐ Never got training	☐ I got training	
Patient-Centered Care (PCC)	☐ Never knew about PCC	☐ I Know PCC approach.	
On average, I spend interviewing my patient time of	☐ 5-10 minutes	☐ 10-15 minutes	☐ 15-20 minutes

Part two: Communication Tasks,

Please **tick one circle** for each statement below to show how much you consider it as important: (These 16 questions were adapted from a self-assessment tool developed by Gremigni *et al.* 2016). Scales are modified by the researcher.

	Not at all important	Somewhat important	important	Mostly important	Totally important
Provide clear information to the patient.	☐	☐	☐	☐	☐

Turn to the patient in a calm and quiet tone	☐	☐	☐	☐	☐
Show respect to the patient as a person rather than a case.	☐	☐	☐	☐	☐
Pay attention to what the patient says.	☐	☐	☐	☐	☐
Show interest in what the patient feels about his status.	☐	☐	☐	☐	☐
Show interest in what the patient feels about his status.	☐	☐	☐	☐	☐
Show interest in what the patient knows about his disease/prognosis.	☐	☐	☐	☐	☐
Show interest in what the patient wants from care.	☐	☐	☐	☐	☐
Show interest in what the patient expects from care in this hospital.	☐	☐	☐	☐	☐
Understand the emotions that the patient may have.	☐	☐	☐	☐	☐
Check how illness affects the patient's work and family.	☐	☐	☐	☐	☐
The doctor acts as putting himself in the "patient's place."	☐	☐	☐	☐	☐
Inspire confidence and security when touching the patient.	☐	☐	☐	☐	☐
Give the patient enough time to ask and talk about his disease.	☐	☐	☐	☐	☐
Ask the patient questions that allow him to express his view.	☐	☐	☐	☐	☐
Encourage him and transmit optimism	☐	☐	☐	☐	☐
Offer him the opportunity to discuss and decide together what to do.	☐	☐	☐	☐	☐

Part Three: Working Environment,

Please **tick one circle** for each statement below to show how much you agree it applies to the hospitals, other doctors, patients, and nurses in your work settings: Items are developed by the researcher.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Hospital culture <u>does not</u> support effective medical interview with patients.	☐	☐	☐	☐	☐
I am overloaded with work and don't have enough time for a good interview.	☐	☐	☐	☐	☐
Other doctors support my good interview and facilitate that.	☐	☐	☐	☐	☐
Nurses cooperate positively with me to interview patients effectively.	☐	☐	☐	☐	☐
In general, patients tend to give less information due to social fears.	☐	☐	☐	☐	☐
Most patients are not aware of their health status and their disease.	☐	☐	☐	☐	☐
Few patients judge communication tasks as valued or relevant to health care	☐	☐	☐	☐	☐
I don't think that communication tasks help in clinical reasoning or improve the quality of medical care.	☐	☐	☐	☐	☐
I feel satisfied with my work in this hospital.	☐	☐	☐	☐	☐
I find my job as interesting	☐	☐	☐	☐	☐
I prefer to be with formal style rather than warm or friendly style.	☐	☐	☐	☐	☐

Part Four: Personal traits,

	Definitely False	Mostly False	Neutral	Mostly True	Definitely True
I am always courteous even to disagreeable people.	☐	☐	☐	☐	☐
There have been occasions when I took advantage of someone.	☐	☐	☐	☐	☐
I sometimes get resentful when I don't get my way.	☐	☐	☐	☐	☐
No matter who I am talking to, I am always a good listener.	☐	☐	☐	☐	☐

CHAPTER 6

Conclusions and future research

6.1 Summary of the thesis

In seeking to improve public healthcare services, performance measurement is the crucial first step. The measurement generates information that stimulates the public organizations taking the type and direction of actions they need. In response to the absence of performance measurement system across the River Jordan, the West Bank and Jordan, this research project focused on performance measurement at the public hospital level from an operational perspective. The research project addresses two major performance dimensions: the productive efficiency by employing a standard methodology in healthcare context known as Data Envelopment Analysis (DEA) and the effectiveness of medical interview process. The latter describes a well-documented quality dimension in healthcare literature and examines the doctors' views on Patient-Centered Care (PCC), i.e., how doctors approach their patients' problems and make treatment decisions.

