Comparing Financial Efficiency and Quality of Care in Telemedicine, and Clinical Visits for Chronic Patients Registered in Primary Healthcare Centers of Makkah, Saudi Arabia

Roaa Mansour M Alhutayli[1], Mahmoud adil shakuri[2], Amani Onayzan Alsaeedi[1], Bashayr Adnan Bajaber[2], Maram Abdullah Almalki[2], Rawan Ismail Filfilan[3], Alaa shawkat Jadidi[4], Rehab Ahmed Alghamdi[1], Meaad Ahmed sulaimani[1], Rahaf Siraj Hayatalhazmi[2], Basel Salem Alsaidi[5]

[1]Family medicine Consultant, primary health care - Makkah health cluster, Saudi Arabia
[2]Family medicine Senior Registrar primary health care Saudi Arabia
[3]Consultant Family medicine, Academic and training affairs- Family medicine Academy, - Makkah health cluster, Saudi Arabia
[4]Senior Registrar Preventive medicine, Primary health care data department, Makkah health cluster, Saudi arabia
[5]General Physician, primary health care - Makkah health cluster, Saudi Arabia

Abstract

Primary healthcare plays a fundamental role in advancing public health, and the evaluation of its effectiveness is crucial part for ongoing enhancement and evolution. The escalating prevalence of non-communicable diseases is placing significant burden on the healthcare resources of both developed and developing countries. The aim of this study is to evaluate the financial efficiency and quality of care provided through telemedicine in virtual clinics compared to traditional clinical visits for chronic patients attending Primary Healthcare Centers (PHCs) in Makkah, Saudi Arabia. This research is using an analytical cross-sectional study design, and it included all adults registered in the HIS for 2023 with DM or HTN. The researcher compared in-person and virtual visit costs and some of the health outcomes. The study included 106,828 participants, with 392,441 visits to Primary Health Centers. The distribution was 52.12% male and 47.88% female, with 53.89% having DM and 46.11% HTN. Education level significantly influences visit preferences ($p = 0.003$), with higher educated participans evenly splitting between in-person and virtual visits, while those with no literacy favored in-person visits. Significant cost differences were observed between in-person and virtual visits ($p < .001$), with in-person visits incurring higher lab test counts and costs. In conclusion, our findings show that virtual visits and telehealth services have lower costs compared to the in-person consultations, with almost identical health outcomes for both groups. Which indicates that the virtual and in-person consultations have comparable quality.

Keywords: Primary healthcare, Saudi Arabia, Chronic diseases, Telemedicine, Clinical visits, Financial efficiency, Healthcare outcomes.

1. Introduction

The World health organization (WHO) describes the primary health care (PHC) as an all-encompassing strategy aimed at enhancing and structuring health systems at a national level, and thus facilitating the access to healthcare services and promoting wellness among communities. This approach provides an individual's comprehensive and holistic health requirements, covering everything from preventive measures and health promotion to treatment, rehabilitation, and sometimes palliative care. Primary health care stands as the cornerstone for achieving universal health coverage, as it is the most comprehensive, equitable, and economical approach. Moreover, it plays a crucial role in boosting the strength of health systems, enabling them to prepare for, manage, and recover from potential emergencies and crises. (WHO, 2018)

The significance of PHCs as per Pan American Health Organization (PAHO) comes from its role as the foundational mechanism driving Universal Health Coverage (UHC), the health-related Sustainable Development Goals (SDGs), and health security. This crucial commitment is highlighted through various key documents, including the Declaration of Astana, World Health Assembly Resolution 72/2, the 2019 Global Monitoring Report on UHC, and the high-level meeting on UHC by the United Nations General Assembly. The goals set forth by UHC, the health-related SDGs, and health security are not only ambitious but also attainable. There is a pressing need to quicken the pace of progress, with PHC serving as the critical pathway for this advancement. (WHA, 2019).

1 Sustainable Health Goals

Through decades, the journey toward sustainable development has been denoted by global collaborations and key milestones. It began with the adoption of Agenda 21 at the Earth Summit in Rio de Janeiro in 1992, aiming for a global partnership for sustainable development. The commitment was continued in the World Summit on Sustainable Development in Johannesburg in 2002, which encompassed poverty eradication and environmental protection, and was repeated at the Rio+20 Conference in 2012 with the proposal to develop the Sustainable Development Goals (SDGs). This was capped in the adoption of the 2030 Agenda for Sustainable Development at the UN Summit in 2015, introducing 17 SDGs as a comprehensive framework for global efforts. Today, the Division for Sustainable Development Goals (DSDG) within the UN Department of Economic and Social Affairs leads these efforts, advocating for widespread implementation and engagement to bring the ambitious 2030 Agenda to fruition (United Nations, 2023).

The United Nations have a vision both ambitious and transformative. This vision encompasses a world eradicated of poverty, hunger, disease, and deprivation, a world where every form of life thrives. The envisioned society doesn't have fear and violence, where universal literacy succeeds, and there is an equitable access to education at all levels, healthcare, and social protection is a reality for all, ensuring the holistic well-being of individuals. In this future, the

human right to safe and potable drinking water and sanitation is right, hygiene standards are elevated, and food is abundant, safe, affordable, and nutritious. Human settlements are safe, resilient, and sustainable, with universal access to affordable, reliable, and sustainable energy.

