Reducing Inaccurate Referrals to Dental Home Care Using Dental Virtual Clinic

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Abstract: *The rise in the number of older people in Saudi Arabia, who suffer from chronic, mobility-restricting diseases necessitates need for domiciliary care Companies such as Dental Home Care (DHC). This research aims at examining the effects of adopting a new concept of a virtual dental clinic at Prince Sultan Military Medical City (PSMMC) to minimize inapposite referrals, misallocation of resources, and to improve patients' outcomes in DHC services. By means of virtual dental clinics, teleconsultations can facilitate preliminary examinations necessary to exclude or include patients in the DHC programme. This model is expected to enhance the efficient and effective use of resources, minimize call-frequency based encounters and increase patient and provider satisfaction. Both, retrospective and prospective investigations were performed including one year prior to the virtual clinic as well as one year post implementation. Studies show that virtual screening succeeded in achieving high accuracy in referrals, sustainability in effective resource utilization and cost savings; all of which affirm optimization of DHC processes.*

Keywords: *Dental virtual clinic, Dental, Saudi Arabia, Dental Home Care (DHC)*

INTRODUCTION

Under the umbrella of Saudi Arabia's Vision 2030, which aimed at achieving health care for all, the health care system has gradually turned its attention to domiciliary care services more especial in elderly and home-bound patients (Armfield *et al.*, 2006). Dental Home Care (DHC) programs have been developed to deliver

necessary dental services to patients who cannot attend health facilities due to physical, psychological, or by other reasons. However, the successful implementation of DHC delivery faces a problem of identifying eligible patients since wrong identification leads to wastage of time and other resources, elevated costs, and unsatisfied patients (Nicolas *et al.*, 2007).

This growing concern demands a credible screening model through which only deserving individuals should receive DHC. To ineligible referrals, issues like staff hour misallocation, transportation misallocation and misallocation of consumable items has become the order of the day. Some of these inefficiencies compromise operations while others increase costs and reduce the quality of care that is accorded to qualifying patients (Chanpong *et al.*, 2005). Telemedicine and teledentistry have progressively become potentially suitable for these weaknesses as virtual dental clinics. Patients can even be evaluated and checked if they are suitable for the DHC without a face-to-face encounter, which makes use of virtual consultation an appropriate tool in fee-for-service practices (Armfield *et al.*, 2009; van Wijk & Hoogstraten, 2009). This paper focuses on the virtual dental clinic of PSMMC and its effectiveness in perusing goals like effective patient referral, minimize unessential referral and optimum utilization of the DHC (Armfield, 2010). The study provides an understanding of how virtual dental consultation yielded positive and novel solutions that could revolutionize patient care delivery at a health facility level, in the face of limited resources and scope together with the financial capacity to support changes (Milgrom *et al.*, 2009).

Aims

In addition, the primary research question focuses on the impact of virtual dental clinics to increase accuracy of DHC referrals at PSMMC (Schuller *et al.*, 2003; Pohjola *et al.*, 2007). Specific objectives include:

1. Minimizing the referral errors percentage related to DHC to less than 5% by using virtual screening procedures.
2. Reduction in real-life time spent for screenings as well as equipment and people's time for travel and many other resources' optimization as a result of digital screenings.
3. Redesigning the DHC referral and mechanisms of effective patient and provider satisfaction in a progressive manner.

These aims help in the goal of sustaining the DHC practices according to the Saudi Arab Vision 2030 by pushing health services that are accessible, efficient, and centered on patients.

Materials and Methods

Study design and setting

The research was carried out in the Postgraduate Students Mosque and Medical Centre, in Riyadh, Saudi Arabia with the use of quantitative and qualitative research method. Measures of before and after, and some prediction of future referral data were evaluated in order to determine the effects of virtual screening on DHC service provision both in productivity and precision. Baseline information was collected as retrospective data inclusive of May 2022 to April 2023 to determine existing referral practices, while data was collected as prospective following the implementation of the virtual screening from May 2023 to April 2024 (American Psychiatric Association, 2000; Okoro *et al.*, 2012).

Data collection

Data collection spanned pre- and post-intervention periods and included various indicators of resource usage and referral accuracy:

1. **Referral data:** These included the actual number of new DHC referrals, categorization of referrals rejected by insurance companies and successful virtual screening done.

2. **Resource metrics:** Numbers on the use of PPE, cost of transportation, and time spent on physical visits and costing per patient.
3. **Patient and provider satisfaction:** To evaluate the satisfaction level with the virtual clinic model quantitative feedback was not collected for the project.