The thesis raised many vital signs of public hospitals' operations and quantified how well they perform. Findings highlight weaknesses in essential components of performance throughout the included empirical works and brought to attention the possibility of doing better. Further, our analysis decomposed the sources of inefficient practices, explored factors that influence inefficient performance, and identified the determinants of PCC practices. The employed methods take the existing DEA and PCC literature further by using Malmquist index, Tobit regression, and Multivariate Canonical Correlation methods.

A framework for performance measurement in the context of West Bank and Jordan has been proposed throughout the thesis. The framework builds on the discussion of previous findings and the knowledge of healthcare and management literature. The developed conceptual model intentions approaching the main objective of the thesis, to generate three classes of information that help professionals, managers, and policymakers implement potential improvements by performance measurement. These three-key decision-makers are linked with three fundamental organizational constructs within the hospital: the structure; the process; and the outcome (see Figure 6.1). The essence of the model is to furnish information that can be useful for decision-making based on performance measurement of nine areas that take in hospital operations. The information is not the end; they help public hospitals to start their improvement journey. The

model integrates the professional and the organizational views of hospital operations and clarifies the areas of measurement. Due to the absence of a Palestinian vision of the appropriate health reforms and the lack of performance measurement system, this framework has its scientific merit and overall relevance to the embedded empirical works throughout the thesis. For example, the transitional context could be better understood and managed by including the relevance of donors' role to each domain and construct. The model also contributes, to a greater extent, to the knowledge of performance measurement literature in healthcare organizations.

To map our investigations on the proposed framework, we examined aspects related to six performance measures in public hospitals in West Bank (illustrated in Figure 6.1). Then, Figure 6.2 illustrates aspects related to the four measures we examined for public hospitals in Jordan. The thesis leaves space for future research of other performance measures using other tools as well as DEA and PCC.

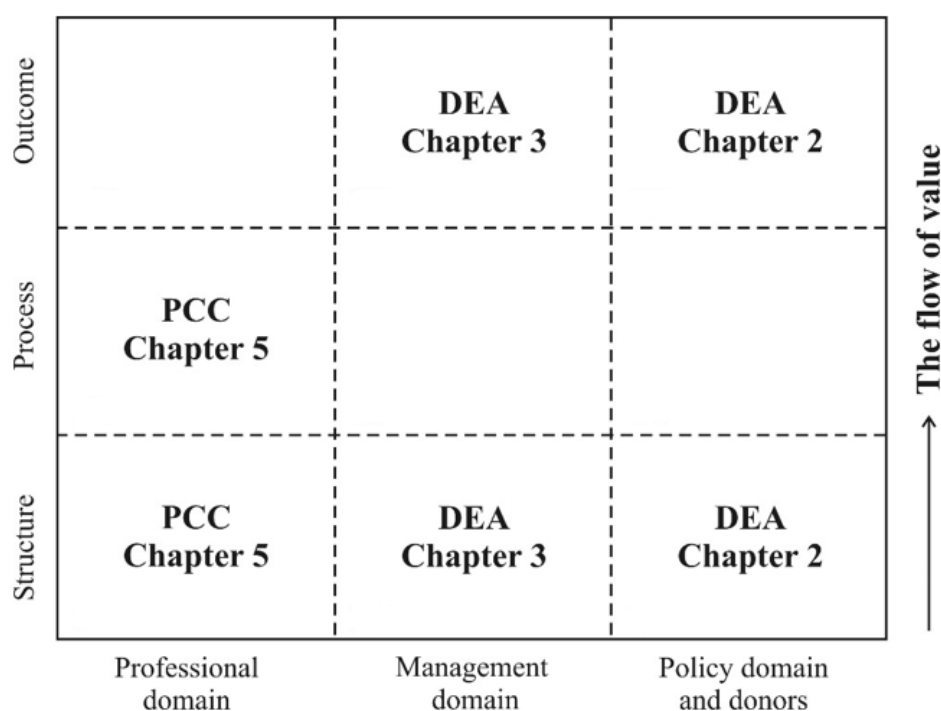


Figure 6. 1 Mapping this work on the proposed performance measurement system -West Bank.

