

IMPACT OF TELEMEDICINE ON HEALTHCARE DELIVERY: A COMPREHENSIVE ANALYSIS OF PATIENT OUTCOMES AND ACCESS

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Abstract

Telemedicine is a viable technique for decreasing hospital packing and upgrading the utilization of clinical assets. To decide whether the hospital ought to offer telemedicine administrations and in what design (the watchman framework or double station administration framework), we make an adapted lining model in this work. Our model likewise considers the cost of transportation and the patients' aversion to delays. Here are our key discoveries. Most importantly, telemedicine administrations can regularly help with bringing down the general expense of the healthcare framework, and patients who are dealt with both on the web and disconnected can acquire from the utilization of telemedicine. Second, the double channel healthcare framework is more versatile than the guard and customary outpatient frameworks. Because of its capability to change the delivery of healthcare, telemedicine, or the far-off arrangement of clinical benefits utilizing media communications innovation, has drawn in a ton of interest as of late. This intensive examination takes a gander at how telemedicine influences openness and patient results across the healthcare environment. This study assesses the complicated effects of telemedicine on healthcare delivery by drawing on a large number of studies, information sources, and scholarly articles.

Keywords: Telemedicine, Healthcare Delivery, Patient, Hospital

1. INTRODUCTION

The landscape of healthcare delivery has seen a significant upheaval recently as a result of the quick development of information and communication technology. Telemedicine, a practice that uses telecommunications technology to bridge the gap between healthcare doctors and patients, regardless of geographical distances, is one of the breakthroughs that has grown significantly in popularity. The delivery and access to medical treatment have been revolutionized by telemedicine, which provides a variety of remote healthcare solutions, from virtual consultations to remote monitoring of patients' vital signs. The role of telemedicine has grown in importance as the globe deals with issues like rising healthcare demands, restricted access to medical institutions in rural and neglected areas, and the need for more effective healthcare delivery models.

This thorough investigation seeks to investigate how telemedicine affects the provision of healthcare, with an emphasis on patient outcomes and accessibility. This study aims to clarify the complex influences of telemedicine on patient care by looking at a wide range of papers, research articles, and empirical data. The investigation will provide light on how telemedicine has altered the established model of healthcare, affected patient outcomes and increased access to medical treatment. Numerous problems that the healthcare sector is currently facing could be solved by incorporating telemedicine into standard medical procedures. Notably, it provides a solution to the problem of healthcare disparities by enabling patients to contact with medical specialists regardless of where they are, so removing geographic barriers that obstruct prompt access to care. The use of telemedicine also includes specialized treatment, mental health services, and even emergency medical interventions in addition to normal consultations. It is critical to fully evaluate the impact of telemedicine on patient outcomes and accessibility as it is adopted into healthcare systems around the world. The objective of this analysis is to add to the body of knowledge by providing insights into the actual advantages and prospective disadvantages of telemedicine adoption. In the end, a detailed analysis of telemedicine's impact on healthcare delivery might pave the way for better patient care, more informed policy choices, and a healthcare system that can adapt to the demands of the modern world.

- **Telemedicine's development in the healthcare system:** Telemedicine is a revolutionary strategy that redefines the conventional parameters of healthcare delivery and was made possible by the development of improved communication technologies. The seamless fusion

of digital platforms and medical expertise enables a variety of services, such as remote patient monitoring and real-time virtual consultations.

- **Addressing Healthcare Disparities:** The unequal distribution of medical resources, which affects rural and underserved communities in particular, is one of the major problems in healthcare. By making it possible for patients in remote areas to receive specialized care, diagnostics, and treatment without having to physically travel, telemedicine holds the potential to reduce these inequities.
- **Improving Accessibility:** People who have trouble moving around or people who live in areas with few medical facilities have difficulty accessing healthcare services. By allowing patients to communicate with healthcare professionals from the comfort of their homes, telemedicine opens up new possibilities for accessibility and lowers the hurdles that come with distance and transportation issues.
- **Impact on Patient Outcomes:** Telemedicine integration has the potential to have a favorable impact on patient outcomes. Telemedicine assists in the early discovery of health disorders, resulting in prompt treatment and an improved prognosis for patients. It does this by enabling early treatments and ongoing monitoring. Additionally, remote monitoring of chronic illnesses results in better disease management and problem avoidance.

