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End User Satisfaction With Cloud Computing:
The Case of Hamad Medical Corporation in Qatar

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ABSTRACT

Cloud computing assures a faster, cheaper, and more efficient rendering of resources, which leads to huge popularity among businesses and specifically the health sector. The major objective of this research is to identify the benefits of cloud computing (CC) and the factors influencing user satisfaction. Utilizing a survey collected from 219 employees, the research model was tested. Results indicated that employee compliance issues, security and privacy issues, economic benefits, operational benefits, functional benefits, and trust are all significant predictors of satisfaction. Management issues and private cloud risks were not significant predictors of satisfaction. The coefficient of determination was $R2 = 0.81$. This study conducted comparisons between different categories of the sample based on their satisfaction level and concluded that age and education were significant discriminators while gender, experience, and department were not. Conclusions and future research are stated in the last section.

KEYWORDS

Cloud Computing, Economic Benefits, Functional Benefits, Hamad Medical Corporation, Management Issues, Operational Benefits, Qatar, Risk, Satisfaction, Trust

1. INTRODUCTION

Following the launch of decade-old Qatar vision 2030, Qatari ministries are now endorsing huge investments in transforming operations and services for multiple industrial sectors via new computing technologies (MoI&CT, 2014). Cloud computing (CC) is a new, low-cost infrastructure solution characterized by being scalable (Sinjilawi et al., 2014). CC is being recognized as able to deliver superior customer satisfaction via its ease of use, adaptability and manageability (Armbrust et al., 2010).

Users satisfaction is one of the vital research areas in evaluating CC impact, which will in turn influence its adoption and the effective use for building loyalty and work efficiencies (Jamal & Naser, 2003). To date, CC impact research within the healthcare sector, where studies utilizing different perspectives and constructs to explore the satisfaction level of employees, has reported contradictory results. As key elements of success in any new technology entail users' satisfaction and trust, the

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implementation of novel methods such as CC into clinical methodologies may largely impact healthcare practices and medical education (Bin-Nordin & Hassan, 2011). Put simply, the transformation of an offline service into a permanent remote online service is critical to improving efficiencies and effectiveness of many organizations, including health organizations. Importantly, the current study focuses on the new CC technology as implemented within the healthcare sector, specifically the Hamad Medical Corporation (HMC) case. Adopting CC in this instance will therefore have the potential to open doors to many well-suited innovations and wide-ranging healthcare scenarios (Chang, Chou & Ramakrishnan, 2009). As a country's economy is largely defined by healthcare sector advances, analysing and explaining the satisfaction and trust perceived in cloud technologies within the HMC setting could influence the adoption of such innovations in various other businesses and services in Qatar. This, in turn, would ease the country's path towards fulfilling Qatar's 2030 vision.

This paper explores end-user satisfaction vis-à-vis CC and its associated benefits and risks. Additionally, trust in the technology is considered a key predictor, making end-user satisfaction (EUS) an important criterion for determining the success of existing technology. This HMC study will focus on employees' satisfaction with CC, their level of trust in the technology, and the benefits and risks faced when using it. Conceivably, the study findings will yield significant insights towards answering the following research questions:

RQ1: What are the benefits of CC services in terms of operational, economic and functional aspects?
RQ2: What are the challenges and risks expected when implementing CC?
RQ3: What are the major factors influencing HMC employees' satisfaction with CC services?

2. LITERATURE REVIEW

Leveraging the competitive advantages of social, economic, environmental, and human resources are the four pillars of Qatar Vision 2030. With the advent of the information era, emerging technologies are being deployed quickly to facilitate the performance of basic monotonous tasks. The socio-technical systems approach is built on the idea that efficient and effective business processes comprise an integration of the human factor, the technological system and the environment (Pasmore, 1988). Humans use the tools, techniques and knowledge (the technological system) intelligently to produce goods and perform services for their customers. CC is essentially a business service process model that is based on information technology (IT) offered via an Internet-dependent infrastructure (Qasim & Abu-Shanab, 2014).

The HMC case we report here showcases continuous services improvements to a growing Qatar public. In this sense, HMC has been a key driver towards achieving a clinical front with various medical innovations in Qatar (MoI & CT, 2014). Increasing demands on healthcare services would require upgraded facilities with innovative solutions such as CC so as to surpass the typical expectations and performance results than those previously anticipated.

2.1 Cloud Computing (CC)

CC has become a vital component of the growing range of information and communications technology (ICT). It may be conceived as business sophistication for having a capability to access diverse facilities via a single network (Buyya et al., 2009). The cloud represents a platform for users to share and access resources. The widespread popularity of CC is due to the computational solutions that it offers within various fields of knowledge. For example, CC provides services to networks, applications, servers and other ICT-related components to link both external and internal customers via the Internet as a medium of connectivity. Cunha et al. (2017) delineates CC as a paradigm with a vision to obtain, share, and modify unlimited resources in real-time. Despite the massive amount of data stored and computed within the cloud, CC renders a feasible and scalable solution. CC is a

typical computing utility that is endowed with the potential to revise and transform existing designs, specifications, and standards of IT hardware and software, thereby making it more effective as a service (Armbrust et al., 2010).

Put simply, CC is beneficial to large organizations such as the HMC, given that it contributes to formulating a smart infrastructure for the healthcare sector. Notwithstanding, due to the extremely exploitable nature of a CC infrastructure, it is mandatory to monitor, control and report the functionalities of the cloud (Mell & Grance, 2011). Moreover, there are diverse deployment methods, which can also be termed as different types of cloud such as public, private, community and hybrid (Youssef, 2012).

For *public cloud,* where common utilities are owned and endorsed by third-party services, its deployment should be first considered. Consideration comes next for *private cloud*, where it is deployed exclusively for a particular private organization; this type of cloud implementation is more common among small businesses, where it presents a superior level of control and better security than the public cloud (Rani, Rani & Babu, 2015; Owopetu, 2013). For the *community cloud,* its deployment is to host scalability for future advances while still looking towards limiting cost, security and other concerns as raised by the public cloud facility (Boampong & Wahsheh, 2012). Finally, *hybrid cloud*, representing a combination of in-house and external services, offers cumulative cloud services and is often considered superior as it incorporates the superior features of public-private facilities (Rashid & Chaturvedi, 2019). Just as with the HMC, such benefits will encourage large service sectors to adapt hybrid cloud model to meet the growing demands.