The thesis fills a literature gap by responding with empirical sound to health care problems that have previously been documented in the descriptive literature for the case of interest. Some examples, the health care system in the Occupied Palestinian territories is fragmented and disorganized (Giacaman et al., 2009). Jordan's stake in the West Bank is unavoidable (Ashton, 2009), the often emphasis on quantity rather than the quality of care in Palestinian hospitals (Hamdan & Saleem, 2013), the subsidized on-going health reforms failed to improve quality or

meet the stressing health needs of the Palestinians (Giacaman et al., 2003), there are concerns about provider-patient relationship in the Mediterranean region (Saleh et al., 2015), Arabic-speaking countries made limited progress in quality management (Tannock & Ahmed, 2008), and finally, in the Middle East countries, health care demand and spending are rising sharply (Alhawsawi & Barach, 2017).

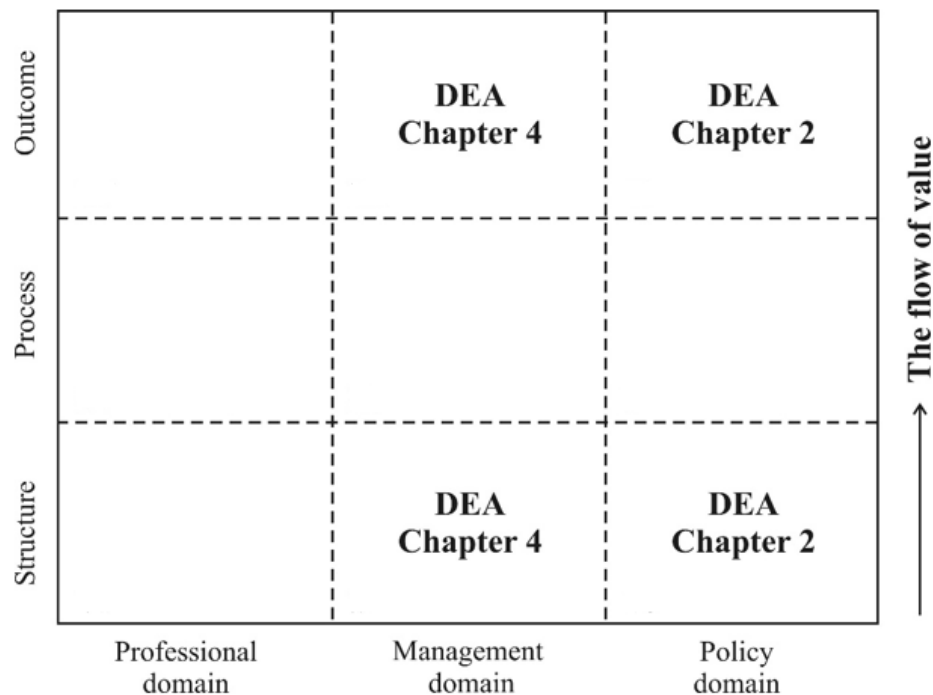


Figure 6. 2 Mapping this work on the proposed performance measurement system -Jordan.

Further, the thesis has the privilege of being the first in employing the PCC frameworks in West Bank and Jordan, The first DEA application in West Bank and the second DEA application in Jordan. Particularly, the thesis contributes to better understanding of the provision of hospital services across the River Jordan being: (1) the first analytical effort to analyze hospital operations and provide real indicators; (2) the first quantifying the delivered intrinsic value of the donors' contributions to the ongoing reforms in West Bank; and (3) the first study to consider, the inadvertently dropped, the implications of associations between Jordan and the Palestinians on health care sector evolution.

The outcomes convey knowledge by evidence to meet information needs of three key actors in the provision of public health services.

- First, the policymakers and donors in West Bank are asked to achieve a balance between investment in technology and "know how" skills to get the acquired benefits of technology. Further, the thesis raised the need for improving the interpersonal skills among Palestinian doctors in respect of communication and a need to revisit the

education curriculums and the poor training programs. In Jordan, policymakers are asked to support holding the progress achieved by managers and benefit from the identified input-output slacks among Jordanian hospitals to meet the increasing demand created by the Syrian refugees. Further investment in technology is required in Jordan to improve capacity performance. While not forgetting to reallocate resources, both countries are recommended to demonstrate performance measurement.

