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A Review and Critique of Teledermatology in the South African Public Health Sector

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Abstract. Nearly 80% of the world's population live in developing countries in Asia, Africa, and Latin America. Many of these countries must face a triple or quadruple burden of disease with severely limited resources and health systems. South Africa (SA) is one such country, and recognises the potential for e-health to moderate these limitations. Dermatological issues remain a concern in SA and globally. Indeed, the World Health Organisation (WHO) has recognised that a number of diseases are most likely to manifest themselves through a dermatological problem before becoming full-blown. However, there is an acute shortage of dermatologists in SA. Teledermatology has promise as a service delivery intervention. This study reports on the current status of teledermatology services in the public health sector of SA. Methods: The study adopted a qualitative, inductive research approach based on a structured literature review of teledermatology in SA. A modified Momentum-Treat tool was used to critique identified teledermatology services. Results: 159 resources were identified, of which 68 were excluded. The remaining 91 resources revealed a history of ad hoc teledermatology services, of which few remained active. Requests for teledermatology service confirmations provided some feedback, together with follow-up meetings and interviews. Discussion: No evidence of scaling of teledermatology services and integration into routine healthcare was found. Of eight services, 4 remain active. Review and modified Momentum-Treat critique showed opportunities for improved readiness assessment, programme governance, and alignment to government policy direction, in order to improve scaling and sustainability. Conclusions Full-scale teledermatology integration is possible, but stronger programme development is needed. Findings will inform development of a teledermatology scale-up framework to assist with future integration of teledermatology into routine healthcare.

Keywords. South Africa, teledermatology, scaling, Momentum-Treat

Introduction

About four-fifths of the global population live in developing countries, most of which are said to face a triple burden of disease: communicable disease, non-communicable disease, and socio-behavioural illness [1]. Often they do so with limited resources, insufficient skilled healthcare providers, and inadequate healthcare systems. e-Health, the use of information and communication technologies (ICT) for health, is being promoted as one means to address some of these challenges [2].

South Africa (SA) suffers from a quadruple burden of disease: HIV/AIDS and tuberculosis, high maternal and child mortality, non-communicable diseases, and violence and injuries [3, 4]. The leading cause of death is HIV/AIDS with morbidity

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and mortality in relation to skin diseases including HIV/AIDS, skin cancer, and burn wounds [5, 6]. Indeed, the World Health Organization (WHO) has recognised that a number of diseases are most likely to manifest themselves through a dermatological problem before becoming full-blown [7]. But there is an acute shortage of dermatologists in South Africa, with the majority (65%) of the 167 registered dermatologists in private practice and concentrated in major urban hospitals [8]. The dermatologist to population ratio is 1:310,000 vs the ideal estimate of 1:50,000 [9, 10].

In SA, health related policy development, legislation and programme leadership lies at the National level with the Minister of Health, with responsibility for planning and delivery of services at the level of the 9 Provinces, and with local government responsible for municipal health services relating to environmental health [11]. SA spends 8.5% of GDP on healthcare, higher than the WHO recommended 5.3%, yet health outcomes are not comparable with other developing nations [12]. There is also maldistribution of resources, with SAs health system being comprised a two-tiered public and private system, with the under resourced public sector serving 84% of the 52 million population.

The country requires innovative interventions to address the burden of disease [13], the inequitable access to health services [12], and the appropriate use of ICT through telemedicine [14-16]. Dermatology, partly due to its visual nature and the shortage of dermatologists, is one of the most common uses of telemedicine after teleradiology and telecardiology [17, 18] and is uniquely positioned to enhance the effectiveness and efficiency of the referral process [19]. The SA government has identified the use of telemedicine as a service delivery intervention to support appropriate access to healthcare through the National eHealth Strategy and mHealth Strategy [14, 20].

The government's support for telemedicine's value proposition (enhanced service delivery interventions that improve patient care in rural areas and improve referral decision-making [14, 21]) is demonstrated through formulation of various strategies. These include the formalisation of eHealth [14] and mHealth [20] strategies, together with an ICT Research Development and Innovation Roadmap [22], National Health Normative Standards Framework for systems interoperability [23], National Health Strategy (2014 to 2019) [13, 24], and the development of an Electronic Health Patient Registration System [25]. Attempts to formalise ethical guidelines since 2008 and a telemedicine strategy since 2012 have not yet been realised [26, 27].