When running cloud services, different cloud platforms or architectural formations that are used to manage all IT infrastructures defined under CC should be considered. The first is *Hardware as a Service* or HaaS, which contributes to incorporating hardware virtualization by encapsulating assets via a pay-as-go subscription service or as a data-centric service (Wang, et al., 2010). In clinical terms, the HMC could benefit significantly from HaaS as it precludes the capital expenses of the business while connecting clients to the most effectual digital processing avenue. A second architecture is the *Software as a Service* or SaaS, where the applications and software may be run directly from a web portal or service-oriented standards based on the web application technology (Sridhar, 2016). SaaS represents best practices that are suggested for large environments where the number of requirements varies with time (Wang, et al., 2010). Then, there is the *Platform as a Service* or PaaS, an on-demand service that presents a complete platform for the hosting of an application to enable the business to build the requirements, and for testing, collaborating and running it based on the user requests (Kulkarni, Sutar & Gambhir, 2012). Finally, *Infrastructure as a Service* or IaaS, which represents the final level of cloud infrastructure, comes into play. IaaS represents the cloud standards as virtual machines, storage equipment and servers on demand from the user (Sridhar, 2016). According to (Yang, 2012), the IaaS can be exploited as a fully outsourced service, which can then be claimed based on the user requirements.

2.2 CC & Health Care

Healthcare IT or HIT has generated a novel pathway for transforming healthcare services delivery. The service quality is non-negotiable in health care, especially if the service provider is also a major health delivery organization in a country like Qatar. In order to ensure the privacy of health records and information, relevant governing bodies have been instituted to regulate the health sector for Qatar patients. CC facilitates the functionality and management of many types of resources, including health care resources (CSCC, 2019). While privacy and security of the captured stakeholders' records within an innovative HIT implementation such as CC may be risky, the benefits of CC adoption include functional and operational efficiency and reliability, all of which are vital factors in enriching health care services quality.

Today, the Qatar Electronic Health Record (EHR) that defines the real-time patient recording system is largely powered by cloud computational facilities. According to Bamiah, Brohi, Chuprat &

Ab-Manan (2012), CC powers the process by stabilizing economically imperative factors, such as cost and quality. A cloud facilitation of shared resource that is integrated and maintained among owners can significantly reduce the high costs required in systems integration. Further, its infrastructural cost can also be substantially curtailed via the elimination of duplication and waste (CSCC, 2019). Fundamentally, CC presents a one-stop platform that supports superlative medical systems without the need to have a direct access to the computers or other devices (Al-Masud, 2012). The standards and infrastructures adapted in CC have the capability to congregate, cumulate, and analyse data from diverse real-time or non-real time sources regardless of the place and/or time of data accessibility.

In particular, cloud services are also useful in handling complex administrative functionalities, all of which play a crucial role in the healthcare sector. Basic management chores such as billing, registration, appointment, and scheduling via CC can be cost-efficient and creatively well accommodated (Daman, Tripathi & Mishra, 2016). Starting from fundamental managerial chores to the implementation of sophisticated medical instrumentations, the adoption of CC in health care can provide meaningful co-ordination and active collaboration among users. Cloud services also enable massive virtual data storage without the requirement for any physical location to store patient files or hospital management records. Finally, when CC solutions are juxtaposed with wireless technologies, big health data processing and Internet-related medical services can even be efficiently and effectively offered to the most rural parts of the world (Daman, Tripathi & Mishra, 2016).

At HMC, with continuing and active ICT developments in Qatar, unremitted developments have been achieved via various medical innovations, for example, innovative e-health strategies, bio mimicry, tele-monitoring, shared medical imaging, genetic profiling, and self-diagnosis (MoI & CT, 2014). Moreover, Electronic Medical Record System (EMRS) with various upgrades have been implemented over multiple years with the objectives of expanding HMC communication system, advancing medical consultations, and playing a crucial part in the Qatar health service sector. At this point, it is imperative to devise or choose a novel cloud service that would provide access to state-of-the-art applications and solutions to assist both the academics and medical professionals in meeting with the growing demands of the public in their health care needs and general well-being.

2.3 CC & End-User Satisfaction (EUS)

To date, CC research chiefly discusses the application of various cloud features and services in satisfying the user's demands (Guimaraes & Paranjape, 2014). For healthcare services, the employees represent the primary end-users as they deploy the technology to carry out their daily clinical chores whereas customer satisfaction may be defined as the ability to meet customers' needs and wants. To satisfy customer demands, healthcare institutions should vie for a value-based care orientation v. one that is just volume-based. Essentially, this value-based perspective strives to satisfy all of the customers' demands in the short term; in the longer term, it aims to aid the medical personnel and staff in rendering proper services to the customers. Patients can be concerned directly or indirectly with the adapted innovation, where increasing the involvement of end-users is a driving force for the care provider organizations to improve their services (Dixon-Fyle & Kowallik, 2009). Simply, more innovations will enable patients to be assisted in understanding their health behavioural patterns and hence, they will be more satisfied with the system (Devadass, Sekaran & Thinakaran, 2017).

According to Turunen (2013), in order to achieve high end-user satisfaction (EUS), an organization should involve these end-users personally when implementing any novel service or technological innovation. While it may not be possible to directly involve the end-users in all key managerial decision-making processes, their involvements may be tracked via a statistical survey. The impact of any novel techniques on the end-users can then be traced to substantiate any claim that the innovation has evidently improved the organizational processes. Measuring the EUS of an innovation will, among other things, help measure the quality of service offered by the organization (Pilevari, Toloei, & Sanaei, 2013).

CC & customer trust: For CC to be trusted by end-users, CC services adopted by the organization should not only meet all technical specifications and requirements via effective data managements, but also eliminate potential current and future risks (Guimaraes, 2014). When external service providers offer CC services, trust becomes a vital component in service-oriented infrastructures (Abu-Shanab & Qasim, 2014). The question of trust typically encompasses issues of privacy, interoperability, and security (Sen, 2013). A major question remains as to what additional measures should be adopted to gain the full loyalty of the end-user in adopting CC. Here, it is vital to probe the opinions of HMC users regarding their trust level in CC. For this reason, the following hypothesis is stated:

H1: Trust will have a significant positive influence on users' satisfaction with CC.

2.4 Benefits of CC

A range of benefits, risks and challenges surrounds CC adoption in health care services. Among other things, major types of benefits include economic, operational and functional benefits whereas challenges and risks will be discussed in the section to follow.