An incremental cost model was also developed in order to generate statistics pertinent to the monetary consequences of decreased demand to face-to-face screening and excellent resource management.

Methodology

The specific approach chosen for the study implemented a structured and systematic approach to this issue regarding the DHC referral (McGrath & Bedi, 2004; Armfield *et al.*, 2007). Several key components were included:

1. **Virtual screening:** All new DHC referrals were to book for initial telehealth appointments. This approach facilitated collection of information on patients' general and dental health as well as an initial determination of their fitness for DHC from a distance.
2. **Patient exclusion criteria:** Parameters were set to exclude those who should not be offered DHC such as having severe neurological diseases, learning disabilities or having conditions that require hospital care. Effectively, what this mean is that through virtual exclusion of ineligible patients DHC was able to provide care to deserving home-based patients.
3. **Preparation and training for dental professionals:** It is worth mentioning that the dental staff went through separate training for online consults with patients. Course elements included telemedicine equipment, patient interaction and communication, and methods of assessing patients' needs from afar to assist providers in identifying the patients who meet program criteria. Standard protocols were given to the staff so that they may effectively utilize their time online to perform online screening efficiently.
4. **Data analysis and monitoring:** Data derived from referrals were assessed on monthly basis in relation to proportion of correct/incorrect referrals, and costs. Other data routinely submitted and analyzed were total number of referrals in a month, total virtual screenings, total resources used. These variables have been compared with baseline data to determine changes after intervention.
5. **Technology and infrastructure:** The virtual screening was enhanced by a HIPAA compliant telemedicine system that incorporated video calling to enable understanding of patient's conditions by the providers. Technical assistance was given in order to facilitate use of the technology in existing processes effectively (Brahm *et al.*, 2012).

Statistical analysis

Characteristics of the cross-sectional and longitudinal data were analyzed using descriptive statistics such as frequencies, percentages, and averages on the baseline referral data and the outcomes of the implemented intervention. Preliminary costs to wear PPEs, fuel expenses, and the number of staff hours spent on the implementation procedures were also quantified before and after implementation. Referral patterns and treatment delivered at first point contact were measured by analyzing the monthly referral data and comparing the percentage of correct referrals and incorrect referrals and treatments given at first instance to identify numerical evidence of changes.

Results and Discussion

Baseline data (May 2022 - April 2023)

In the twelve months prior to the introduction of the virtual screening, there were 239 referrals to DHC, each of whom had to attend a face to face screenee visit. Out of them 55 patients (23%) were declared ineligible for

DHC after face-to-face encounter which resulted in wasted resources which also included staff time, cost for travel, and PPE consumption. This inefficiency thus called for a more efficient screening process (Chanpong *et al.*, 2005; Milgrom *et al.*, 2009).

Post-implementation data (May 2023 - April 2024)

The implementation of virtual screening resulted in substantial improvements:

1. Among newly referred patients, 94 of 343 DHC patients would have been ineligible based on virtual screening and would not require an in-person screening visit.
2. The average of the percentage of inaccurate referrals after the implementation of the intervention was 2.8%, reducing the inaccurate referrals to below 5% as per the target of the study.
3. Within one visit of the first DHC, the amounts of direct treatments offered amplified, and the proportions of resources shifted to ineligible cases declined suggesting the enhancement of patient care, and precision (Armfield *et al.*, 2007).

Table 1. Retrospective data for one year

Year	Month	Total number of new patients	Screening only	Number of patients with wrong referrals seen
2022	May	15	15	6
2022	June	18	18	6
2022	July	20	20	2
2022	August	21	21	5
2022	September	24	24	4
2022	October	25	25	4
2022	November	18	18	5
2022	December	19	19	6
2023	January	29	29	7
2023	February	19	19	3
2023	March	17	17	2
2023	April	14	14	5
Total		239	239	55

Table 1 shows the total number of the newly referred cases to the DHC in one year was 239 and all of them were visited for screening only and 55 patients (23%) did not meet the acceptance criteria for DHC. This data indicates that 55 eligible patients who met the criteria could be treated instead of those wrongly referred patients. Another indication that can be withdrawn from these retrospective data is that 239 visits were only for screening which was costing the hospital time and money for providing equipment, material, PPE, instrument, disinfection and sterilization and vehicle fuel. Adding to that the patient satisfaction was negatively affected because patients and their family were expecting treatment rather than screening only.