2. REVIEW OF LITREATURE

M. (2018) In this study, the context of telemedicine within the field of medical technology is examined, and its impacts on patient outcomes are assessed. The integration of telemedicine into the healthcare system and its impact on patient care are examined by the authors. The study addresses the wider implications for healthcare delivery and patient outcomes, shedding light on the possible advantages and difficulties of telemedicine.

E. A. (2019) An updated and thorough analysis of the empirical data supporting telemedicine treatments in primary care is provided by this systematic review. The effect of various telemedicine strategies on patient outcomes in a primary care context is examined by the authors. In order to provide insights into the effectiveness, challenges, and possibilities of telemedicine in enhancing primary care delivery and patient outcomes, the review synthesizes data from a number of research.

The economic assessment of telemedicine interventions is the main subject of Bergamo's systematic review from 2015. In order to determine the validity of economic analyses made in the field of telemedicine, the study objectively evaluates the body of existing literature. The review helps to comprehend the validity of economic analyses in assessing the cost-effectiveness and utility of telemedicine technology by analyzing methodological approaches and the standard of evidence.

R. M. (2016) This paper from a perspective explores the changing telemedicine landscape and prospective effects on healthcare over the next ten years. The authors examine how telemedicine is probably going to influence how virtual care is delivered in the future. The essay emphasizes the advantages and drawbacks of telemedicine adoption while highlighting how it might improve patient care delivery and increase access to medical services.

Review by Hailey et al. (2016) explicitly discusses tele mental health applications. The study evaluates telemedicine's efficiency in providing mental health treatments by looking at how it affects patient outcomes and the standard of care. The authors offer insights into how telemedicine can address mental health requirements and improve patient wellbeing by examining a variety of elemental health interventions.

J. E. Hollander (2017) This study looks into how patients feel about using telemedicine for remote follow-up after ER visits. The authors investigate how patients view telemedicine as a form of post-injury care. The study contributes to a better knowledge of patients' experiences with remote care delivery by highlighting patient happiness, convenience, and the possibility for greater patient participation through telemedicine follow-up.

3. THE MODEL FORMULATION

This paper determines the balance answer for the healthcare frameworks in three cases, contingent upon the design of the healthcare framework: customary outpatient framework, where just the disconnected station gives healthcare administration; guardian framework, where the telemedicine focus is embraced as the watchman and all patients should go there for the main conclusion; and for those patients who were not restored on the web, they will be alluded to the disconnected station. Contingent upon their net utility, patients could pick either channel for the underlying analysis.

3.1 Outpatient System Traditionally Used

In this segment, we investigate the situation where the hospital only offers disconnected administrations and all patients, paying little heed to where they are arranged, should truly visit the hospital. This present circumstance can act as a rule. To depict this system, we make a M/M/1 queueing model. We set the expected to hang tight time for a patient in the disconnected channel as and set the shopper net utility according to the typical holding up time (counting administration time) capability in Hua et al.. There are two viewpoints to the framework cost. One is the all outcost for treating patients, displayed as. Both hanging tight and transportation costs for patients are covered.

$$\min TC^F(\mu_1^F) = \int_0^1 (tx + \theta_1 W_1^F) \Lambda dx + c_1 \mu_1^F$$

3.2 Gatekeeper System

This part considers the situation in which the hospital assigns the telemedicine administration as the guardian and all patients visit the online telemedicine community for the underlying finding. The tele-expert treatment might have the option to fix a few people. Their regular stand by time is. The talented specialists actually need to treat different patients. The more extended hanging tight period is for customary disconnected treatment. Obviously and can be utilized to show the contrast among disconnected and online help rates. The guard framework's dynamic issue may be communicated as

$$TC^T(\mu_1^T, \mu_2^T) = \int_0^1 [\theta_2 W_2^T + k(tx + \theta_1 W_1^T)] \Lambda dx + c_1 \mu_1^T + c_2 \mu_2^T$$

The initial term addresses the whole cost for the patient. It includes the proper expense of web based holding up as well as the speculative expenses of disconnected pausing and travel. The interests in disconnected and online help limits are made in the second and third terms.