2 Current Situation in Saudi Arabia

Within the Kingdom of Saudi Arabia, the rich cultural and traditional society, deeply rooted in Islamic teachings and Arab customs, has significantly influenced its society for centuries, including the healthcare sector (Long, 2005). This heritage is reflected in the kingdom's governance and extends to its healthcare system, which is emphasized by Islamic principles of justice, consultation, and equality (Bureau of Experts at the Council of Ministers, 1991). These great values shape the legal and social frameworks and also guide the operational and ethical standards within the healthcare sector. Consequently, the health services in Saudi Arabia are filled with a commitment to equity, patient rights, and community engagement, reflecting the kingdom's cultural and religion.

The influence of Saudi Arabia's centralized tradition is particularly evident within its healthcare services, where the societal norms and traditions play a pivotal role in shaping the structure and operation of healthcare organizations (Albougami, 2015; Almutairi, 2015). From primary healthcare centers to specialized hospitals, the delivery of health services is significantly influenced by the cultural and religious context of the country. This includes aspects such as language and communication, which are crucial in ensuring the quality of care, especially given the diverse workforce that includes expatriate nurses (Albougami, 2015).

Furthermore, the challenge of cultural and language differences underscores the need for sensitivity and adaptability in the provision of healthcare, highlighting the barriers that can arise when healthcare professionals and patients do not share the same cultural or linguistic background (Almutairi, 2015). This situation calls for targeted strategies to overcome such barriers, ensuring that all individuals receive the highest standard of care, irrespective of their cultural or linguistic background.

In essence, the culture and traditions of Saudi Arabia, rooted deeply in Islamic law, exert a profound influence on the fabric of the kingdom's society, including its healthcare system. The principles of Islam, along with the distinctive Saudi traditions, form the backbone of organizational cultures within the country, dictating the manner in which healthcare services are structured and delivered. Acknowledging and understanding this cultural context is crucial for healthcare professionals operating within Saudi Arabia, as it directly impacts the effectiveness, accessibility, and quality of healthcare services provided to the population.

2. Research Analysis and Results

Descriptive Analysis

Descriptive analysis for the total population

Table 4-0-1 total population descriptive table

Clinic_Name	Visits count	Patients count	Gender	Average of Age	morbidities
Family Medicine Clinic	88944	24183	Female	55.97	DM
Family Medicine Clinic	85797	22987	Female	59.05	HTN
Family Medicine Clinic	112016	29004	Male	55.97	DM
Family Medicine Clinic	90788	22829	Male	58.09	HTN
Family Medicine Virtual Clinic	3911	2173	Female	55.12	DM
Family Medicine Virtual Clinic	3263	1807	Female	58.85	HTN
Family Medicine Virtual Clinic	4438	2206	Male	52.14	DM
Family Medicine Virtual Clinic	3284	1639	Male	54.65	HTN
	392441	106828			

The table presents data collected from a Family Medicine Clinic, including both in-person and virtual visits, segmented by gender and specific morbidities—Diabetes Mellitus (DM) and Hypertension (HTN). The total number of male patients is 55,678, 52.12% . and female patients are 51,150, 47.88% For conditions, there are 57,566 ,53.89% patients with DM and 49,262, 46.11% with HTN.

The in-person Family Medicine Clinic recorded a total of 88,944 visits from 24,183 female patients with an average age of 55.97 years, all diagnosed with DM. Additionally, there were 85,797 visits from 22,987 female patients with an average age of 59.05 years, diagnosed with HTN. Male patients visiting the same clinic included 112,016 visits by 29,004 individuals with an average age of 55.97 years, diagnosed with DM, and 90,788 visits by 22,829 individuals with an average age of 58.09 years, diagnosed with HTN.

In the virtual setting, the Family Medicine Virtual Clinic had 3,911 visits from 2,173 female patients with an average age of 55.12 years, diagnosed with DM, and 3,263 visits from 1,807 female patients with an average age of 58.85 years, diagnosed with HTN. Male patients in the virtual clinic included 4,438 visits by 2,206 individuals with an average age of 52.14 years, diagnosed with DM, and 3,284 visits by 1,639 individuals with an average age of 54.65 years, diagnosed with HTN.

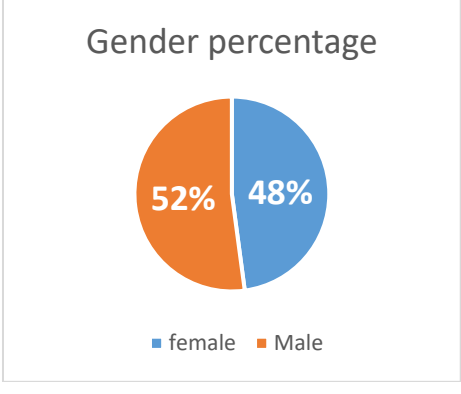

Figure 4 2 Pie chart for gender.

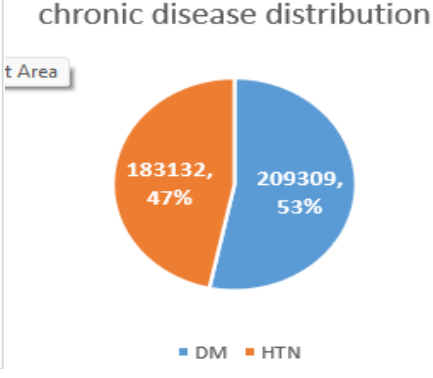

Figure 4 1 Pie chart for chronic disease

Table 0-2 virtual patients and visits

virtual patients	virtual visits	average per year	per month
174	1511	8.683908046	0.723659

Table 0-3 in-person patients and visits

in person patients	In person visits	average per year	per month
332	7868	23.69879518	1.9748996

Table (4-2) provides statistics for virtual patient visits at Makkah's Primary Healthcare Centers (PHCs), including the number of virtual patients, visits, and average visits per year and month. On average, virtual patients visited the PHCs about 8.68 times per year, equivalent to approximately 0.72 visits per month. Table (4-3) presents data on in-person patient visits, displaying the corresponding figures for in-person patients and visits, with an average of 23.70 visits per year and 1.97 visits per month.