Table 2. Patients' data for one year after intervention

Year	Month	Total No. of new patients	No. of patients after Virtual screening	Excluded patients / (wrong referral)	Screening only	Screening and education	Number of patients with wrong referrals seen	Screening and other treatment	% of patients not fit for DHC
2023	May	24	19	5	0	1	1	18	4%
2023	June	40	28	12	0	5	2	33	5%
2023	July	45	34	11	0	2	2	30	4%
2023	August	30	21	9	0	2	1	19	3%
2023	September	27	24	3	0	1	0	23	0%
2023	October	29	25	4	0	2	1	23	3%
2023	November	24	18	6	0	3	0	15	0%
2023	December	23	19	4	0	3	1	16	4%
2024	January	25	18	7	0	1	1	17	4%
2024	February	30	13	17	0	2	0	11	0%
2024	March	17	12	6	0	2	0	10	0%
2024	April	29	19	10	0	2	1	17	3%
Total		343	250	94	0	26	10	232	3%

Notably, as shown in **Table 2**, all newly referred patients (343 patients) were screened virtually, and 94 patients (27%) were excluded because they did not meet the acceptance criteria for the dental home care program due to their complex medical conditions. During the virtual screening, several issues were identified, including severe neurological disorders, significant intellectual disabilities, and INR levels requiring hospitalization for close observation and supervision.

The exclusion of these patients allowed for 94 others to be scheduled for domiciliary dental treatment. However, 26 patients (8%) remained unclear and required further inspection and evaluation during their first visit before proceeding with dental treatment. For these cases, oral and dental health education was included in the visit for patients and their guardians to raise awareness about the importance of oral health, particularly for this vulnerable group.

From this group, 10 patients were ultimately seen and removed from the dental home care waiting list. The main reasons for their exclusion from the DHC were the complexity of the necessary dental treatments, which required advanced dental settings, such as implant cases or fixed prostheses. Additionally, some proposed treatment plans were not approved by the patients or their families. A few patients were uncooperative and displayed resistance to dental treatment, making it challenging to manage them in a home environment. These categories accounted for 10 patients (3%) of the total number of new referrals.

Table 3. patients' data for four months during control phase

Year	Month	Total No. of new patients	No. of patients after Virtual screening	Excluded patients / (wrong referral)	Number of patients with wrong referrals seen	% of patients' seen with wrong referrals after virtual screening

2024	May	31	27	4	1	3.2
2024	June	21	16	5	1	4.8
2024	July	27	20	7	0	0
2024	August	28	20	8	1	3.6
Total		107	83	24	3	2.8

Implementing virtual screening for all newly referred patients to the Dental Home Care service at PSMMC has yielded impressive results in reducing inappropriate referrals. As shown in **Table 3**, the percentage of patients with wrong referrals was sustained below the 5% target for a period of 4 months. In fact, only 3 out of 107 patients had incorrect referrals after the virtual screening process was put in place. The average percentage of wrong referrals over this 4-month period was just 2.8%.

Table 4. Cost reduction in one year after intervention

| Item		Quantity	Price/piece	Total
Gasoline		1835.4 L	2.33	4276.482
PPE	Gloves (100 pieces=15)	2058 pcs	0.15	308.7
	Face Masks (50 pieces=10)	1029 pcs	0.2	205.8
	Face Shields (1 piece 15)	343 pcs	15	5145
	Head Cap (100 pieces=59)	1029 pcs	0.5	514.5
	Shoe cap (100 pieces= 95)	2058 pcs	0.95	1955.1
	Gowns (100 piece=150)	1029 pcs	1.5	1543.5
Consumable	Alcohol = 85	114 bottles	20	2280
	(one per trip) Sanitizer= 20	114 bottles	20	2280
	x 343=686 Liners (1 piece=1 SR)	1029 pcs	1	1029
	Gauze =7	343 pcs	3	1029
	Cotton rolls = 7	343 pcs	3	1029
	(box/patient = 3 SR Tissue (1	343 pcs	3	1029
Exam Kit		343 pcs	5	1715
Total cost reduction/year				24340.082

Table 5. Total time waste

Number of the trip for 343 patients considering 3 patients in each trip	Dental Home Care vehicle average trip duration / 3 patients	Total time waste for 343 patients	Driving hours	Set up	Exam and Hx taking	Disassembly