3.3 Dual-Channel Service System

In this part, we research the situation in which the underlying determination is given by both the conventional disconnected outpatient and the telemedicine focus. Patients pick between three choices in view of their utility: (a) all patients go straightforwardly to the disconnected channel

for the main finding; (b) all patients go to the web-based channel for the primary determination; and (c) a few patients from one gathering go to the disconnected channel for the principal conclusion while different patients from that gathering go to the internet-based channel for the principal analysis. As such, is the disconnected channel's portion of the overall industry. At the point when the appearance rate is equivalent to the result rate, the framework is a M/M/1 framework [42]. The projected appearance pace of abuse is just about as high as the appearance pace of the web channel. Accordingly, the disconnected channel's general appearance rate is. Taking everything into account, the double channel administration framework's appearance rate capability can be composed as'

$$(\lambda_1^D, \lambda_2^D) = \begin{cases} (\Lambda, 0) & x_0 \geq 1 \\ (\Lambda x_0 + k\Lambda(1 - x_0), \Lambda(1 - x_0)) & 0 < x_0 < 1 \\ (k\Lambda, \Lambda) & x_0 \leq 0 \end{cases}$$

4. TOTAL COST IMPLICATIONS

Various variables affect the three help frameworks' joined expenses. To additional think about the three frameworks, we investigate and offer mathematical models.

4.1 Comparison of the Three Systems

The base absolute costs of the guard framework and the customary outpatient framework are first differentiated. In view of its high worth, telemedicine can fundamentally lessen costs for the healthcare framework. Our exploration beneath centers around changes in the frameworks' general expenses, which incorporate both the hospital's venture and the expense of the patients, since we consider not-for-profit general hospitals and endeavor to distinguish the best procedure according to the point of view of the whole healthcare framework.

The general expenses of the guard framework and the double channel administration framework are then analyzed. The progressive clinical framework in China is at present being executed through various strategies, and telemedicine is a key component. The utilization of telemedicine urges more patients to get clinical consideration at home or locally facility, which diminishes the congestion in everyday hospitals. In any case, how should the hospital to utilize the telemedicine administration? This is as yet a substantial concern on the grounds that telemedicine execution requires impressive monetary costs and acclimations to the healthcare framework. The

framework organizer can settle on better choices with the guide of prior exploration and anticipating.

4.2 The Effect of Parameters on the Systems' Total Costs

We look at the general expenses of the three help frameworks and the impacts of various boundaries utilizing mathematical investigation. Lemma 6 exhibits that while there may not generally be an ideal answer for a double help framework, there is consistently a base by and large expense. The base worth can be acquired either in the area or on the limit on the grounds that the goal capability has two limit limits. We analyze four arrangements of basic impacting factors: transportation costs, telemedicine abuse rates, disconnected and internet holding up expenses, and administration limit costs. The healthcare administration process is impacted by a large number of variables.