Descriptive Analysis for the chosen sample

Table 0-4 Descriptive Demography for the sample chosen.

category	person and virtual	Valid	Missing	Mean	Std. Deviation	Minimum	Maximum
visits	person	604	0	12.917	15.219	1	105
visits	virtual	173	0	8.723	6.086	1	67
Age	person	604	0	46.925	13.806	20	97
Age	virtual	173	0	54.445	14.989	22	86
BMI	person	601	3	31.618	29.99	9.5	168.691
BMI	virtual	155	18	32.831	21.209	15.29	250
DBP	person	593	11	89.4	15.524	42	113.53
DBP	virtual	155	18	79.758	5.88	60	110.67
SBP	person	593	11	131.34	32.597	79.67	191.83
SBP	virtual	155	18	126.246	11.944	113	204

Table 4-4 provided that the average number of visits for in-person and virtual consultations. the average number of visits was 12.917 for in-person and 8.723 for virtual per year, with respective standard deviations of 15.219 and 6.086. The mean age for in-person visits was 46.925 (SD = 13.806), and for virtual visits, it was 54.445 (SD = 14.989). The Body Mass Index (BMI) averages were 31.618 (SD = 29.99) for in-person and 32.831 (SD = 21.209) for virtual consultations. Diastolic Blood Pressure (DBP) mean values adjusted to 89.4 (SD = 15.524) for in-person and 79.758 (SD = 5.88) for virtual, while Systolic Blood Pressure (SBP) averages were 131.34 (SD = 32.597) for in-person and 126.246 (SD = 11.944) for virtual, demonstrating refined averages across the board.

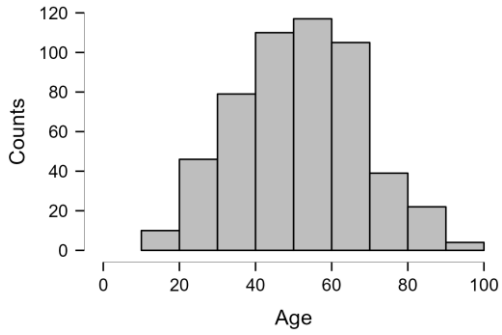

Figure 0- 0-1 Bar-chart showing age distribution among in-person visits

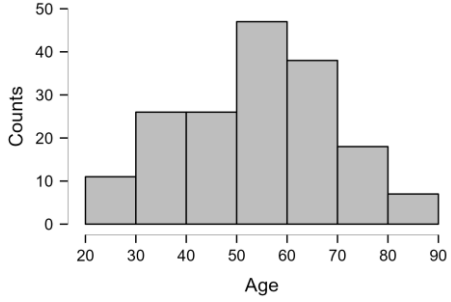

Figure 0-2 Bar-chart showing age distribution among virtual visits

Table 0-5 T-test comparing age visits between in-person and virtual visits

Column1	Test	Statistic	df	p
Age	Student	-1.7	703	0.09
	Mann-Whitney	41778		0.068

Table 0-6 test of normality of age distribution showing deviation from normality

category	Type of visit	W	P
Age	person	0.992	0.005
	virtual	0.981	0.02

Table 4.5 shows that when comparing the ages of patients attending in-person versus virtual visits, the T-test reveals no significant difference, while the Mann-Whitney test hints at a difference, though not strongly significant. The choice of Mann-Whitney is supported by Table 4.6, which indicates non-normal age distributions for both visit types, justifying the use of this non-parametric test over the T-test.

Table 0-7 Distribution of visits type based on the chronic diagnosis of visitors

Type	DM	HTN	both	Total
In-person visitors	83	51	185	319
Virtual visitors	55	20	94	169
Total	138	71	279	488

Table 0-8 chi-square test of chronic diagnosis of visitors

Chi-Squared Tests	value	df	P value
X^2	3.082	2	0.214
N	488		

Table 4.7 categorizes visit types by chronic conditions, with in-person visits at 319 and virtual visits at 169. The majority of both are patients with both DM and HTN.

Table 4.8's chi-square test, with a value of 3.082 and a p-value of 0.214, suggests no significant link between visit type and chronic condition among the 488 patients examined.

Table 0-9 Nationality distribution among the sample

Nationality	in-person	virtual	Total
AFGHANISTAN	3	1	4
	0.386 %	0.129 %	0.515 %
ALGERIA	1	0	1
	0.129 %	0.000 %	0.129 %
BANGLADESH	11	4	15
	1.416 %	0.515 %	1.931 %
CHAD	1	0	1
	0.129 %	0.000 %	0.129 %
EGYPT	10	5	15
	1.287 %	0.644 %	1.931 %
ETHIOPIA	2	0	2
	0.257 %	0.000 %	0.257 %
INDIA	3	1	4
	0.386 %	0.129 %	0.515 %
JORDAN	1	0	1
	0.129 %	0.000 %	0.129 %
LIBYAN ARAB JAMAHIRIYA	1	0	1
	0.129 %	0.000 %	0.129 %
MALI	2	0	2
	0.257 %	0.000 %	0.257 %
MYANMAR	1	1	2
	0.129 %	0.129 %	0.257 %
NIGERIA	2	1	3
	0.257 %	0.129 %	0.386 %
PAKISTAN	11	8	19
	1.416 %	1.030 %	2.445 %
PALESTINIAN TERRITORY, OCCUPIED	2	0	2
	0.257 %	0.000 %	0.257 %
SAUDI ARABIA	520	139	659
	66.924 %	17.889 %	84.813 %
SUDAN	12	0	12
	1.544 %	0.000 %	1.544 %
SYRIAN ARAB REPUBLIC	3	0	3
	0.386 %	0.000 %	0.386 %
TURKEY	1	0	1
	0.129 %	0.000 %	0.129 %
UNKNOWN	1	2	3
	0.129 %	0.257 %	0.386 %
YEMEN	16	11	27