114	275 minutes	31350 minutes 522.5 hours/ year	50+50+20+20= 140 minutes (2.3 hours driving/trip) • 50 minutes from base to 1st patient • 20 minutes from first patient to the second. • 20 minutes from the second to the third • 50 minutes from the last patient to go back to base	15 minutes X 3 patients (45 minutes)	15 minutes X 3 patients (45 minutes)	15 minutes X 3 patients (45 minutes)
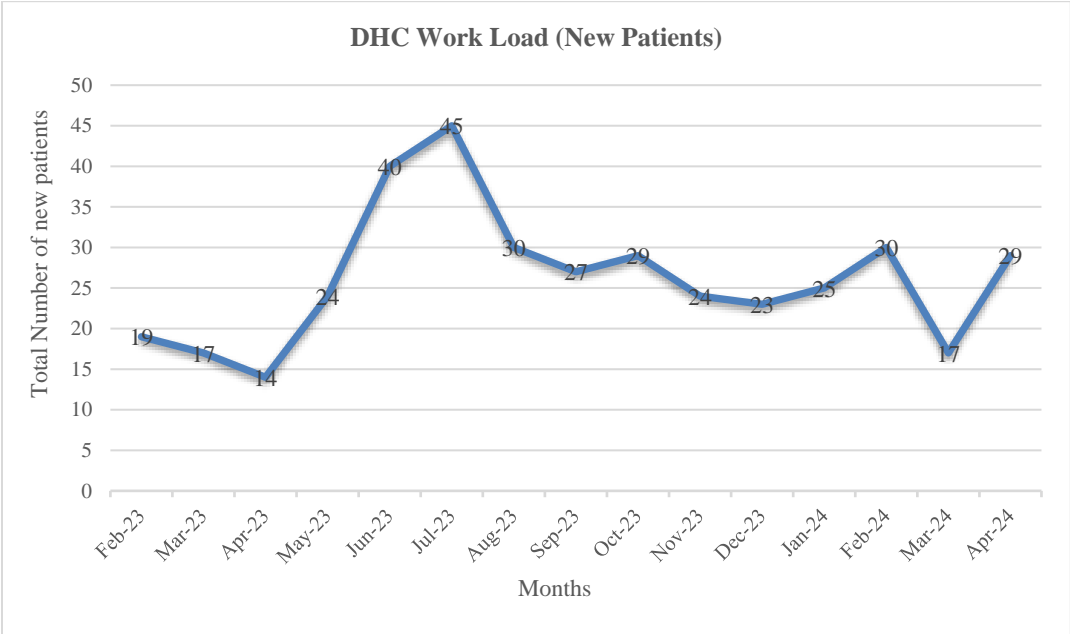
Figure 1. DHC work load for new patients
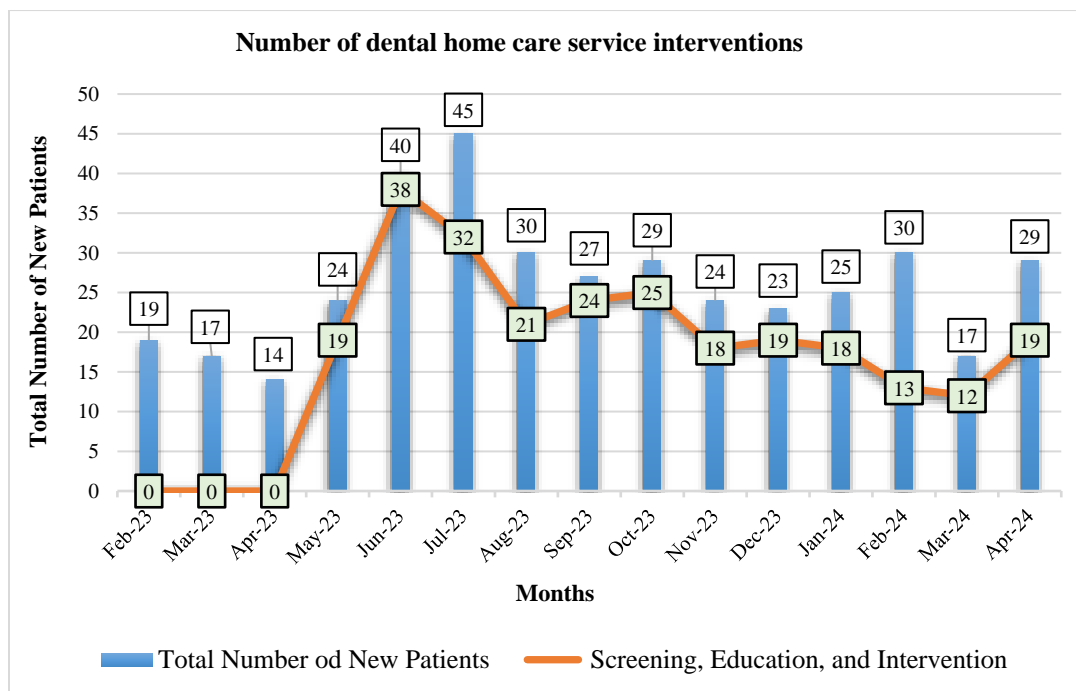
Figure 2. Number of dental home care service interventions