The initial national telemedicine programme, the National Telemedicine System, (NTS) launched in 1999 did not include teledermatology. The NTS failed for various reasons ranging from low system utilisation and cost effectiveness concerns, to technical and organisational challenges [28, 29]. The province of KwaZulu-Natal (KZN) took advantage of the videoconferencing infrastructure installed for the NTS, and synchronous teledermatology was initiated in 2003.

While teledermatology has been practised, no teledermatology service has yet been scaled-up to meet the needs of a Province or SA as a whole [30, 31]. An opportunity exists to address this scale-up gap by developing a teledermatology scale-up framework (TD-SF) that would enable the widespread operationalisation of teledermatology in the public health sector. The aim of this study is to gain an understanding of the history and current status of teledermatology programmes in South Africa's public health sector to inform the development of a TD-SF.

1. Methods

The study adopted a qualitative, inductive research approach [32, 33] based on a structured search of databases of peer-reviewed journals, Scopus, PubMed, and Science Direct, and grey literature.

Search strings included the following terms: teledermatology, telemedicine, or telehealth, linked to South Africa and SA's nine Provinces (Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West, Western Cape). Only papers in English, and published to the end of 2015 were sought. In addition, hand searching of electronic grey literature was performed by doing backward and forward secondary reference checking [34]. eMail requests were sent to authors to confirm the status of identified teledermatology services. Inclusion criteria were reference to teledermatology or teledermatology related telemedicine programmes or services in any of the country's nine provinces. All abstracts were screened for inclusion criteria and full texts of included records were read and analysed.

The services were categorised into three groups according to the communication mode: asynchronous, synchronous, or hybrid. In addition a high-level critique of the identified services was performed using a modification of the 2015 MOMENTUM-TREAT-Toolkit (Momentum-Toolkit) [35], intended to support the scaling-up of telemedicine programmes. The toolkit comprises a core requirement, four domains, five elements, 18 critical success factors (CSF), and supporting indicators (Table 1) [35]. The core requirement is based on the Model for Assessment of Telemedicine (MAST) [36], and must be met prior to considering scale-up . The developers of the toolkit recommended the tool be adapted to specific contexts, and indicated that some CSFs overlapped. Taking this into consideration, the Momentum-Toolkit was modified, and only CSFs 1, 2, 3, 4, 9 and 17 were selected (Table 1). This selection was representative across the four domains and enabled a high-level critique: CSF1 relates to context; CSF 2 relates to context and core requirements; CSFs 3 and 4 relate to people; CSF 9 relates to plan; and CSF 17 relates to run. Additional criteria such as financial plan to support CSF 9 (business plan) and technological readiness to support CSF 1 (cultural readiness) were included (Table 2). A Likert scale was used to evaluate how well the service met a selected CSF (1 = "Not Met", 2 = "Unsure", and 3 = "Met").

Ethical clearance for this study was granted by the Humanities and Social Sciences Research Ethics Committee of the University of KwaZulu-Natal.

2. Results

A total of 159 unique records were identified of which, 68 did not meet the inclusion criteria. The remaining 91 records were from journal articles (44), conference papers (14), web pages (11), theses and dissertations (9), books (4), and reports (9). There was a steady increase in the number of peer-reviewed teledermatology and related service literature over the past 21 years: 21 (1995–2005), 24 (2006–2010) and 46 (2011–2015).

Table 1. Adaptation of the MOMENTUM-TREAT-Toolkit with selected CSFs in bold and shaded.

Elements	Core requirements	Domains			
		Context	People	Plan	Run
Strategy and management (strategic elements necessary for the initiation of the services)	**Need for evidenced based intervention** **IT system design**	**CSF 1: Cultural readiness**	**CSF 3: Leadership**	CSF 7: Resource aggregation	
		CSF 2: Compelling need			
Organisation and management (management challenges for successful implementation)			**CSF 4: Stakeholder involvement**	CSF 8: Primary Client	
			CSF 5: Patient centeredness	**CSF 9: Business plan**	
				CSF 10: Change management	
Legal and security (important legal and security issues)				CSF 11: Legal and security conditions	CSF 13: Legal and security guidelines
					CSF 14: Legal and security experts
					CSF 15: Privacy awareness
Technology and market (technical infrastructure and market relations)			CSF 6: User friendliness	CSF 12: Potential to scale-up	CSF 16: IT and eHealth infrastructure
					CSF 17: Service monitoring
					CSF 18: Market procurement

Fourteen requests for teledermatology service confirmations were sent and feedback from seven (50%) received (Western Cape, Eastern Cape, KwaZulu-Natal (KZN), and Limpopo). five interviews conducted. Sufficient literature was available to critique services in only three provinces, Eastern Cape, Western Cape, and KZN. Currently, there are only four active services, two in KwaZulu-Natal (Dlova N and Mosam A, 2016, interviews) and, two in Western Cape (Todd G, 2015, email).