It is sensible to utilize verifiable information from Xiangya Hospital (1.1 million every year), Peking Association Clinical School Hospital (2.26 million every year), and Tongji Hospital (4.8 million every year) to gauge the overall hospital confirmation rates in China, which midpoints out to 14.5 patients each moment in a solitary general hospital. Hence, for general investigation, we set people each moment to address the general appearance pace of the healthcare framework. The compensations of master specialists and telespecialists are the critical signs of administration limit costs. The pay of master specialists was misleadingly fixed to be two times that of tele-subject matter experts, or, as per the Lee et al. (2012) study. For various patients, there are different holding up times both disconnected and on the web. By and large, the expense of delaying time online is not exactly that of stalling time disconnected, accordingly we set and. We decide the transportation cost, which incorporates both the cost of involving a transport or other sort of transportation as well as the time spent voyaging. Various factors impact the abuse rate, consequently we set. We look at the general costs for the three frameworks involving a similar introductory incentive for every one of the three.

4.2.1 Impact of Transportation Cost

The effect of transport costs on the consolidated costs of the three frameworks is found in Figure 1. The standard outpatient framework performs better while the expense of transportation is generally low; when the expense of transportation rises, the double channel administration framework performs best. Notwithstanding, when the expense of transportation arrives at a

specific level, the guardian framework's expense is equivalent to that of the double channel administration framework, and both are better than the customary outpatient framework. Joining with Recommendation 2, it very well may be concluded that a hospital ought to possibly offer disconnected channel administration when the expense of transportation is insignificant and the populace it serves is fairly little. In any case, offering double channel administration is ideal. The guard framework won't be the best game-plan for this situation because of changes in the expense of transportation.

Table 1:Effect of t on these systems' overall costs.

| Total Cost (TC) | Transportation Cost (T) |
|-----------------|-------------------------|
| 12 | 2.3 |
| 19 | 3.2 |
| 29 | 3.6 |
| 35 | 4.1 |
| 38 | 5.3 |
| 40 | 5.9 |
| 46 | 6.2 |

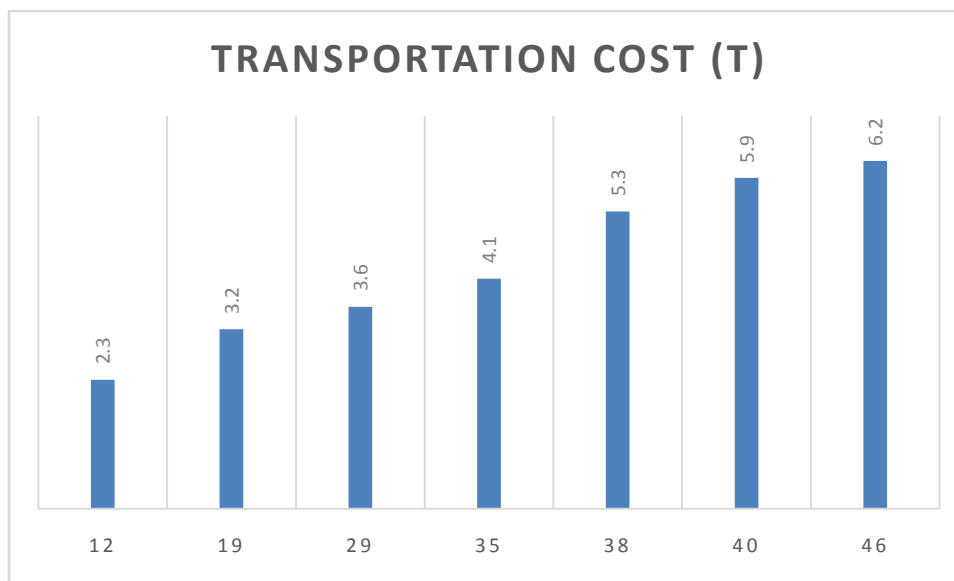


Figure 1: Effect of t on these systems' overall costs.

4.2.2 Impact of Mistreatment Rate,k

The conventional outpatient technique is unaffected by the telemedicine misbehavior rate. In any case, it might raise the general expense of both the double channel administration framework and the watchman framework. Figure 2 shows that as the pace of abuse rises, the general expense of the double channel administration framework doesn't rise directly. From the get go, at a low abuse rate (), the ascent steadily dials back. The hospital is saving on telemedicine, and more patients are getting their underlying judgments disconnected. Due to the more noteworthy telemedicine interest in the double station administration framework, when the abuse rate hits an edge number (for instance, when), the increment will speed up. It would be best for the hospital for this situation to quit offering a web-based help channel.