	2.059 %	1.416 %	3.475 %
Total	604	173	777

Table 4-9 provides a breakdown of patient nationalities attending in-person and virtual visits at Primary Healthcare Centers (PHCs) in Makkah, Saudi Arabia. It shows the number and percentage of patients from different countries for each visit type. The most significant numbers are observed among Saudi Arabian nationals, with 520 patients attending in-person visits and 139 patients opting for virtual visits, totaling 659 individuals.

Table 0-10 Educational status

Education Status	Column1	person	virtual	Total
Higher Education	Count	11	2	13
	Expected count	10.795	2.205	13
	% within column	1.937 %	1.724 %	1.901 %
Illiterate	Count	108	8	116
	Expected count	96.327	19.673	116
	% within column	19.014 %	6.897 %	16.959 %
Intermediate Education	Count	61	8	69
	Expected count	57.298	11.702	69
	% within column	10.739 %	6.897 %	10.088 %
Primary Education	Count	88	18	106
	Expected count	88.023	17.977	106
	% within column	15.493 %	15.517 %	15.497 %
Secondary Education	Count	75	11	86
	Expected count	71.415	14.585	86
	% within column	13.204 %	9.483 %	12.573 %
University	Count	53	17	70
	Expected count	58.129	11.871	70
	% within column	9.331 %	14.655 %	10.234 %
Unknown	Count	172	52	224
	Expected count	186.012	37.988	224
	% within column	30.282 %	44.828 %	32.749 %
Total	Count	568	116	684

Table 0-11 chi-square test comparing the education status with type of visits

Column1	Value	df	p
X^2	19.726	6	0.003
N	684		

Incorporating the significant findings from Tables 4-10 and 4-11 and highlighted by a critical chi-square result ($X^2 = 19.726$, $df = 6$, $p = 0.003$), the analysis in Table 4-10 demonstrates that education level significantly impacts healthcare visit preferences. Higher Education respondents exhibit a balanced distribution between in-person and virtual visits, suggesting a level of ease with both modalities. Conversely, the Illiterate cohort strongly prefers in-person visits, reflecting potential barriers to virtual healthcare access, as indicated in Table 4-11. Intermediate and Primary Education groups show a propensity for in-person visits, aligning well with projected trends. Remarkably, individuals with University education display a greater inclination towards virtual visits, indicating that higher educational attainment may be associated with increased engagement with virtual healthcare services. This comprehensive overview, informed by the

detailed examinations of Tables 4-10 and 4-11, underscores a discernible trend where educational background significantly influences the choice of healthcare access methods.

Table 0-12 Occupation status

Occupation	Column1	person	virtual	Total
Administration	Count	0	1	1
	% of total	0.000 %	0.141 %	0.141 %
Education	Count	1	0	1
	% of total	0.141 %	0.000 %	0.141 %
Housewife	Count	4	0	4
	% of total	0.565 %	0.000 %	0.565 %
Others	Count	3	1	4
	% of total	0.424 %	0.141 %	0.565 %
Private sector	Count	47	15	62
	% of total	6.638 %	2.119 %	8.757 %
Public/Government sector (MOH)	Count	5	0	5
	% of total	0.706 %	0.000 %	0.706 %
Public/Government sector (military)	Count	12	3	15
	% of total	1.695 %	0.424 %	2.119 %
Public/Government sector (non-military)	Count	65	9	74
	% of total	9.181 %	1.271 %	10.452 %
Retired	Count	37	14	51
	% of total	5.226 %	1.977 %	7.203 %
Self-employed	Count	13	3	16
	% of total	1.836 %	0.424 %	2.260 %
Student	Count	1	0	1
	% of total	0.141 %	0.000 %	0.141 %
Unemployed	Count	383	88	471
	% of total	54.096 %	12.429 %	66.525 %
Unknown	Count	2	1	3
	% of total	0.282 %	0.141 %	0.424 %
Total	Count	573	135	708

Table 0-13 chi-square tests comparing occupation to type of visits

Column1	Value	df	p
X^2	13.042	12	0.366
N	708		

Table 4-12 shows occupation status related to healthcare visit types, highlighting a significant number of unemployed individuals preferring in-person visits. While there are noticeable preferences for in-person visits among various occupation groups, the differences in visit type preference across occupations are not statistically significant. This is supported by Table 4-13, where the chi-square test ($X^2 = 13.042$, df = 12, p = 0.366) indicates no significant association between occupation and visit type, suggesting occupation does not significantly influence whether individuals choose in-person or virtual healthcare services.

Comparative analysis (T-tests) for Costs of visits

Physicians cost analysis

Table 0-14 visits type distribution based on physician level

job		In-person	virtual	Total
Registrar	Count	1448	784	2232
	% within column	28.989 %	59.756 %	35.389 %
Resident	Count	3045	437	3482
	% within column	60.961 %	33.308 %	55.208 %
consultant	Count	502	91	593
	% within column	10.050 %	6.936 %	9.402 %
Total	Count	4995	1312	6307

Table 0-15 chi-square test for physician level compared to type of visit

Column1	Value	df	p
X^2	432.577	2	< .001
N	6307		

Table 4-14 reveals that Resident physicians predominantly conduct in-person visits, while Registrars are more involved in virtual visits. Consultants have the least involvement in both types. The overall trend favors in-person visits. Table 4-15 confirms this observation with a significant chi-square test result ($X^2 = 432.577$, $df = 2$, $p < .001$), indicating a strong association between the physician's level and the visit type, showcasing clear preferences based on the physician's rank.