Economic Benefits

Economic benefits may be defined primarily as financial benefits achieved via cost reductions such as via the re-organizing of the workforce, through supplementing energy and lowering infrastructure cost, and/or by eliminating waste and redundancies. Ankeny (2011) argues that shifting to the cloud strategy could curtail IT investments, which would ease hefty capital requirements, especially for health sector organizations. Resource pooling is an ability offered by cloud services, wherein a single cloud provider serves multiple users via the use of a multi-tenant model. Additionally, the "pay as you go" service model requires organizations only to pay for services that are deemed necessary, allowing servicing to be scaled up when and if the organization is ready to deploy needed advancing servicing. Researchers have reported that an organization's motivation for implementing a cloud system is largely driven by the cost reduction it offers (reaching up to 45.5%) (Sahandi et al., 2013). Ankeny (2011) asserts that the subscription models that are solely handled by the cloud service providers contribute more towards the reduction in cost.

H2: Economic benefits will have a significant positive influence on users' satisfaction with CC.

Operational Benefits

Scalability and agility are the operational advantages associated with cloud services. Cloud techniques simplify the administration of technical infrastructure, completely deserting the use of complex and expensive hardware (Anandhi & Chitra, 2012). A cloud system also provides web access to data from any location anytime (Qasim & Abu-Shanab, 2014). Essentially, it reduces the amount of data that needs to be stored on desktops. Inevitably, competition is boosted via dynamic and steady changes (Blomquist, 2012), which means that commercial organizations need to cope with the rising trends and altering customer preferences in order to stay on an enhanced track. This requires that system be agile, which is characteristics of the cloud feature where innovation and *agility* go hand in hand to meet the user's demands. As Shayan et al. (2013) note, various industries pursue novelty by leveraging advanced computing adaptations, standards and applications, such as CC, to gain a superior competitive advantage.

Recent studies also supported the importance of CC in sustaining agility by highlighting the contribution of the Internet via the swift delivery of services (Chuang, Nakatani & Chen, 2015). Prior to implementing CC, all possible business-related strengths, opportunities impediments, applications and hazards should be well explored if the implemented CC is to achieve superiority against alternatives (Marston, Li, Zhang & Ghalsasi, 2011). As viewed by Rosenthal et al. (2010), CC offers a data warehouse that backup all of the stored data. Aside from having elasticity and flexibility,

CC amplifies agility by maintaining and managing software while reducing maintenance and spare parts. Elasticity means the CC is easily adaptable to changes in the workload while flexibility denotes the ability to deploy CC as a solution to meet augmented market demands swiftly. Some researchers prefer to use scalability, the ability to manage the augmentation of resources and to handle obsolete or diminishing resources that are already included within the application, when discussing CC. Such scalability may be illustrated by adding/removing software or computing infrastructure functionalities (Buse, 2011; Lin & Chen, 2012).

H3: Operational benefits will have a significant positive influence on users' satisfaction with CC.

Functional Benefits: As an Internet-based infrastructure, CC functionality can be expanded into multiple platforms and applications (Doukas & Maglogiannis, 2012). The Internet is presented as a medium in CC, through which all software functionalities are established based on industrial demands (Snowden, 2009). For instance, services may be requested on-demand to implement any intelligent application model that enforces smart algorithmic functions. As well, the cloud will eliminate much physical paperwork with the handling of medical records, a medium that is highly susceptible to manual errors (Shreve, et al., 2010). Not surprisingly, the HMC in Qatar has adapted EHR facilitations to form the basis of all CC solutions within the Qatar health sector.

H4: Functional benefits will have a significant positive influence on users' satisfaction with CC.

2.5 Challenges & Risks in Cloud Implementation

Notwithstanding, CC is still an Internet-based platform susceptible to various technological and security glitches, operational bottlenecks, which would prevent its adaptation within several businesses (Dillon, Wu & Chang, 2010). Privacy issues generally arise from the absence of regulation when a technology is launched or implemented (Qasim & Abu-Shanab, 2014). The following small sections will review the risks of CC.

Management Challenges & Risks

The implementation of CC will introduce a large number of changes with regards to organizational functioning patterns. Change management is inevitable, where it is considered a critical managerial concern that will alter the outcome of adoption process (Carroll, Van der Merwe & Kotzé, 2011). A basic operational issue is moving the data into the cloud as it is the responsibility of the management to decide what details that should be moved (Khajeh-Hosseini, Greenwood & Sommerville, 2010). Moreover, this business migration raises critical concerns, and would also imply that there would be concerns related to the integration of various conventional techniques through the use of novel cloud techniques. The following hypothesis is stated:

H5: Management challenges and risks will have a significant positive influence on users' satisfaction with CC.

Challenges Faced in the IT Front

The implementation of modern innovations, such as CC services, has a tendency to transform the organization digitally. As most of the human tasks will be usurped by cloud services, the primary changes to be witnessed would be the elimination of manual work (e.g., Khajeh-Hosseini, Greenwood & Sommerville, 2010). Further, major modifications may have to be adapted to facilitate the storage of massive volumes of dynamic data in targeted storage devices, hardware and networks (Goel,

Kiran & Garg, 2011). Newly employed services will often demand that the organization upgrade the capabilities of existing technology.

Besides these strategic IT changes, the target business, in most cases, demand service and application customization in order to meet competitive demands (Joint & Baker, 2011). CC is an Internet service that would be challenged or have its operations obstructed if the organization does not have cutting-edge Internet connectivity. Importantly, strong infrastructural and managerial support must be provided by the implementing organization in order to ensure quality of services, business process efficiencies and meaningful users' satisfaction (Marston, Li, Zhang, & Ghalsasi, 2011). The following hypothesis is therefore stated:

H6: Private cloud issues will have a significant positive influence on users' satisfaction with CC.

Security & Privacy in the Cloud

Security and privacy are two vital factors that determine the effectiveness of any newly implemented technology (Sen, 2013; Abu-Shanab & Qasim, 2014). Data security and privacy are crucial IaaS services; in fact, any vulnerability in the services delivered will affect the reputation of the business (Thakur & Awasthi, 2017). The primary goal of CC is to help businesses reduce cost by moving all physical data resources stored in multiple desktops to the cloud, where these data resources can be aggregated, stored, maintained and updated without anomalies. Past research has also reported that 37% of businesses faced malicious attacks (Chou, 2013). When users sense that the privacy and security of their information are being threatened, their faith and satisfaction with the system will significantly decline. The following hypothesis is therefore advanced.

H7: Security and Privacy will have a significant and positive influence on users' satisfaction with CC.