Table 2:Effect of k on these systems' overall costs.

| Total Cost (TC) | Mistreated rate (k) |
|-----------------|---------------------|
| 25 | 2.3 |
| 29 | 2.9 |
| 35 | 3.6 |
| 46 | 6.2 |
| 52 | 4.8 |
| 59 | 5.10 |
| 62 | 5.9 |

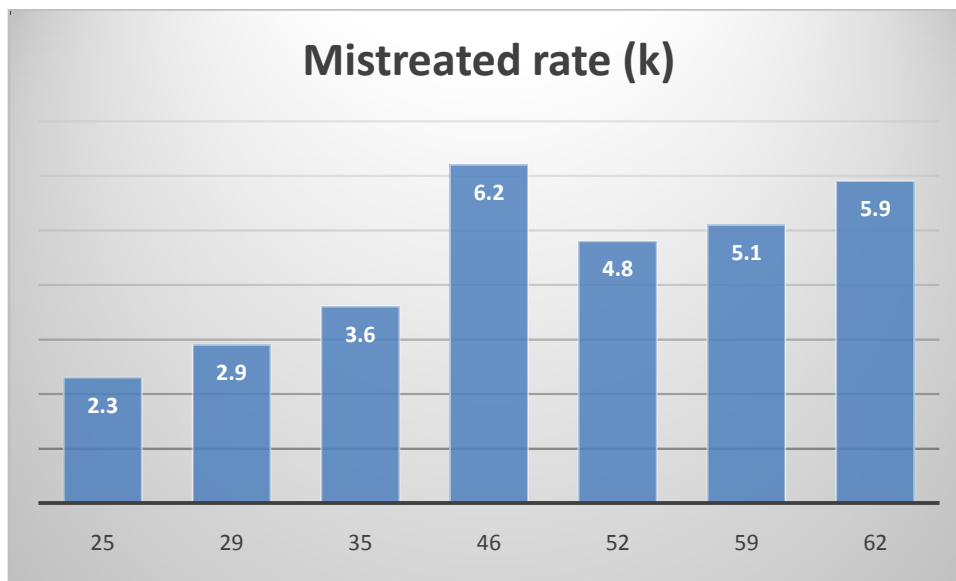


Figure 2: Effect of k on these systems' overall costs.

Most constant sicknesses, like diabetes, stroke, coronary illness, and hypertension, can profit from telemedicine, while specific direct ailments, for example, skin conditions, issues of the urinary framework, and sensitivities, have high paces of fix. Subsequently, telemedicine ought to be generally used to treat specific problems. Furthermore, as telemedicine innovation progresses, more diseases can be dealt with on the web and the pace of misbehavior will quickly decline. Joining this with Figure 2, we can express that while the double station administration framework will be ideal during the telemedicine administration establishment stage, the guard framework might turn into the future standard.

4.2.3 The effect of waiting times, θ_1 and θ_2

Here, we inspect the effect of patient holding up costs on the general framework costs. Figure 3 shows that, yet not straightly, the general expenses of the three frameworks ascend as the disconnected holding up cost does. This is because of the way that more patients are going to online channels for healthcare administrations while hospitals help their interest in disconnected channels to abbreviate stand by times. The general expense of the regular outpatient framework stays consistent in Figure 3, however the watchman framework develops straightly as the web based holding up cost rises. The double channel administration framework is more noteworthy than the traditional outpatient framework when it increments slowly.