Two projects were reported in the Eastern Cape, neither of which is active. In 1999 a store and forward service was reported between a general practitioner in rural Port St Johns, and the University of Walter Sisulu, the Medical University of South Africa, Armed Forces Institute of Pathology (USA) and the Lemuel Shattuck Hospital (USA) [37]. In 2002 the project was migrated to an Internet based, asynchronous modality using iPath, and was last reported in 2004 [38].

In KZN a store and forward email based service started in 2001 between UKZN and doctors at the most rural hospitals. Due to lack of connectivity in the hospitals doctors had to use their own computers from home after hours using dialup modems to provide the service. This was too labour intensive and the service ended in 2002 (Mars M, 2016, interview). A synchronous service started in 2003, which a proof of concept at one site with the aim of scaling up across the province with three sites active to date [39-41]. This service reduced the referral rate by 75%, enhanced the University's out-reach programmes, and supplemented the continuing medical education programmes

for doctors and nurses [41]. In a few exceptional instances further contact was made by telephone to confirm availability of drugs or the treatment plan. In 2013, a spontaneous, unplanned teledermatology service began, which used smartphones to take, send and receive images and data between residents/registrars undergoing dermatology training and subsequently doctors at rural hospitals, with dermatologists at UKZN. This service continues to grow [6, 42, 43].

In the Western Cape an asynchronous service originated at the University of Cape Town's Department of Dermatology in collaboration with the University of Washington, with referral sites in three provinces [44]. A nurse-led cellular phone based service from a mobile clinic has been reported in the Overberg District [45], and spontaneous use of mobile devices for teledermatology has been reported, similar to that in KZN (Todd G, 2015, email). The results of the high-level critique, based on the adapted MOMENTUM-TREAT Toolkit, are shown in Table 2.

Table 2. Results of high-level critique.

Requirement Type	Description	Eastern Cape	KwaZulu-Natal	Western Cape
Core	Compelling need (CSF 2)	3	3	3
Domain				
1. Context	Cultural Readiness (CSF 1)	2	2	2
	Technological readiness	2	3	2
2. People	Leadership (CSF 3)	3	3	3
	Stakeholder involvement (CSF 4)	2	3	2
3. Plan	Business plan (CSF 9)	2	2	2
	Financial Plan	2	3	2
4. Run	Service monitoring (CSF 17)	3	3	3

All the services achieved a 'met' rating (score of 3) for meeting the core requirements of being based on a defined need. In terms of the context domain, all services received an 'unsure' rating (score of 2) for uncertainty of conducting assessments for cultural readiness. In terms of technological readiness only KZN provided anecdotal evidence that an assessment was performed prior to expanding the videoconference infrastructure from 9 to 37 (Mars M, 2016, interview). In the people domain for KZN literature supports leadership and stakeholder involvement and received a 'met' rating [21, 40]. Although the Eastern Cape [46, 47] and Western Cape [48] provided evidence of service leadership there was insufficient information on stakeholder involvement. In the plan domain, the literature was unclear on the existence of a business and or supporting financial plan for both Eastern and Western Cape. In comparison KZN received an 'unsure' rating based on unclear evidence to support the existence of a business plan, but there was anecdotal evidence of initial supporting financial plans [21]. Finally, all the provincial services performed initial service monitoring and evaluation [37, 41, 48]. The total number of 'met' ratings for the various services across the core requirement and the four domains are 6 for KZN, of which three (50%) are based on anecdotal evidence, and a rating of three each for both Eastern and Western Cape services.

3. Discussion

Various attempts have been made to implement teledermatology in South Africa since 1999. There are currently four active services, with no evidence of a national or

provincial scale-up. There is no evidence of Provincial leadership or budgeting for teledermatology, with the KZN and University of Cape Town services being driven by the medical schools. An unexpected finding was the existence and growth of spontaneous adoption of mobile devices for teledermatology from 2013 onwards. Migration to an Internet based platform was not successful. The literature although increasing, provided scarce programmatic evidence, with the exception of KZN where access to initial leadership was possible.