Employee Compliance & Associated Challenges

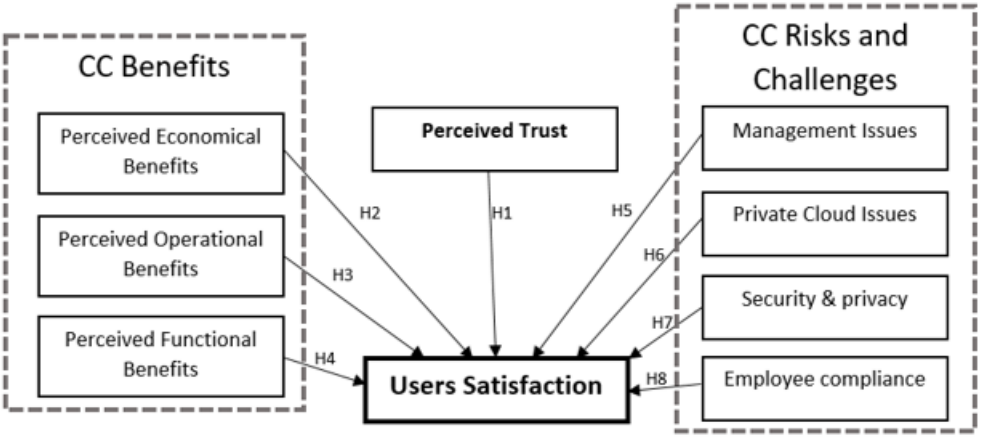
The end-users of HMC cloud are the employees. As such, there may be many possibilities for an HMC employee with access to the cloud to falsify data and breach security given that they would have authorized access to confidential information, thereby raising a serious concern (Khajeh-Hosseini, Greenwood & Sommerville, 2010). Another issue is the downsizing of human resources based on the skill level of existing employees vis-à-vis the new technology (Lin & Chen, 2012). Rapid technological advancements should be coupled with proper adaptations and change management. Expertise in the proper workload distribution will thus optimize the reduction of overall system cost and energy, thereby ensuring an efficient use of accessible and available resources (Beloglazov, Abawajy & Buyya, 2012).

H8: Employee Compliance will have a significant positive influence on users' satisfaction with CC.

In summary, the underlying hypotheses points to eight potential factors that can predict users' satisfaction with CC services, namely, trust, economic benefits, operational benefits, functional benefits, management issues, private cloud issues, security and privacy issues, and employee compliance.

Figure 1 depicts our research model.

Figure 1. The Research Model



3. RESEARCH METHODOLOGY

This research aims to explore the benefits as well as risks and challenges with CC implementation and adoption. In previous sections, we see that relevant and critical information regarding the first two research questions (*RQ1 & RQ2*) could be sought and explored via an extensive literature review. The third research question (*RQ3)* relates to investigating the level of satisfaction of HMC employees when using CC, which requires empirical validation.

Accordingly, we conduct an empirical study to probe HMC employees' perceptions regarding three dimensions (benefits, challenges/risks and satisfaction). The first step comprises developing and assembling a comprehensive, reliable and valid survey instrument, classifying benefits of CC into three areas: Economic (i.e., reducing software and hardware cost, reducing staffing cost, and enabling economic scalability); Operational (i.e., launching apps quickly, improving the development process, encouraging better collaboration, and increasing efficiency); and Functional (i.e., helping to achieve objectives, enhancing data management, making less mistakes, and promoting functional collaboration).

Also, the literature guided us on the main challenges and risks facing organizations when implementing CC and these concepts are categorized into 4 groups: Managerial challenges (i.e., trust in the security and privacy of the system, help in strategizing operations, deliver employees' objectives, provide reports and analytics, and manage operational workflow); Private cloud issues (i.e., backup issues, competencies of IT team/department, security and privacy tradeoffs, and enforcing organizational processes and policies); Employees compliance (i.e., managerial enforcement, change management, benefiting from IT capabilities, performance improvement, and trust issues); and finally, Security-privacy safeguards (i.e., information protection, compliance with laws and regulations, authorization issues, policy regarding employees adherence, and trust related issues.)

3.1 Research Instrument

This study utilizes an English survey instrument to probe HMC employees on their opinions regarding their satisfaction with CC services and key factors that may be influencing such satisfaction measures. The survey employs a 5-points Likert scale, where 1 represents total disagreement while 5 represents total agreement. A high perception noted from such a scale will be implied via a mean ranging from 3.667-5, whereas a low perception will be informed via a mean ranging from 1-2.333.

The administration of the survey questionnaire has been conducted via online distribution among HMC's staff residing in Qatar.

The survey questions are grouped into three sections. The first section is an introduction to research objectives and environment, including a consent form to invite subjects to respond voluntarily (and without pressure) to the survey. The second section comprises questions relating to demographics of the sample to be collected. The third and final section includes the 57 items used for measuring the research model variables ordered in a structured format as follows: five (5) items measuring economic CC benefits; five (5) items measuring operational CC benefits; five (5) items measuring functional CC benefits; five (5) items measuring management issues; five (5) items measuring private cloud issues; five (5) items measuring employees compliance; five (5) items measuring security and privacy; ten (10) items measuring trust in CC; and twelve (12) items measuring users' satisfaction.

Finally, the concluding part of the questionnaire includes an open space for free-style, open comments from respondents. The survey was promoted via an online application platform.

3.2 Research Sampling

In this study, data have been collected from 219 individuals voluntarily, where the online link has been sent via an e-mail list. The demographics of respondents are shown in **Table 1**.

The majority of sample participants is non-Qatari, male, age 30-39, with a graduate degree. The professional experiences of these participants revolve around 10 years or less, with the majority coming from medical professions. The sample size exceeds slightly the sampling requirement needed for the applicable statistical and power analysis (Hair et al., 1998), where the sample size requirement should be over five times the items used in the study (5*29=145 surveys), or 20 times the number of constructs (20*9=1980 surveys).

Table 1. Demographics of Respondents

Demographics & Categories		Frequency	%
Age	19 - 29	55	25.1%
	30 - 39	114	52.1%
	40 - 49	43	19.6%
	50 or older	7	3.2%
Gender	Male	140	63.9%
	Female	79	36.1%
Educational Level	High School	44	20.1%
	Undergraduate	23	10.5%
	Graduate	96	43.8%
	Postgraduate	56	25.6%
Nationality	Qatari	42	19.2%
	Non-Qatari	177	80.8%
Total Years of Experience	5 or less	47	21.5%
	10 or less	108	49.3%
	20 or less	55	25.1%
	more than 20	9	4.1%
Department	Non- medical	75	34.2%
	Medical	144	65.8%

Multiple regression method has been applied for analytical purpose here as it supports the relatively small sample size, where it is considered a robust technique while achieving a higher statistical power vis-à-vis other popular techniques (Cohen et al., 2003).