Table 3: Impact of θ_1 on the total cost of these system

| Total Cost (TC) | Online waiting cost (θ_1) |
|-----------------|------------------------------------|
| 29 | 1.9 |
| 35 | 2.4 |
| 34 | 3.5 |
| 41 | 3.8 |
| 46 | 4.5 |
| 55 | 5.6 |
| 51 | 6.2 |

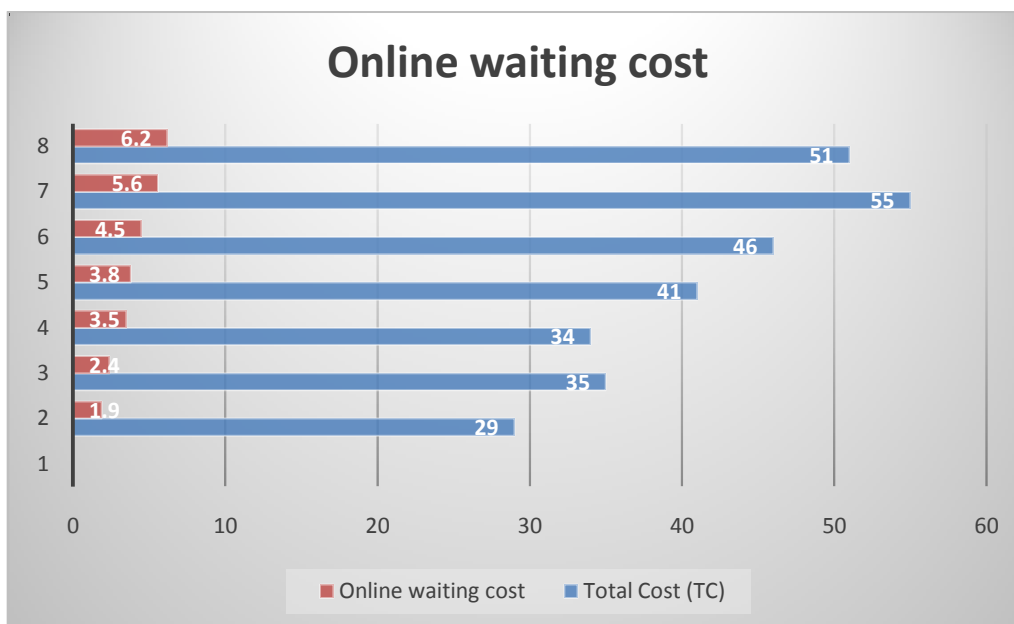


Figure 3: Impact of θ_1 on the total cost of these system

As a rule, particularly for office laborers, web based holding up times are more limited than disconnected holding up times (see Figures 3) Guard frameworks and double channel administration frameworks are without a doubt the unrivaled choices for patients of this kind. Time isn't the essential deciding variable for persistent patients, and both on the web and disconnected holding up times are modest. The impact of one channel's holding up time is portrayed in Figures 3 anyway the impact of the other channel's decent holding up time isn't. They show the relative changes in holding up costs whether they happen disconnected or on the web.

5. CONCLUSION

Telemedicine administrations are turning out to be increasingly more typical in the healthcare framework as data innovation propels. In this paper, we look at three healthcare frameworks and dissect how telemedicine has impacted the delivery of healthcare administrations. We center around the patients' inclination for the first analytic among disconnected and online channels. As per our information, telemedicine sometimes can help with bringing down both the general expense of the healthcare framework and the hanging tight times for patients. In certain cases, we find that the hospital shouldn't offer telemedicine administrations, which is in accordance with Tarakci et al's. finding. Their discoveries, notwithstanding, that treating each patient

utilizing telemedicine is rarely all that strategy, can be extended in specific conditions. Our discoveries show that the watchman framework might be the best strategy in specific conditions. The double channel administration framework, which joins the guard framework and the regular outpatient framework, is for the most part the best strategy. By adjusting the disconnected and online assistance limits, the hospital can choose how to portion the market while permitting customers to pick clinical benefits in light of their utility. Our review's discoveries show that there is a decent market parted among on the web and disconnected arrangements. To get the double channel administration framework's most minimal complete expense, the hospital can shift the on the web and disconnected help limit.

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