- Second, hospital managers can save on average about 15% of resources to reduce hospital transfers and the purchased hospital services. In both countries, better management of outpatient services can improve the estimated efficiencies. In West Bank, inefficiencies were attributed to weaknesses in management practices given by pure technical inefficiency as well as scale inefficiency.
- It is evident from the results of the longitudinal analysis of efficiency in Palestine in chapter three that hospitals displayed regress in productivity attributed to continuous regress in technology. However, international donors heavily supported capacity building reforms and new technologies were installed in healthcare. Therefore, it is believed that emphasis on quantity preceded the quality in Palestinian hospitals (Hamdan & Saleem, 2013). This contradiction with our findings may be the inappropriate adoption of new technologies (i.e., insufficient experience and knowledge or change resistance), which could limit the benefits to be acquired from new technology. Balanced efforts to get the "know how" skills will make up better benefits from the new technology.
- Professionals, mainly doctors, are required to improve soft skill competencies and to realize the benefits of enhancing partnership with patients. This problem, as witnessed by results in chapter five, is not uncommon in the developing countries context, where the patient's perspective is frequently ignored (Andaleeb, 2000; Saleh *et al.*, 2015). Findings show the lack of knowledge and awareness of PCC basics among doctors as a matter of concern, 55% of doctors had never heard about PCC (Section 5.3.3).

6.2 Summary of the appended research works

The point is, the accompanying research can't take responsibility for improvement actions. The purposes of performance measurement can be achieved if the key actors effectively use the intrinsic value of the generated information in the hospital settings: policymakers; managers;

and professionals with the aim of improvements, hence, the final value will be delivered to the patients.

The findings and conclusions at the end of each empirical work discuss the achieved research objectives in detail. It will be useful to summarize the main findings and the following the listed purposes in Section 1.3:

- The first and the core purpose is to improve performance by benchmarking and by managing performance determinants. The appended DEA studies evaluate the relative productive efficiency and identify scale efficiency, pure technical efficiency, and the overall technical efficiency of each hospital. The implications of the country's health Policies on hospital efficiencies are introduced in chapter two. Chapter three analyzes longitudinally the Palestinian hospitals during 2010-2015 and identifies changes in efficiency attributed to technology and changes attributed to management. In chapter five, Palestinian doctors may improve the quality of patient care and reduce the usage of resources when better PCC practices dominate diagnosing and treating their patients. In Jordan, results of chapter four show opportunities for improvements per individual hospital, for each inefficient hospital the composite peer hospitals and the targeted inputs-outputs mix was identified. Further slack analysis showed possible improvements for some inputs or outputs of the weakly efficient hospitals.
- The second purpose is to confirm priorities according to the explored factors of the inefficient performance. Results of Tobit regression model (Section 3.3.5) explore the main efficiency drivers of public hospital operations and facilitates the formulations of policies. Results suggest that bed occupancy rate, outpatient-inpatient ratios, number of beds per 10000 inhabitants, and the number primary care centers in a certain governorate are significant factors to manage and allocate resources more efficiently. Canonical correlation results (Section 5.4.2) provide a straightforward improvement plan for managing contextual factors besides the training and educational needs.
- The third purpose is to motivate hospital managers and policy makers to decrease the level of purchased hospital services from referral hospitals. The identified inefficiencies show opportunities to treat more patients without utilizing more resources and to improve the allocation of resources for better performance.
- The fourth purpose is to learn from evidence during the study period. Chapter two and chapter three, although showed progress in efficiency in West Bank, had surfaced managerial

weaknesses because changes are driven by technological changes rather than gains in efficiency. It is important to balance between the adoption of technology and the development of appropriate training. In Jordan, efficiency progress is attributed to innovative increments in managerial practices, managers should hold on that level and policymakers may invest in technology. Further, managers of inefficient hospitals can learn and benchmark their efficient peer hospitals.

- The fifth purpose is exploring factors that drive better provider-patient relationship with the aim of improving the PCC behaviors among the Palestinian doctors. The PCC is an essential attribute of the high-quality health care system, and the benefits of PCC and its implementation are manifest (Epstein & Street, 2011). The findings of chapter five show that the knowledge of PCC is limited among doctors, 55% had never known about PCC, this calls for revisiting the curriculum of soft skills in medical schools as well as training programs in teaching hospitals. The PCC study contributes to performance literature of integrating intangible resources and related knowledge assets in the process of performance measurement (Zigan et al., 2007).
- Finally, the sixth purpose is to promote policymakers and donors to invest in performance drivers and intangible resources rather than just emphasizing physical quantities. A proposal for policymakers and donors to invest in suggests itself, the design and implementation of a performance measurement system.