Table 0-16 cost of physicians' consultation based on type of visits

Column1	in-person visitors	virtual visitors
Valid	320	170
Mean	1956.094	1055.882
95% CI Mean Upper	2145.959	1174.277
95% CI Mean Lower	1766.229	937.487
Std. Deviation	1726.318	781.968
Minimum	100	100
Maximum	9450	8450

The table shows in-person visitors (320) outnumber virtual visitors (170). In-person visitors have a higher average measure (1956.094) compared to virtual visitors (1055.882), with broader variability indicated by a larger standard deviation. The ranges, shown by the 95% confidence intervals, also highlight this difference, with in-person having both higher lows and highs. Minimum values are the same for both groups, but in-person visitors reach a higher maximum value, suggesting greater extremes in their associated metric.

Table 0-17 T-test comparing types of visits total physicians consultation cost

	Test	Statistic	df	p	Effect Size	SE Effect Size	95% CI Lower	95% CI Upper
Physicians' total cost	Student	6.454	488	< .001	0.613	0.098	0.422	0.802
	Mann-Whitney	34935.5		< .001	0.284	0.055	0.183	0.38

Table 0-18 Test of Equality of Variances (Brown-Forsythe)

	F	df_1	df_2	p
total cost	53.998	1	488	< .001

Table 4-17 reveals significant differences in physicians' total consultation costs between in-person and virtual visits, underscored by strong evidence from both Student's t-test ($t = 6.454$, $p < .001$) and the Mann-Whitney test ($U = 34935.5$, $p < .001$), which points to a clear discrepancy in costs. However, given the significant variance in costs demonstrated by the Brown-Forsythe test ($F = 53.998$, $p < .001$) in Table 4-18, the researcher opt to consider the results of the Mann-Whitney test as more appropriate for our analysis.

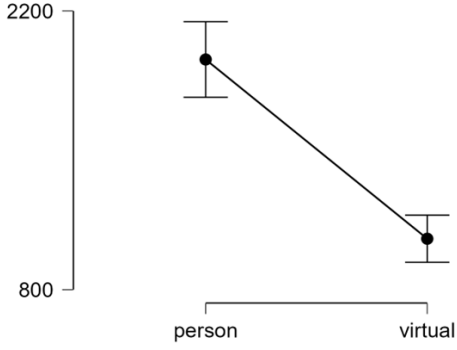

Table 4 19 Mean plot graph showing mean difference in physicians cost by type of visits.

Laboratory tests cost analysis

Table 0-19 Laboratory tests count and cost for both types of visitors

	count of in person visitors lab tests	count of virtual visitors lab tests	cost of in person visitors lab tests	cost of virtual visitors lab tests
Valid	328	173	328	173
Mean	5.351	3.312	350.933	193.642
Std. Deviation	6.338	5.37	402.751	304.22
Minimum	0	0	0	0
Maximum	28	21	1827	1128

Table 4-20 compares laboratory test counts and costs between in-person and virtual visitors. In-person visitors had an average of 5.351 lab tests per visit with a mean cost of 350.933 SAR, while virtual visitors averaged 3.312 lab tests per visit at a lower mean cost of 193.642 SAR. The standard deviation indicates greater variability in both test counts and costs for in-person visitors compared to virtual ones. The maximum number of lab tests and the highest lab test cost were also higher for in-person visits (28 tests and 1827 SAR, respectively) than for virtual visits (21 tests and 1128 SAR, respectively). This data suggests that in-person visits tend to involve more lab tests and incur higher costs compared to virtual visits.

Table 0-20T-test analysis comparing count of labs between the two types of visitors.

	Test	Statistic	df	p
Count of Lab tests	Student	3.603	499	< .001
	Mann-Whitney	36393		< .001

Table 0-21 test of equality of variances (Brown-Forsythe)

	F	df_1	df_2	p
Count of Labs	11.3	1	499	< .001

Given the significant variance in lab test counts between in-person and virtual visits, as highlighted by the Brown-Forsythe test in Table 4-22 ($F = 11.3$, $p < .001$), the data suggest a non-normal distribution. Therefore, the Mann-Whitney test, which does not assume data normality, is more appropriate for our analysis. Table 4-21's Mann-Whitney result ($U = 36393$, $p < .001$) indicates a significant difference in the number of lab tests between the two types of visits. Based on this, we'll consider the Mann-Whitney test's findings as more relevant, reflecting the actual impact of visit type on the count of laboratory tests conducted, especially given the non-normal distribution of the data.

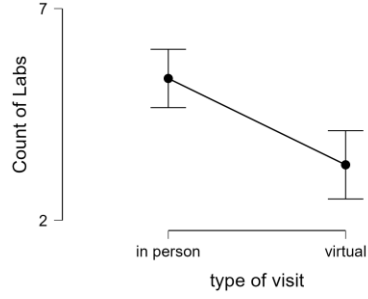

Figure 0-3 mean plot showing the mean of laboratory count for the type of visitors.