4. DATA ANALYSIS & DISCUSSION

Altogether, the intended purpose of this study is to identify the extent in which, if at all, relationships exist between the dependent and the independent variables as provided in our proposed research model (**Figure 1**).

Ultimately, the study aims to understand the key factors influencing HMC EUS with CC services. In addressing the research questions posed, SPSS is applied for all tests needed. The first step in the analysis process is to validate the survey instrument used in this research, where Cronbach's alpha has been used as an estimate of internal consistency and reliability.

Table 2 depicts our analytic results, where all Cronbach's alpha values have resulted in above the recommended threshold of 0.8 (Hair et al., 1998). It is apparent that two of the constructs exceed 0.9 (trust and satisfaction). The rationale for this is the previously extensive validation performed at source from which these items have been adopted (Hammouri & Abu-Shanab, 2020; Al-Sharafi et al., 2019).

Table 2. Cronbach's Alpha Value of Major Constructs

Constructs	N	Number of items	Cronbach's Alpha
Economic Benefits (EB)	219	5	0.830
Operational Benefits (OB)	219	5	0.888
Functional Benefits (FB)	219	5	0.876
Management Issues (MI)	219	5	0.851
Private Cloud Issues (PCI)	219	5	0.818
Employee Compliance (EC)	219	5	0.877
Security & Privacy (S&P)	219	5	0.857
Trust (T)	219	10	0.905
Satisfaction (S)	219	12	0.942

4.1 Descriptive Analysis

The next step in the analytic approach is the items' level analysis, where item means are estimated by computing the average of the items included in the measure. **Table 3** represents the means and standard deviations of items for the three-benefit dimensions.

Table 4 represents the means and standard deviations of the challenges and risks items being measured.

As shown, **Table 4** shows the results relating to the risks and challenges constructs, where all four related variables have scored in the moderate levels (highest mean = 3.69) except for "employees compliance." More specifically, with the exception of three items, that is, *Q27*, *Q28* and *Q29,* the rest of the item means have scores that are more or less in the moderate level range. This drop in the means scores may be caused by a limitation of the perception of the constructs. While the item

Table 3. Descriptive Statistics for Economic, Operational & Functional benefits

Economic Benefits	**Mean**	**Std. Dev.**
Q1: Cloud computing saves cost of hardware	4.46	0.755
Q2: CC saves costs of software	4.42	0.746
Q3: Cloud computing saves costs on IT staffing	4.40	0.738
Q4: CC enables management to increase/decrease IT requirements on-demand	4.29	0.864
Q5: Management uses saving incurred by CC on other strategic aspects	4.38	0.861
Overall Economic Benefits (EB)	4.39	0.605
Operational Benefits	**Mean**	**Std. Dev.**
Q6: Ability to launch new products or service rapidly	4.27	0.906
Q7: A better tool for development teams	3.88	0.999
Q8: Enables better collaboration amongst teams across the organization	4.16	0.982
Q9: A better platform to continuously evaluate the process	4.15	0.909
Q10: CC has increase efficiency in my department	4.29	0.875
Overall Operational Benefits (OB)	4.15	0.719
Functional Benefits	**Mean**	**Std. Dev.**
Q11: CC helps me achieve my overall work objectives quickly and efficiently	4.35	0.835
Q12: CC application is better for data management	4.37	0.750
Q13: The software we are using fits the department objectives	4.30	0.893
Q14: There are less mistakes after applying work using CC	4.38	0.834
Q15: CC assisted in the overall collaboration between teams	4.32	0.924
Overall Functional Benefits (FB)	4.34	0.695

statements have been positively worded, where subjects may tended to evaluate high, the connotation of these items being associated with risks may have confused subjects, who may well feel that they are reporting an unrealistic perception. Such an issue can perhaps be avoided in the future by using a positive label or changing the items to a set of negative statements. Past research results have supported somewhat equal observations when adopting similar constructs (Carroll et al, 2011; Khajeh-Hosseini et al., 2010; Marston et al., 2011; Thakur & Awasthi, 2017; Beloglazov et al., 2012).

Table 5 represents the means and standard deviations of trust and satisfaction.

As shown throughout **Tables 3, 4 and 5**, high estimates of means for all items, which represents the valued view of employees toward various aspects of CC have been more or less recorded. The highest item mean score is for *Q1* (hardware cost), while the lowest mean score is for *Q7* (suitable for development team). The rationale behind such an observation may be due to the sampling nature where most of the measured items are not closely related to developmental functions.

Some variations have been observed with the standard deviations (SDs), where *Q7* (again, relating to the development team) has the highest SD. The overall construct means are all in the high level scores (> 3.66), with the mean for "economic benefits" scoring the highest v. that for "operational benefits" the lowest. Such observed results emphasize the beliefs of the HMC respondents that CC comprises huge economic benefits to the business, although not as much for operational purposes. Overall, most of the items are also low on SD, meaning there may be little difference, if any, among the HMC respondents in their expressed perceptions. More generally, as with the observation on **Table 4** results, the results of previous research support our observations for most, if not all, the

Table 4. Descriptive Statistics for Management Issues, Private Cloud Issues, Employees' Compliance and Security-Privacy Issues

Challenges & Risks (Management)	**Mean**	**Std. Dev.**
Q16: I trust my organization's security measures and don't mind having my personal information stored in it	3.35	0.812
Q17: CC assists the organization in implementing strategic goals	3.36	0.857
Q18: Software & CC combination assist our employees to deliver their objectives	3.43	0.795
Q19: CC helps provide reports and analytics on-demand	3.41	0.849
Q20: CC assists in viewing and measuring the overall workflow	3.56	0.943
Overall Management Issues (MI)	3.42	0.685
Challenges & Risks – Private Cloud Issues (PCI)	**Mean**	**Std. Dev.**
Q21: Our organization has a remote and separate back-up server/s	3.37	0.951
Q22: We have a complete and capable IT team	3.42	0.922
Q23: CC enables implementing updates/upgrades without service interruption	3.56	0.948
Q24: Security and Privacy remains the biggest challenge and risk factors	3.26	1.032
Q25: The organization's processes and politics is an obstacle to the development and for providing on-demand service provision	3.47	0.940
Overall Private Cloud Issues (PCI)	3.42	0.774
Challenges & Risks – Employee Compliance	**Mean**	**Std. Dev.**
Q26: Management has communicated and managed transition to CC	3.58	0.985
Q27: It is easy for me to cope with any change in process or policy	3.66	1.029
Q28: I am aware of the capabilities that CC provides and I am benefitting from it	3.84	1.045
Q29: CC helps me achieve my work objectives faster	3.77	1.012
Q30: I fully trust CC and IT team to handle process and operational maintenance	3.59	0.936
Overall Employee compliance (EC)	3.69	0.808
Challenges & Risks – Security and Privacy	**Mean**	**Std. Dev.**
Q31: We are well-protected when it comes to cloud security and privacy	3.43	0.823
Q32: Security and privacy measures are compliant with the regulatory laws	3.30	0.882
Q33: Our staff do not abuse their authorization privileges	3.33	0.814
Q34: We have a proper "whistle blowing" policy that covers CC	3.29	0.843
Q35: CC is trustworthy and more secured than the previous system	3.37	0.793
Overall Security & privacy (S&P)	3.34	0.671