6.3 Research limitations and future research

Public hospitals consist of too many dimensions that can't be captured in one method (Zigan et al., 2007). Hence, it is essentially hard to approach the measurement of their performance effectively (Hariharan et al., 2004). Because our work represents the first step to introduce the culture of performance management across the River Jordan, the proposed model designates a broad view of hospital performance. Therefore, more investigation and continuous refining are required to develop and implement this model, improving the model may consider specific professional individuals and specific departments in the hospitals.

The main limitations of this research work were:

- The lack of data, there is no systematic reporting of data among the investigated hospitals which is a common limitation when addressing developing countries. Quality measures as the adjusted mortality rate measure, patients' surveys or case mix amongst others are not reported.

- The geographical separation between West Bank and Gaza limited the scope of work to West Bank which is only part of the Occupied Palestinian Territories.
- The lack of reliable operational data in the private sector limited the comparability of performance between public and private sectors.

The appended empirical studies, though covered many aspects proposed in our framework, other aspects are not included which suggest future research:

- Evaluation of health outcomes and patient views, future research may employ instruments (surveys) to measure to measure patient satisfaction, quality indicators as waiting time, and patients' information needs.
- Patients' perceptions of PCC practices, a study would allow for better understanding of the delivery of PCC.
- Evaluating "what matters" in non-clinical processes during hospitalization. For example, hygiene issues, discharge procedures, and the surrounding environment.
- Value-based DEA model is an example of advanced DEA methodology. Advance models can be useful to refine the estimated efficiency scores by conventional DEA models and may deliver greater value to the relevant decision makers.
- Hospitals encompass various individual professionals as nurses, laboratory technicians, radiology technicians, pharmacists amongst others. These professionals are highly relevant for performance improvement. Their individual and team capabilities could be addressed and developed by further research.

To sum up, this research project accomplished generating information highly relevant to key actors in public hospital settings and provided guidelines for improving performance. The final value delivered by the research findings will be acquired only when these key actors use the findings to accomplish improvements for the sake of the patients. Otherwise, the thesis is valuable for its own sake. This problem is well-known as "knowing-doing" gap in performance literature (Taticchi et al., 2010). It will be useful to present and discuss the findings with decision-makers in the Palestinian Ministry of Health.

Appendix G.

Supplementary data: input-output data for West Bank 2010 - 2015.

Source: Palestinian Annual Statistical Health Reports 2010-2015.

<http://www.moh.ps/index/Books/BookType/2/Language/ar>

	West Bank, MOH Hospital, 2010	No. of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
P01	Yatta	30	31	59	42	11008	26609	62171
P02	Salfit	50	29	90	51	11921	9179	24380
P03	Jericho	54	38	96	50	10661	11209	33822
P04	Nablus/Watani	55	26	115	82	17899	40241	38407
P05	Qalqillya	56	28	81	48	19494	27936	30928
P06	Tulkarm	108	53	144	71	25527	23607	59823
P07	Beit Jala	119	63	161	62	37748	30321	41967
P08	Jenin	123	61	195	69	39265	37135	70810
P09	Nablus/Rafidia	212	95	251	101	54831	59370	63311
P10	Ramallah	164	92	364	145	43859	54385	98328
P11	Hebron	216	89	248	98	81462	99234	92958

	West Bank, MOH Hospital, 2011	No. of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
P01	Yatta	34	29	65	43	10676	23006	57625
P02	Salfit	50	13	92	43	12902	9584	21696
P03	Jericho	54	34	96	53	10971	11695	36239
P04	Nablus/Watani	55	22	115	78	16596	38920	37220
P05	Qalqillya	56	18	82	56	14939	19666	26763
P06	Tulkarm	105	39	154	70	26099	21590	55824
P07	Beit Jala	113	58	166	65	35110	29385	48313
P08	Jenin	127	54	202	69	38672	34545	77616
P09	Nablus/Rafidia	213	76	255	108	57405	55062	72608
P10	Ramallah	170	92	386	146	52761	45268	104390
P11	Hebron	195	81	264	97	76989	97218	87299

	West Bank, MOH Hospital, 2012	No. of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
P01	Yatta	34	27	74	45	12080	23919	65835
P02	Salfit	50	27	94	49	14156	11279	23772
P03	Jericho	54	33	95	49	14839	16632	40469
P04	Nablus/Watani	55	14	117	77	17227	40171	42849
P05	Qalqillya	56	31	88	57	15687	24337	30189
P06	Tulkarm	105	38	156	75	27892	26577	62022
P07	Beit Jala	113	61	188	65	40031	31888	52761
P08	Jenin	127	53	194	75	40011	39199	81288
P09	Nablus/Rafidia	215	77	259	107	61179	75533	88887
P10	Ramallah	176	85	378	141	59058	61738	118984
P11	Hebron	236	76	276	90	94008	103090	108983