Table 0-22 T-test comparison between types of visitors cost of laboratory tests

	Test	Statistic	df	p
Laboratory tests costs	Student	4.503	499	< .001
	Mann-Whitney	36809.5		< .001

Table 0-23 Test of Equality of Variances (Brown-Forsythe)

	F	df_1	df_2	p
Sum of lab cost	16.307	1	499	< .001

Table 4-23 demonstrates that the Mann-Whitney test reveals significant differences in the cost of laboratory tests between in-person and virtual visitors ($p < .001$), highlighting a distinct economic impact of visit type on healthcare services. This significant difference in laboratory test costs is further supported by the results from Table 4-24, which shows a significant variance in lab test costs ($F = 16.307$, $p < .001$), indicating a non-normal distribution of the data. The non-normal distribution led us to prioritize the Mann-Whitney test for our analysis, as it is more suitable for data that does not follow a normal distribution, thus providing a more accurate reflection of the costs associated with different types of visits.

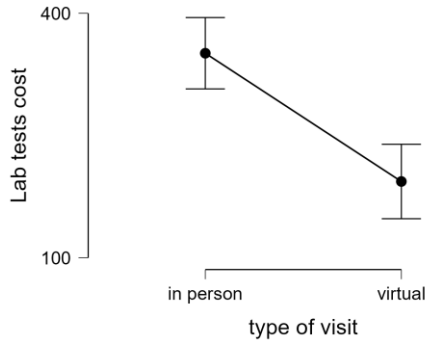

Figure 0-4 mean plot showing the mean of laboratory cost for the type of visitors

Clinical outcomes analysis

Table 0-24 descriptive statistics for HA1c test results for both groups

	Virtual	person
Valid	83	462
Missing	2	4
Mean	7.821	7.943
Std. Deviation	1.813	1.839
Minimum	4.6	4.7
Maximum	13.6	13.2

The summary of HbA1c levels for virtual (83 valid, 2 missing) and in-person visits (462 valid, 4 missing) reveals slight differences in average levels (7.821 for virtual vs. 7.943 for in-person) and similar variability (standard deviations around 1.8 for both). The range of HbA1c levels extends from 4.6 to 13.6 for virtual visits and 4.7 to 13.2 for in-person visits, indicating a broad variability within each group despite the minor difference in averages.

Table 0-25 Independent Samples T-Test comparing HA1c results between types of visits

	Test	Statistic	df	p	Effect Size	SE Effect Size	95% CI Lower	95% CI Upper
HA1c	Student	-0.56	543	0.576	-0.067	0.119	-0.3	0.167
	Mann-Whitney	18304.5		0.511	-0.045	0.069	-0.178	0.089

Table 0-26 Test of Normality (Shapiro-Wilk)

	Type of visit		W	p
HA1c	Virtual	0.949	0.002	0.002
	In-person	0.965	< .001	< .001

Table 4-25 presents an Independent Samples T-Test and Mann-Whitney test comparing HbA1c results between in-person and virtual visits. Neither test shows a statistically significant difference in HbA1c levels between the two groups, with p-values of 0.576 for the Student's t-test and 0.511 for the Mann-Whitney test. This suggests that the type of visit (in-person vs. virtual) does not significantly impact HbA1c results. The effect sizes are small and the confidence intervals include zero, further indicating no significant difference.

Table 4-26's Test of Normality (Shapiro-Wilk) for HbA1c results reveals that data for both virtual ($W = 0.949$, $p = 0.002$) and in-person visits ($W = 0.965$, $p < .001$) significantly deviate from normal distribution.

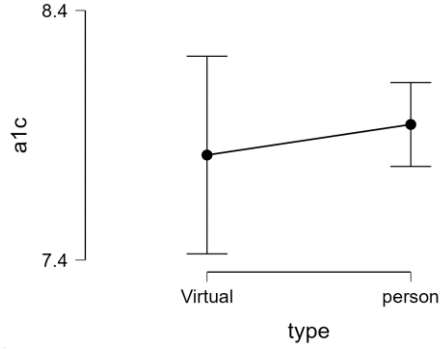

Figure 0-5 mean plot showing differences between in-person and virtual visits.

Table 0-27 Descriptive statistics for BP measurements

	Group	N	Mean	SD	SE	Coefficient of variation
Average of SBP	person	327	136.343	16.172	0.894	0.119
	virtual	155	126.246	11.944	0.959	0.095
Average of DBP	person	327	74.01	8.117	0.449	0.11
	virtual	155	79.758	5.88	0.472	0.074
MAP	person	327	94.787	9.395	0.52	0.099
	virtual	155	95.254	6.645	0.534	0.07

Table 4-28 shows blood pressure measurements and indicate slight differences between in-person and virtual visits. In-person visits show a higher average systolic blood pressure (SBP) of 136.343 mmHg compared to virtual visits at 126.246 mmHg, with in-person visits also displaying slightly more variability. Conversely, diastolic blood pressure (DBP) averages lower for in-person visits (74.01 mmHg) than for virtual (79.758 mmHg), with in-person visits showing greater variability. Mean arterial pressure (MAP) remains nearly identical between groups, with in-person at 94.787 mmHg and virtual at 95.254 mmHg, though in-person visits exhibit marginally more variability. These findings underscore nuanced differences in BP readings between visit types, with potential implications for healthcare management and monitoring.

Table 0-28 Independent Samples T-Test comparing BP measurements of SBP, DBP and MAP.