observations of the other tabulated scores for the similarly adopted constructs (e.g., Ankeny, 2011; Shayan et al., 2013; Doukas & Maglogiannis, 2012; Shreve, et al., 2010).

Finally, the trust and satisfaction constructs are behavioural and could have resulted from the perceptions of other measured variables. Here, the item means are all in the high level (>3.667), with item Q48 having the highest score (mean = 4.45, relating to the security of information), and item Q51 having the lowest score (mean = 4.23, relating to training). Statistically, the overall mean scores may be considered to be high with low SDs. This observation emphasizes that with the high perceptions of subjects toward trusting CC, HMC employees are generally being highly satisfied with the services offered. Such an observation is also supported by the previous research results when

Table 5. Descriptive Statistics for satisfaction and trust

Satisfaction	**Mean**	**Std. Dev.**
Q36: CC has made my job easier	4.38	0.765
Q37: It is easier for me to achieve my targets with CC	4.40	0.756
Q38: It is easier for me to coordinate with other departments	4.30	0.852
Q39: Approval process is much faster	4.35	0.898
Q40: I have a better overview of process operations	4.36	0.802
Q41: I am able to work remotely	4.36	0.853
Q42: There are less mistakes after switching to CC	4.32	0.851
Q43: CC releases resource to be used else where	4.40	0.848
Q44: CC has provided better data management	4.33	0.853
Q45: Applications interface is user-friendly	4.33	0.848
Q46: Our work productivity has increased with CC	4.34	0.881
Q47: The applications we use via CC is functional	4.26	0.924
Total Satisfaction (S)	4.35	0.661
Trust	**Mean**	**Std. Dev.**
Q48: The patient's information is secure and private	4.45	0.824
Q49: Our systems managed by CC are up to date	4.35	0.772
Q50: We have a strong IT team, who is capable and trained	4.37	0.781
Q51: We receive regular training on all aspects of CC	4.23	0.964
Q52: We receive regular bulletins on CC threats	4.25	0.935
Q53: Our data entries undergo quality checks	4.29	0.886
Q54: Our workstations are properly set-up with controlled access	4.37	0.805
Q55: Our data is constantly backed up and updated	4.35	0.872
Q56: I have signed an affidavit of secrecy or a privacy confirmation	4.35	0.856
Q57: We have limited access to the internet	4.24	0.947
Total Trust (T)	4.32	0.637

similar constructs have been adopted (e.g., Hammouri & Abu-Shanab, 2020; Guimaraes & Paranjape, 2014; Devadass et al., 2017; Pilevari et al., 2013).

4.2 Correlations

In the next analytic step, we focus on bivariate correlations, which serve two major purposes. First, its deals with the multicollinearity issues; that is, excessively high correlations can present a threat if the score exceeds 0.85.

If we inspect the estimated Pearson's correlation matrix shown in **Table 6**, we can see that all correlations have a value between 0.415 and 0.835.

Table 6. Pearson's Correlation Matrix

Constructs	EB	OB	FB	MI	PCI	EC	S&P	T
Economic Benefits (EB)	1							
Operational Benefits (OB)	.625	1						
Functional Benefits (FB)	.720	.721	1					
Management Issues (MI)	.700	.675	.793	1				
Private Cloud Issues (PCI)	.612	.624	.662	.783	1			
Employee compliance (EC)	.476	.415	.513	.541	.545	1		
Security & privacy (S&P)	.555	.550	.595	.643	.641	.517	1	
Trust (T)	.606	.604	.708	.693	.706	.561	.658	1
Satisfaction (S)	**.672**	**.654**	**.689**	**.701**	**.676**	**.580**	**.703**	**.835**

Moreover, all correlations are significant at the 0.01 level, where such an indication serves the second purpose of this analytical step. If insignificant values exist between satisfaction and any of the independent variables, then it will fail to support its assumption and the related hypotheses. Observe that the highest correlation, 0.835, is the correlation score between trust and satisfaction whereas the lowest value is related to operational benefits and employees compliance at 0.415. This observed result is aligned with previous research findings as mentioned in the literature review, where satisfaction is expected to correlate with all adopted constructs.

The bivariate correlations between the independent variables drive our attention to a future opportunity regarding such an influence. As shown in **Table 6**, examples of strong relationships that might yield significant results include: T vs. PCI, PCI vs. MI, FB vs. MIFB vs. T, MI vs. EB. All of these relationships indicate a conceptual option that can be easily and rationally validated.

4.3 Regression Analysis

The final step in analysis toward hypotheses testing in our case is achieved via the multiple regression analysis.

The Multiple Regression (MR) approach is a robust technique when one dependent variable is predicted by a set of independent variables. The MR method used is based on entering all independent variables in the model. Results indicates a significant prediction with a coefficient of determination value of adjusted $R^2 = 0.770$ (value of F 8,210 = 92.03, $p<0.001$). Such an observation infers that the set of independent variables together explains 77% of the variance in EUS.

Table 7 shows the coefficient table of MR analysis.

As shown, results indicate that the five variables that are significant predictors of HMC employee satisfaction include T (trust), EB (economic benefits), OB (operational benefits), S&P (security and privacy) and EC (employee compliance). All p values exceeding the threshold of 0.05 may be considered to be insignificant. The highest significant predictor from the research model as found is trust, while the lowest predictor relates to employee compliance.

Hypotheses *H1, H2, H3, H7* and *H8* receive empirical support, while hypotheses *H4, H5* and *H6* have not been supported.