Despite the intention to scale up in KZN, this has not been realised. While the National Department of Health (DOH) supports the concept of telemedicine it is noteworthy that the reported teledermatology services originated at University Medical Schools, the Medical Research Council (MRC) of South Africa and the Council for Scientific and Industrial Research. There is little or no evidence of support from the respective Provincial Departments of Health, with the exception of the Eastern Cape, which provided digital cameras to 50 clinics for asynchronous teledermatology [31]. In Limpopo province the Provincial DOH entered into a public private partnership for the implementation of telemedicine services, including teledermatology. No data have been reported for either of these services. A recent survey found little evidence of Provincial DOHs taking ownership of telemedicine or budgeting for it.

Other constraints exist. The Health Professions Council of South Africa, the statutory body regulating medical practise has hampered telemedicine uptake through press releases stating that “telemedicine is unethical” [49] and tardiness in releasing guidelines for the ethical practice of telemedicine, which have been in development since 2007 [50].

The pervasiveness and utility of mobile technology is evident in the spontaneous uptake of mobile devices to provide healthcare services at the point of care. The cost of ownership and cost of connectivity for such services are borne by healthcare providers to the benefit of the healthcare system [43]. Although there is no reported resistance by patients or clinicians to the use of mobile devices in this fashion, concerns have been raised about data security and clinicians bearing the costs. Supporting this is evidence from Botswana that patients find mobile teledermatology acceptable [51], and from a Korean study that the process was found to be simple and the diagnostic accuracy “superior” to non-dermatologist diagnosis [52].

There is evidence of telemedicine devices having been installed in all provinces by the MRC but no data on their subsequent use are available. The continued reality of box dropping in the provinces, whereby equipment is procured and installed without a holistic systems implementation approach, is seen as an end in itself, which contributed to a premature termination of the NTS [40, 53, 54]. The exception to this is Limpopo Province where the public private partnership aided implementation of telemedicine services, but no data on its use have been reported. The critique reflected this overall trend of informal planning with ‘unsure’ ratings.

The WHO’s Expandnet network confirms that scale-up needs to be planned for from the outset to ensure success [55]. Furthermore there is no compromise for adopting a holistic approach to context sensitive, technological, financial, and human resource planning for an intervention. In addition there is a need for alignment with national strategies, definition of measurable objectives, performing readiness assessments, rigorous implementation management, and feedback loops to enable the realisation of intended impact. Van Gemert-Pijnen et al. and Van Dyk provide support for the adoption of an holistic approach [56, 57].

The Momentum programme [35] provides one of the more recent attempts to incorporate a holistic approach, but further refinement is required to ensure it meets the unique South African context. Mars and Dlova [41] and a related study by Colven et al and O'Mahony et al. [37, 48] provide evidence of evaluating the outcome of the intervention against defined objectives including educational benefit. Colven found up to 60% enhancement of diagnostic acumen of primary care providers, and Mars and Dlova found that referring doctors highly rated the educational benefit of case discussion with the dermatologist during and after synchronous consultation [41, 48].

The critique was limited by the paucity of peer-reviewed teledermatology specific literature for all the Provinces, resulting in only three Provinces being considered. Furthermore the requests for confirmation and additional information from authors of reported services were largely unsuccessful with the exception of KZN, Western Cape, and Limpopo. In addition the available literature lacked detailed project conception, planning, implementation and operational information. Of importance is that the reviewed papers reflect on the state of the services at the publication date and not their current state. The state of services in the Western Cape, KZN and Limpopo were confirmed through emails, and interviews.

Conclusion

Although limited, the understanding gained of teledermatology's history and current state in SA will inform the development of a holistic conceptual teledermatology scale-up framework of potential value domestically and elsewhere. Scale-up will contribute towards equitable dermatologist access through an efficient, effective, and sustainable referral service delivery intervention. The framework should embrace the bottom-up progress and ensure alignment with the Provincial and National Government's top-down strategic and policy direction. In particular, the results from the high-level critique and literature (showing a requirement for an evidenced based health need; cultural and technological readiness; leadership and stakeholder buy-in; business and financial planning; and service monitoring) will provide the initial minimum requirements for the development of the teledermatology scale-up framework.

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