Resource utilization and cost efficiency

The virtual clinic model demonstrated significant reductions in resource usage:

1. Approximately 522.5 staff hours of savings per annum along with decreases in transports and PPE usage.
2. Overall, it was concluded that number of Saudi Arabia Riyals 24,340 was saved annually, following the aspects of less travelling, PPE utilization, and working expenses.
3. Virtual screening decreased physical encounters; hence most DHC s could use the limited resources well and deliver focused care to patients that really needed the services.

Patient and provider satisfaction

Students' survey statements highlighted better satisfaction with virtual screening because physical visits were closely avoided, and patients are only referred to appropriate care environments. Coordination of DHC also improved job satisfaction of the healthcare providers by decreasing workloads of DHC referral strengthening a sustainable DHC service delivery model.

The findings support the possibility of VDC in constraining the DHC referral system disparities in line with Vision 2030 objectives of convenient health care in Saudi Arabia. Due to VCA for DHC eligibility, referrals that were false were minimized and more of such resources where produced meaningfully at PSMMC (Armfield *et al.*, 2006). This shift to virtual screening can be viewed in the context of other changes in teleradiology seen around the world with teeth teleconsultation showing high efficacy in handling of the first appointments and restricting face-to-face evaluations (van Wijk & Hoogstraten, 2009).

The concept of virtual clinic at PSMMC eliminated operational cost while at the same time increasing the satisfaction of both the patient as well as the provider. This eliminated a lot of futile trips that otherwise would have been made because patients understood better the offers by DHC through initial consultations from home. It leads to openness and satisfied clients, and empowers people and their kin to make wise choices on their health concerns. However, some the barriers to put into practice virtual screening include; lack of

technology amongst the employees, poor technology access in the rural region imply the need to enhance infrastructure and training for the employees. All these are important in growing the telemedicine front and enhancing on virtual clinic especially where there is poor access. In order to improve the precision of remote screening, additional assessment instruments that may be adopted by PSMMC include high definition video and live intraoral camera. It is also important to invest in secured telemedicine platforms, the rigorously and standard formulation of patient privacy policies to increase the level of users' acceptance and the utilization of virtual dental services across Saudi Arabia (American Psychiatric Association, 2000; Schuller *et al.*, 2003). Application of a virtual dental clinic to manage DHC referrals at PSMMC have enhanced improved the accuracy of the referrals, optimized resources available while enhancing patient satisfaction (Armfield, 2010). This approach wills not only help Saudi Arabia achieve Vision 2030 goals for availability of adequate health facility with proper health care for the population, but it is also scalable model which could be implemented in other healthcare facility care dominion to improve domiciliary care facilities services (McGrath & Bedi, 2004). Despite these barriers like technology, access, and training, there is a great opportunity that virtual clinics can revolutionize the DHC referral pattern in the interest of efficiency and patient outcome. We expect that as these and other telemedicine technologies advance in the future for DHC services throughout Saudi Arabia, the care of elderly and homebound patient's advances as well (Pohjola *et al.*, 2007).

Implications for future research

The positive findings from the present study also form a basis for future examination of the efficiency of Virtual clinics in different arenas of domiciliary healthcare. Subsequent researches may assess patients' experiences as well as the general performances of virtual clinics in the long-term. Moreover, it may be useful to explore the applicability of such a concept to other specialties of healthcare services where patients need frequent interactions with the clinicians. It could also be broadened by studying patient characteristics, analyzing the attitude of people of different age towards virtual services, and evaluating the effects of telemedical services on patients' compliance with a prescribed treatment regimen. Research exploring the socio-economic effects of virtual clinics in relation to its application on the growth of socio-economically disadvantaged populations could help the nation and other parts of the world understand how to harness telemedicine to eliminate socio-economic disparities in accessing quality and timely healthcare facilities.

Conclusion

Due to the decrease in the number of unessential physical examinations as well as the improvement in resource utilization and satisfaction of patients and providers, the virtual clinic program in PSMMC is clear proof of the shift towards the utilization of the digital health solutions in the modern world. It is crucial to underline that this study embraces the large perspective for application of the telemedicine within comprehensible, cost–effective and the patient-centered healthcare, enforcing the sense of the value of the virtual screening within the context of the domiciliary health care services.

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