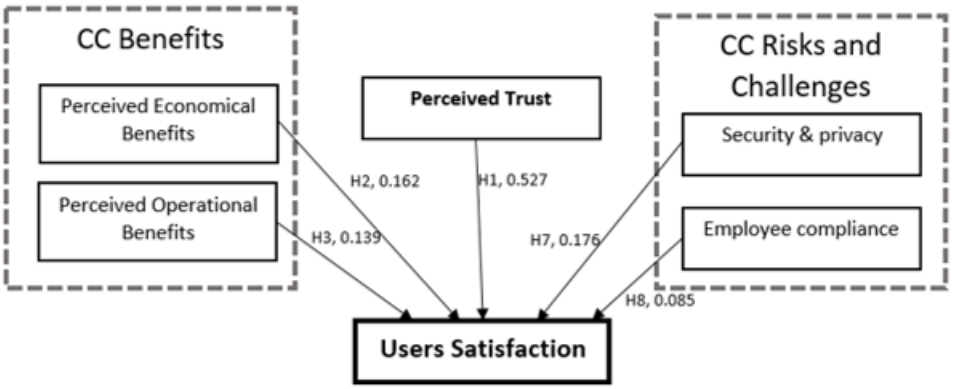
Figure 2 shows the refined research model, where the insignificant predictors have been dropped and the standardized beta values are labelled on the relationships.

Altogether, the study results encompass three dimensions: benefits, challenges/risks, and trust. Clearly, items relating to benefits have been positively related to users satisfaction; yet, not all aspects of anticipated benefits have been appropriately realized by the end-users. Our proposed separation of the three types of benefits to be gained receives only partial support, wherein the functional benefits

Table 7. Multiple Regression Coefficient Table

Predictors	Unstandard. Beta		Standard. Beta	t	Sig.	Hypotheses
	B	Std. Error				
(Constant)	0.045	0.179		0.25	0.801	
Trust (T)	0.547	0.057	0.527	9.64	0.000	H1: Supported
Economic Benefits (EB)	0.177	0.055	0.162	3.21	0.002	H2: Supported
Operational Benefits (OB)	0.128	0.046	0.139	2.77	0.006	H3: Supported
Functional Benefits (FB)	-0.061	0.061	-0.064	-0.99	0.320	H4: Not Supported
Management Issues (MI)	0.047	0.065	0.048	0.72	0.471	H5: Not Supported
Private Cloud Issues (PCI)	-0.031	0.050	-0.037	-0.63	0.528	H6: Not Supported
Security & Privacy (S&P)	0.173	0.047	0.176	3.69	0.000	H7: Supported
Employee Compliance (EC)	0.070	0.034	0.085	2.05	0.042	H8: Supported

Figure 2. Refined Research Model



fail to be valued as a significant predictor. The underlying rationale here may have to do with the content of items and the variable definitions, where participants may have been influenced by the conceptual projections of the presented constructs to more positively viewed mostly the economic and operational factors. In fact, this finding is not surprising as it is also consistent with previous research findings indicating that various industries have the novelty and ability to change by leveraging advanced computing adaptations, standards, and applications, such as CC, in order to gain a superior competitive lead (Blomquist, 2012; Ankeny, 2011).

Beyond benefits, the next dimension relates to perceived risks and challenges facing adopters of innovative technologies such as CC. Again, not all four proposed factors have been fully supported, as only security and privacy and employee compliance are found to be significant predictors. Notably, the security and privacy issues are potent issues whenever CC is being promoted (e.g., Dillon, Wu

& Chang, 2010; Thakur & Awasthi, 2017). Employee compliance closely relates to the employees' behaviour and participating subjects may have been slightly defensive when they are asked to rate item related to their conscious use efforts and attitudes (e.g., Khajeh-Hosseini et al., 2010; Marston et al., 2011). Moreover, the other two factors do not generally relate to their daily practices as end-users, that is, where private cloud issues and management issues are concerned, these items are best handled and realized by the HMC management team.

Finally, trust also is found to be a significant predictor and is, in fact, the highest reported predictor among all independent variables. This result supports many of the previously mentioned research findings as reported earlier (Guimaraes, 2014; Sen, 2013).

The last test conducted aims at comparing the *satisfaction* level of different categories of the responding participants vis-à-vis their demographic factors (Mansour, 2013). Results indicate significant differences between the means of satisfaction across and along the following demographic dimensions: Age (older more than younger), nationality (Qatari more than non-Qatari), and education (high school subjects more than graduate and postgraduate). The specific details of the results and those particular categories with significant differences are highlighted in **Table 8**.

Table 8. ANOVA test results (comparing means)

Factor	Means differences (between-groups)	F	Sig
Gender	No significant differences	0.168	0.682
Age	19-29 (4.097) & 40-49 (4.49)	3.947	0.009
Department	No significant differences	1.935	0.166
Experience	No significant differences	0.993	0.397
Nationality	Qatari (4.81) & Non-Qatari (4.23)	30.02	0.001
Education	High School (4.72) & Graduate (4.26)	6.26	0.001
	High School (4.72) & Postgraduate (4.23)		
Marital Status	No significant differences	0.559	0.456

*Dependent variable: Satisfaction

Table 8 also shows which means are higher; as an example, Qatari subjects reported higher satisfaction level than non-Qatari subjects. The results however also depict contradictory perceptions as older people and lower in educational level report a higher means of satisfaction (i.e., being more satisfied). Here, our argument of managerial issues and private cloud risks and/or challenges appears to be defeated somewhat based on the ANOVA results in that non-significant effects have been recorded for department type, experience, and educational report; in other words, evidential support is lacking. Importantly, such results as presented in **Table 8** should be digest with caution as available resources with respect to the sample size for conducting both the regression and ANOVA tests have been limited.

Second, there is also the issue of unbalanced sample size vis-à-vis the ANOVA testing which may have affected the results based on a violation of certain assumptions. Specifically, the demographic factors applied are unbalanced where the following variables have not been equally distributed within and across the responding subject categories: Age, gender, educational level, nationality, experience, and department. Even so, care is needed when comparing such percentages vis-à-vis the represented Qatari population. On this basis, future studies will be needed vis-à-vis the ANOVA tests to replicate and validate the results we have obtained or to affirm our various conclusions.

Finally, when the factor included more than two categories, Scheffe post hoc test, which is considered a more conservative test, has been applied to secure more precise results. Notwithstanding, our overall findings in terms of the relationships assumed in the study have been generally supported by previous research, although for precise statistical reasoning, the significance of a factor appears to be more dependent on the sample perceptions than the underlying rationale or the associated conceptual foundation.

5. CONCLUSION

As noted, this study addresses three (3) key research questions relating to the benefits, challenges and satisfaction of CC in HMC. In this sense, the study results may be generalizable to large healthcare organizations within the Qatar setting.