	Test	Statistic	df	p	Effect Size	SE Effect Size	95% CI Lower	95% CI Upper
Average of SBP	Student	6.971	481	< .001	0.68	0.101	0.483	0.875
	Mann-Whitney	37939.5		< .001	0.493	0.056	0.404	0.572
Average of DBP	Student	0.652	481	0.515	0.064	0.098	-0.128	0.255
	Mann-Whitney	13157.5		< .001	-0.482	0.056	-0.563	-0.393
MAP	Student	0.683	481	0.495	0.067	0.098	-0.125	0.258
	Mann-Whitney	24794		0.662	-0.025	0.056	-0.134	0.086

Table 0-29

	F	df_1	df_2	p
Average of SBP	29.873	1	481	< .001
Average of DBP	0.496	1	481	0.482
MAP	0.516	1	481	0.473

Table 4-29 presents the results of an Independent Samples T-Test comparing blood pressure (BP) measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) between two groups. For SBP, both the Student's t-test ($t = 6.971$, $p < .001$) and Mann-Whitney test ($U = 37939.5$, $p < .001$) show significant differences, with moderate effect sizes suggesting substantial distinctions in SBP between the groups. Conversely, for DBP, neither test indicates significant differences, with p-values of 0.515 for the t-test and < .001 for the Mann-Whitney test. MAP results are also nonsignificant, with p-values of 0.495 and 0.662 for the t-test and Mann-Whitney test, respectively. Table 4-30 further confirms the significant difference in SBP between groups, with an F-value of 29.873 ($p < .001$), while DBP and MAP do not show significant differences based on the F-test results. These findings suggest that while SBP significantly differs between groups, DBP and MAP do not exhibit notable distinctions.

3. Conclusion

In conclusion, this study was designed to compare the costs and health outcomes of two types of PHC visits in Makkah, Saudi Arabia, in 2023, specifically targeting patients with Hypertension (HTN) and Diabetes Mellitus (DM). The researcher analyzed the costs associated with PHC visits, including physician fees and laboratory tests, and assessed the health outcomes through basic metrics for the two diseases: blood pressure readings and HbA1c levels.

The research findings indicate that the costs were lower for the group utilizing virtual visits and telehealth services, while the health outcomes were similar between the two groups. This parity in health outcomes suggests that the quality of services provided via virtual consultations matches that of in-person visits. Therefore, the researcher can conclude that telehealth is a cost-effective alternative to traditional in-person care without compromising the quality of healthcare delivered to patients with HTN and DM in Makkah. This study supports the broader implementation of telehealth solutions in the region, especially considering the economicand accessibility benefits demonstrated.

WORKS CITED

Academy of Medical Royal Colleges. (2012). The benefits of consultant-delivered care. London: AMRC. Retrieved from http://aomrc.org.uk/publications/statements/doc_download/9450-the-benefits-of-consultant-delivered-care.html (Accessed June 7, 2013).

Aldakhil, M. (2012). Saudi food guide: palm healthy food. Riyadh: Ministry of Health.

Albougami, A. (2015). Role of language and communication in providing quality healthcare by expatriate nurses in Saudi Arabia. Journal of Health Specialties, 3(3), 166. https://doi.org/10.4103/1658-600x.159898

Declaration of Alma-Ata International Conference on Primary Health Care, Alma-Ata, USSR, 6–12 September 1978. (2004, June). Development, 47(2), 159–161. https://doi.org/10.1057/palgrave.development.1100047

Almutairi, K. M. (2015). Culture and language differences as a barrier to provision of quality care by the health workforce in Saudi Arabia. Saudi Medical Journal, 36(4), 425–431. https://doi.org/10.15537/smj.2015.4.10133

Al-Sakkak, M. A., Al-Nowaiser, N. A., Al-Khashan, H. I., Al-Abdrabulnabi, A. A., & Jaber, R. M. (2008). Patient satisfaction with primary health care services in Riyadh. *Saudi Medical Journal, 29*(3), 432-436. PMID: 18327374.

American Telemedicine Association - ATA. (2024, February 26). ATA. https://www.americantelemed.org/

Al Asmri, M., Almalki, M., Fitzgerald, G., & Clark, M. (2020, April 1). The public health care system and primary care services in Saudi Arabia: a system in transition. Eastern Mediterranean Health Journal, 26(04), 468–476. https://doi.org/10.26719/emhj.19.049

Atkinson, S., & Haran, D. (2005, February). Individual and district scale determinants of users' satisfaction with primary health care in developing countries. Social Science & Medicine, 60(3), 501–513. https://doi.org/10.1016/j.socscimed.2004.05.019

Batbaatar, E., Dorjdagva, J., Luvsannyam, A., Savino, M.M., & Amenta, P. (2016). Determinants of patient satisfaction: a systematic review. Perspectives in Public Health, 137(2), 89–101. doi:10.1177/1757913916634136.

Bureau of Experts at the Council of Ministers. (1991). [Basic Law of Governance – Saudi Arabia]. Riyadh: The Council of Ministers. Retrieved from https://laws.boe.gov.sa/BoeLaws/Laws/LawDetails/16b97fcb-4833-4f66-8531-a9a700f161b6/2 (Accessed August 24, 2019).

Cabrera-Barona, P., Blaschke, T., & Kienberger, S. (2017). Explaining Accessibility and Satisfaction Related to Healthcare: A Mixed-Methods Approach. *Social Indicators Research, 133*(2), 719-739. https://doi.org/10.1007/s11205-016-1371-9.

Camgöz-Akdağ, H., & Zineldin, M. (2010, April 27). Quality of health care and patient satisfaction. Clinical Governance: An International Journal, 15(2), 92–101. https://doi.org/10.1108/14777271011035031

Campbell, S. M., Reeves, D., Kontopantelis, E., Sibbald, B., & Roland, M. (2009, July 23). Effects of Pay for Performance on the Quality of Primary Care in England. New England Journal of Medicine, 361(4), 368–378. https://doi.org/10.1056/nejmsa0807651

Cheng, C., Humphreys, H., & Kane, B. (2022). Transition to telehealth: Engaging medical students in telemedicine healthcare delivery. *Irish Journal of Medical Science, 191*(5), 2405-2422. https://doi.org/10.1007/s11845-021-02720-1.