	West Bank, MOH Hospital, 2013	No. of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
P01	Yatta	34	28	77	44	11258	22399	54396
P02	Salfit	50	29	96	48	11919	14078	26659
P03	Jericho	54	31	104	50	13709	14842	40871
P04	Nablus/Watani	55	11	108	73	16938	40515	41395
P05	Qalqillya	58	32	95	58	18970	22533	33243
P06	Tulkarm	114	36	159	76	29309	26564	62022
P07	Beit Jala	131	63	203	79	41641	32201	47248
P08	Jenin	160	49	233	80	42658	37663	66657
P09	Nablus/Rafidia	200	72	283	110	62174	73245	90017
P10	Ramallah	185	68	317	115	64196	72842	134961
P11	Hebron	275	75	298	93	102139	93932	131842

	West Bank, MOH Hospital, 2014	No. of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
P01	Yatta	34	30	77	46	12648	21231	57495
P02	Salfit	50	30	97	47	11878	12173	30027
P03	Jericho	54	36	105	51	12777	15023	43379
P04	Nablus/Watani	55	11	115	75	17756	38116	45828
P05	Qalqillya	58	32	99	56	18748	21207	36549
P06	Tulkarm	114	36	177	79	28851	27690	60663
P07	Beit Jala	131	60	207	78	36430	37001	50538
P08	Jenin	160	50	252	77	48772	36349	69039
P09	Nablus/Rafidia	200	72	308	103	62760	69621	92645
P10	Ramallah	231	82	395	143	74010	85915	140024
P11	Hebron	275	67	320	94	114364	94790	132994

	West Bank, MOH Hospital, 2015	No. of Beds	Doctors	Health Cadre	Admin Cadre	Inpat. Days	Out patient	EM
P01	Yatta	36	37	83	42	13307	26462	59044
P02	Salfit	50	28	102	47	13122	14892	32447
P03	Jericho	54	35	94	46	14131	18970	43402
P04	Nablus / Watani	55	16	114	67	17256	37454	47367
P05	Qalqillya	58	40	101	57	20102	22689	36742
P06	Tulkarm	117	41	190	73	30520	32185	64958
P07	Beit Jala	131	61	205	76	37987	43413	43980
P08	Jenin	163	53	247	80	53608	42368	84600
P09	Nablus / Rafidia	200	80	294	100	63954	74817	93220
P10	Ramallah	238	94	390	142	84782	90748	140899
P11	Hebron	275	64	319	88	120853	102197	106023

Appendix H.

Supplementary data: input-output data for hospitals in Jordan 2010 - 2015.

Source: Jordanian Annual Statistical Health Reports 2010-2015.

<http://www.moh.gov.jo/EN/Pages/Periodic-Newsletters.aspx>

	Jordan, JMOH, 2010	Number of beds	Doctors.	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	300	223	437	106	82172	326800	145711
J02	Princess Basma	202	257	643	182	65469	372195	207832
J03	Prince Faisal	151	74	326	90	46325	173620	140832
J04	Jarash	135	50	340	103	24820	117365	105946
J05	AL-Hussein / Salt	152	174	394	106	35711	190446	126738
J06	Dr. Jameel Al-Totani	138	96	327	73	35615	94816	102864
J07	Ma'an	131	40	137	56	30399	57717	52513
J08	AL-Iman	130	46	279	94	21593	104956	107704
J09	AL-Karak	132	112	402	92	26217	83055	33736
J10	AL-Nadeem	120	88	306	96	27545	116754	69758
J11	Prince AL-Hussein	112	48	235	71	4118	8976	12006
J12	AL-Ramtha	110	50	242	69	20048	95129	68677
J13	Princess Raya	82	36	221	62	15621	90772	55501
J14	Ghor AL-Safi	82	41	193	45	22194	51746	55569
J15	Mua'th Bin Jabal	78	27	169	50	13405	77250	52548
J16	Queen Rania AL-Abdullah	72	35	136	36	10173	25500	42211
J17	AL-Mafraq	70	43	266	72	18230	84845	71547
J18	AL-Yarmouk	61	39	180	70	13062	87985	68430
J19	AL-Shuneh (South)	51	30	136	38	12335	44414	31266
J20	Abu - Obaidah	46	28	161	55	10067	104008	29053
J21	Princess Eiman\ ma'di	45	31	146	38	10400	49508	48405
J22	Princess Salma	38	29	120	45	7109	27158	30334