A comprehensive literature review is first employed to address the first two research questions (*RQ1 & RQ2*). In Section 3 (Research Method), we summarize the outcome from the literature review in which the perceived benefits and challenges of CC have been grouped into seven major categories: economic benefits, operational benefits, functional benefits, managerial challenges, employee compliance challenges, security-privacy challenges, and private cloud challenges. *RQ3*, the third research question emphasizes HMC employees' perceptions of CC benefits and challenges as well as trust and overall satisfaction with CC adoption.

A research model has been developed vis-à-vis the proposed set of variables, ultimately resulting into a 57-item questionnaire survey instrument administered online to a representative sampling of HMC employees and staff. The study findings support the key role of economic benefits, operational benefits, security-privacy, employee compliance, and trust in predicting the satisfaction of CC users. Conversely, the study results did not significantly support the conceptual and/or perceived influence of management issues, private cloud issues and functional benefits.

All bivariate relationships examined have been found to be significant, and the ANOVA tests conducted to compare across means of various demographic and other relevant variables support partial influence of age and education, and full support for the role of nationality. As per the results, the key role played by CC is its ability to provide equal services to all users, irrespective of their professional levels. The low cost of CC services also contributes to its phenomenal growth in past decades. Finally, it is argued that embracing CC in the Qatari healthcare business will facilitate progress, and enable the achievement of Qatar 2030 vision.

5.1 Implications & Recommendations

The theoretical implications of this study's include the consolidation of prime information regarding the perceived values of CC that would positively influence EUS. Such thinking aligns with the proposed research model vis-à-vis a sociotechnical systems perspective, where technological benefits, and associated risk-challenge perceptions will be major predictors of EUS. Especially in a country like Qatar, such new perspectives on CC add to our knowledge about its impact on adoption and/or implementation.

The practical implications of the study support a better understanding of conditions under which CC is used by HMC end-users. Additionally, the study improves our understanding of how CC may be beneficially applied in HMC and the key issues top management of HMC should explore to improve EUS with CC services. For instance, it appears that economic and operational benefits are key to successful CC adoption while issues related to top management (private cloud and management issues) are not as important to operational daily CC users.

This study contributes to our awareness of the need for a robust and reliable instrument to cover the key issues related to CC implementation in Qatar healthcare setting. Such an instrument may also aid top HMC management team when looking to design effective strategies to enhance CC services, which is a key determinant in achieving high performance. The primary contribution of this study for

both researchers and practicing HMC managers is the need to reinforce the measurable values of CC use and adoption impact. Given the lack of research on the relationships among the variables being studied here, our findings may contribute to add to the knowledge base of the current extant literature.

Importantly, HMC managers need to take actions to improve the utilization of CC. For example, end users at HMC can be instructed on the use of CC services via properly planned training sessions. Moreover, where proper authorization has been granted to trusted individuals to access and use data stored on the cloud, these individuals should be familiar with HMC security guidelines and policies. As well, maintaining patients' privacy is a crucial factor in the medical field; as such, the recommendation to HMC management is that more resources should be assigned to keep the on-going development in CC and its related technologies, along with diverting funds to develop future plans that will aid in eliminating any current obstacles and fears that might inhibit end users from using CC. An internal feedback system in HMC is therefore recommended to evaluate the continuously different aspects of its new technology (in our case, the CC usage activities). Last, the HMC management team should carefully measure the value of longer term CC usage in order to continually improve the performance, quality, and process of such implemented systems.

5.2 Limitations & Future Works

Analysis of the proposed research model attains an $R^2 = 0.77$, which is considered substantial in the social sciences (Hair et al., 1998). Notwithstanding, more factors may be explored in future research. According to past healthcare research reports, agility, flexibility, and accuracy of Internet services to ensure continuous cloud services within an organization like HMC could contribute to additional investigation on EUS. Moreover, HMC is a large healthcare corporation in Qatar, while the survey is only covered responses from 219 individual respondents. Apparently, collecting and evaluating responses from a larger group of HMC's staff to firmly demonstrate the impact of cloud services among HMC users can further extend the current study. In other words, a larger sample size can support our conclusions based on two major factors: First, an excellent representation of population; and second, the need to further overcome the deficiencies of certain analytic and statistical tests (such as normality) based on small sample size issues.

Interestingly, another fertile area for future research exploration is the patient perception of CC-related services. Future studies, for example, may expand and/or readapt the survey instrument while targeting a selective sample of patients to see how their perceptions regarding the utilization of CC in medical sector compare with those of the HMC employees. Still, the theoretical framework must now be modified so as to be adapted to fit with changing and evolving factors that patients may be influenced by in their thinking. As this study fails to strongly support the role of management issues and private cloud issues, it calls for splitting the sample by proposing two distinct research models, one suited for managers and the other for operational users. These two groups of respondents may differ significantly in their understanding of CC issues and thus deserve different methodological treatments. Another limitation of this study is the instrument used, where noticeable difference may be seen in the scoring of means for benefits v. risks. While risks are negative in their connotation, they have been presented with a positive spin in the survey questionnaire. As noted previously, such related issues may have influenced the results of our study.

As for practical implications and future directions related to HMC; we see that hospitals need to focus on the raising awareness regarding the benefits of CC for employees. If we review the items in **Tables 3 & 4**, we see that respondents did not report high perceptions regarding the following challenges facing the organization: managerial issues (items *Q16-Q20*), issues related to private cloud directions (*Q21-Q25*), two of the items related to employees compliance (*Q26 & Q30*), and all items related to security-privacy (*Q31-Q35*). HMC needs to consider raising the awareness regarding CC security and the information privacy of patients and employees. The awareness regarding the contribution of CC in workflow, reports, analytics, and overall work objectives should also be raised.

Had this been the case, we would have expected HMC employees, who reported a moderate perception of the link between CC and HMC strategic directions, to have reacted rather differently.

Based on the relational tests, it appears that HMC needs to focus on trust as it yields the highest beta value among all predictors of satisfaction (beta 0.527). To understand the trust dimension, HMC needs to raise awareness about the security-privacy measures implemented on the patients' information, promote the IT departmental capabilities, provide training on CC and raise further awareness on its new threats and applications, and spell out clearly the procedures for accessibility and control. HMC employees also note in free-style comments the importance of auditing transactions conducted on the medical systems, and the backup procedures. In the end, although much attention has been given to study CC use in Qatar HMC, so much more remaining works appear to be waiting for us to fully understand the impact of adopting CC and other innovative technologies for the healthcare sector in Qatar.

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