Crow, R., Gage, H., Hampson, S., Hart, J., Kimber, A., Storey, L., et al. (2002). The measurement of satisfaction with healthcare: implications for practice from a systematic review of the literature. Health Technology Assessment, 6, 1–244.

Saudi Ministry of Health. (2014). Diabetes at-a-glance: Saudi Health Information Survey for non-communicable diseases in the Kingdom of Saudi Arabia. Riyadh, Saudi Arabia.

DONABEDIAN, A. (1996). The Effectiveness of Quality Assurance. International Journal for Quality in Health Care, 8(4), 401–407. https://doi.org/10.1093/intqhc/8.4.401

Cartwright, W. S. (1999, March). Methods for the economic evaluation of health care programmes, second edition. By Michael F. Drummond, Bernie O'Brien, Greg L. Stoddart, George W. Torrance. Oxford: Oxford University Press, 1997. The Journal of Mental Health Policy and Economics, 2(1), 43–43. http://dx.doi.org/10.1002/(sici)1099-176x(199903)2:1<43::aid-mhp36>3.0.co;2-7

Evans, D. B., Hsu, J., & Boerma, T. (2013, August 1). Universal health coverage and universal access. Bulletin of the World Health Organization, 91(8), 546-546A. https://doi.org/10.2471/blt.13.125450.

Fielding, R., Kause, J., Arnell-Cullen, V., & Sandeman, D. (2013). The impact of consultant-delivered multidisciplinary inpatient medical care on patient outcomes. *Clinical Medicine (London), 13*(4), 344-348. https://doi.org/10.7861/clinmedicine.13-4-344.

Green, A., & Davis, S. (2005, April). Toward a predictive model of patient satisfaction with nurse practitioner care. Journal of the American Academy of Nurse Practitioners, 17(4), 139–148. https://doi.org/10.1111/j.1041-2972.2005.0022.x

Gulliford, M., Figueroa-Munoz, J., Morgan, M., Hughes, D., Gibson, B., Beech, R., & Hudson, M. (2002, July 1). What does "access to health care" mean? Journal of Health Services Research & Policy, 7(3), 186–188. https://doi.org/10.1258/135581902760082517

Health statistics annual book, 2009. Riyadh: Ministry of Health.

Health statistics annual book 2013. Riyadh: Ministry of Health.

Hekkert, K. D., Cihangir, S., Kleefstra, S. M., van den Berg, B., & Kool, R. B. (2009, July). Patient satisfaction revisited: A multilevel approach. Social Science & Medicine, 69(1), 68–75. https://doi.org/10.1016/j.socscimed.2009.04.016.

Kersnik, J. (2001, August). Determinants of customer satisfaction with the health care system, with the possibility to choose a personal physician and with a family doctor in a transition country. Health Policy, 57(2), 155–164. https://doi.org/10.1016/s0168-8510(01)00118-x

Kim, S., & Kim, S. (2007, June). Interpersonal Caring: A Theory for Improved Self-Esteem in Patients with Long-Term Serious Mental Illness – I. Asian Nursing Research, 1(1), 11–22. https://doi.org/10.1016/s1976-1317(08)60005-5.

Lauer, J.A., et al. (2017). Paying for Needed Health Workers for the SDGs: An Analysis of Fiscal and Financial Space. In: Health Employment and Economic Growth: An Evidence Base. World Health Organization.

Long, D.E. (2005). Culture and customs of Saudi Arabia. Westport, CT: Greenwood Press.

Mahler, H. (2008). Primary health care comes full circle. Bulletin of the World Health Organization, 86, 747–748. doi:10.2471/BLT.08.041008.

McVeigh, T. (2016). South Africa's Latest Weapon Against HIV: Street Dispensers for Antiretrovirals. The Guardian. July 17. Retrieved from https://www.theguardian.com/world/2016/jul/17/atms-dispense-antiretrovirals-south-africa-hiv.

Ministry of Health Saudi Arabia. Licensing Requirements for Pharmacies. Retrieved from https://www.moh.gov.sa/en/Ministry/Rules/Pages/default.aspx. Published September 1, 2023.

Morrison, F. (2011, September 26). Encounter Frequency and Serum Glucose Level, Blood Pressure, and Cholesterol Level Control in Patients With Diabetes Mellitus. Archives of Internal Medicine, 171(17), 1542. https://doi.org/10.1001/archinternmed.2011.400

Naidu, A. (2009, June 12). Factors affecting patient satisfaction and healthcare quality. International Journal of Health Care Quality Assurance, 22(4), 366–381. https://doi.org/10.1108/09526860910964834

Johnstone, I. (2021, December 1). Organisation for Economic Co-operation and Development (OECD). Yearbook of International Environmental Law, 32(1), 284–289. https://doi.org/10.1093/yiel/yvac037

Otani, K., Kurz, R. S., & Harris, L. E. (2005, September). Managing Primary Care Using Patient Satisfaction Measures. Journal of Healthcare Management, 50(5), 311–324. https://doi.org/10.1097/00115514-200509000-00007

Palladino, R., Lee, J. T., Hone, T., Filippidis, F. T., & Millett, C. (2016, July). The Great Recession And Increased Cost Sharing In European Health Systems. Health Affairs, 35(7), 1204–1213. https://doi.org/10.1377/hlthaff.2015.1170

A view from the World Health Organization: Primary care. (1980, August). Journal of Public Health. https://doi.org/10.1093/oxfordjournals.pubmed.a043331