	Jordan, JMOH, 2011	Number of beds	Doctors.	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	300	224	435	160	18789	278869	144677
J02	Princess Basma	202	261	632	177	62831	292933	205393
J03	Prince Faisal	154	71	343	88	45196	170311	137765
J04	Jarash	155	54	347	100	24497	118327	114130
J05	AL-Hussein / Salt	152	176	397	125	24222	141355	105414
J06	Dr. Jameel Al-Totani	138	96	331	84	38154	93552	113998
J07	Ma'an	131	39	265	59	29483	56791	49740
J08	AL-Iman	130	53	308	99	20358	96057	104355
J09	AL-Karak	127	112	367	116	27020	77529	27994
J10	AL-Nadeem	120	69	289	103	26183	106022	97067
J11	Prince AL-Hussein	112	46	273	50	20523	44711	84437
J12	AL-Ramtha	110	45	241	71	22083	76965	82982
J13	Princess Raya	86	33	240	64	14464	76327	67313
J14	Ghor AL-Safi	82	39	193	45	22707	43662	48540
J15	Mua'th Bin Jabal	78	34	161	49	10935	74735	51210
J16	Queen Rania AL-Abdullah	72	32	143	30	12396	23426	38634
J17	AL-Mafraq	72	38	283	73	19292	83544	59873
J18	AL-Yarmouk	61	38	199	54	11347	81920	73664
J19	AL-Shuneh (South)	51	33	139	48	7901	30711	24544
J20	Abu - Obaidah	46	33	164	51	9459	109306	30153
J21	Princess Eiman\ ma'di	45	34	149	43	7845	43173	55763
J22	Princess Salma	38	33	127	41	6924	28631	30905

	Jordan, JMOH, 2012	Number of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	300	211	510	100	67676	297089	137568
J02	Princess Basma	202	293	630	176	68089	357847	172075
J03	Prince Faisal	154	66	320	80	46341	184566	132398
J04	Jarash	159	75	363	83	27126	131147	115720
J05	AL-Hussein / Salt	152	180	395	94	37578	154582	97213
J06	Dr. Jameel Al-Totani	138	119	333	86	39450	93925	106817
J07	Ma'an	131	46	257	59	30779	64096	49128
J08	AL-Iman	130	51	278	89	20081	103135	110020
J09	AL-Karak	86	121	362	118	22982	94413	33797
J10	AL-Nadeem	120	54	250	87	26219	114160	149270
J11	Prince AL-Hussein	116	63	269	68	23183	66777	101822
J12	AL-Ramtha	110	57	242	70	23402	92593	124151
J13	Princess Raya	86	39	233	61	16745	81421	64281
J14	Ghor AL-Safi	82	39	188	42	23261	43056	44216
J15	Mua'th Bin Jabal	75	36	147	50	11362	84317	46616
J16	Queen Rania AL-Abdullah	72	34	166	40	11160	30425	39317
J17	AL-Mafraq	68	47	286	76	19575	88675	72920
J18	AL-Yarmouk	64	41	200	60	14236	88308	80157
J19	AL-Shuneh (South)	60	32	137	47	9560	45528	27507
J20	Abu - Obaidah	46	25	161	49	9413	118752	46846
J21	Princess Eiman\ ma'di	45	35	146	39	7185	56748	57124
J22	Princess Salma	38	33	120	48	7537	33735	27506

	Jordan, JMOH, 2013	Number of beds	Phy.	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	246	211	566	99	71553	308858	58819
J02	Princess Basma	202	266	567	172	67548	359618	57030
J03	Prince Faisal	166	72	336	74	44474	181588	38626
J04	Jarash	159	73	391	87	27692	122757	36974
J05	AL-Hussein / Salt	152	196	393	91	30857	141564	65851
J06	Dr. Jameel Al-Totani	140	106	330	77	36450	100872	33082
J07	Ma'an	131	51	352	50	29355	60525	7531
J08	AL-Iman	130	52	285	70	21380	98660	87075
J09	AL-Karak	86	130	354	113	20915	107728	3783
J10	AL-Nadeem	120	62	294	99	29397	115098	41269
J11	Prince AL-Hussein	118	67	284	67	22675	55710	68098
J12	AL-Ramtha	110	64	252	71	24787	94433	43500
J13	Princess Raya	94	42	233	61	18289	82983	23922
J14	Ghor AL-Safi	82	44	205	35	22488	37733	17530
J15	Mua'th Bin Jabal	75	35	161	44	10698	85572	13107
J16	Queen Rania AL-Abdullah	74	37	186	30	12490	32348	13616
J17	AL-Mafraq	70	50	373	70	21353	94639	37303
J18	AL-Yarmouk	64	58	210	51	14669	93852	3510
J19	AL-Shuneh (South)	60	35	151	45	9180	47106	18621
J20	Abu - Obaidah	46	37	161	53	9129	115955	24531
J21	Princess Eiman\ ma'di	58	34	170	30	7300	52805	48008
J22	Princess Salma	38	39	133	29	6118	31384	7890

	Jordan, JMOH, 2014	Number of beds	Doctors.	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	221	208	644	131	60315	290435	107252
J02	Princess Basma	202	260	632	158	67957	275521	146011
J03	Prince Faisal	178	71	349	73	44469	186665	159193
J04	Jarash	159	65	387	92	26796	123445	127548
J05	AL-Hussein / Salt	152	173	429	104	34600	156096	109590
J06	Dr. Jameel Al-Totanj	140	124	316	83	38842	104871	123104
J07	Ma'an	131	39	349	50	31693	64711	54960
J08	AL-Iman	130	54	286	86	21663	98265	129321
J09	AL-Karak	124	140	451	112	24071	103284	41667
J10	AL-Nadeem	120	53	272	46	35748	128240	132000
J11	Prince AL-Hussein	118	60	286	67	19931	52573	126466
J12	AL-Ramtha	110	55	266	70	21931	86373	163131
J13	Princess Raya	94	38	250	60	19732	81211	75412
J14	Ghor AL-Safi	82	44	209	32	23137	41658	56373
J15	Mua'th Bin Jabal	75	36	155	65	11333	88358	61753
J16	Queen Rania AL-Abdullah	72	36	181	34	10301	34111	39546
J17	AL-Mafraq	70	44	320	63	22136	101354	110089
J18	AL-Yarmouk	67	46	226	51	13427	98443	89689
J19	AL-Shuneh (South)	60	34	153	46	7862	48349	33789
J20	Abu - Obaidah	60	36	171	53	8941	105154	24087
J21	Princess Eiman\ ma'di	58	34	176	29	8090	49736	63927
J22	Princess Salma	38	32	125	41	6711	37943	28975

	Jordan, JMOH, 2015	Number of beds	Doctors	Health Cadre	Admin. Cadre	Inpatient Days	Outpatient Visits	EM
J01	AL-Zarqa	496	211	516	137	107334	187402	23652
J02	Princess Basma	202	260	453	226	68668	290488	197879
J03	Prince Faisal	178	73	239	109	43812	169050	201711
J04	Jarash	116	60	284	90	27524	106279	13968
J05	AL-Hussein / Salt	152	168	347	137	36692	150630	100462
J06	Dr. Jameel Al-Totanj	140	130	221	83	40095	110132	182136
J07	Ma'an	131	47	259	57	32716	77867	69767
J08	AL-Iman	130	53	220	70	20938	93691	133477
J09	AL-Karak	165	146	339	109	24897	112162	64130
J10	AL-Nadeem	120	62	184	82	33696	96520	145029
J11	Prince AL-Hussein	120	71	207	74	19838	51610	115946
J12	AL-Ramtha	110	68	201	74	20577	57669	125914
J13	Princess Raya	94	36	198	51	19581	84160	80704
J14	Ghor AL-Safi	82	40	159	42	21827	40551	52871
J15	Mua'th Bin Jabal	75	35	117	37	9977	88639	64939
J16	Queen Rania AL-Abdullah	72	39	123	32	8291	31915	33503
J17	AL-Mafraq	70	34	171	74	18262	82110	115218
J18	AL-Yarmouk	67	46	154	65	14007	78230	87400
J19	AL-Shuneh (South)	60	34	118	33	11123	60900	40880
J20	Abu - Obaidah	60	36	116	39	9043	100288	28196
J21	Princess Eiman\ ma'di	58	37	130	39	8282	49054	70942
J22	Princess Salma	38	33	85	34	6966	40249	32428

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