POST-IMPLEMENTATION EVIDENCE-BASED DECISION MAKING: THE TELEHEALTH ASSESSMENT TOOL FOR HEALTH (TeATH)

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Abstract
Few telehealth implementations survive the initial pilot phase, and any anticipated Return on Investment seldom materialises. Within South Africa a reason is the lack of post-implementation monitoring and assessment. To address this practice gap we developed a simple and practical tool to allow decision- and policymakers to assess the post-implementation state of current telehealth applications. Recognised management approaches were reviewed, and elements adopted or adapted to develop the new decision support tool. A systems-based approach, applying a revised People, Process, and Technology methodology (incorporating Infrastructure), and Balanced Score Card and e-Readiness principles, was applied. This allowed development of the Telehealth Assessment Tool for Health (TeATH), whose utility was demonstrated by assessing the current performance of existing teleradiology implementations in three Provincial hospitals in Mpumalanga Province. Expected results were achieved, with TeATH revealing fair performance in the Technology dimension, but poor performance across People, Process, and Infrastructure for all three hospitals. TeATH is a simple and generic tool that provides decision support and guidance to health planners, differentiating weak or lagging implementations for which remedial action can be introduced. The tool has been adopted by the Provincial Department of Health, and has already influenced recent policy decisions. Broad application of TeATH would reduce wasteful expenditure, and facilitate implementation and uptake of telehealth in South Africa and elsewhere.

Keywords: Decision making organisational; decision support; operations research; post implementation evaluation; policy making; telehealth.

Introduction
Considerable investment is being made in developed and developing countries for implementation of eHealth (use of information and Communication Technologies (ICT) for health, including telehealth solutions).1 Telehealth is viewed by many as a critical tool with which to address healthcare issues that exist globally, but in particular for the developing world, especially sub-Saharan Africa. The World Health Organization (WHO) in 2006 reported the continent to be home to 14% of the World’s population, struggling with 24% of the global burden of disease, but served by just 3% of the world’s health workers and with access to merely 1% of world health expenditure.2 This fundamental situation has not changed.

A specific issue is in relation to the Health Human Resources (HHR) situation in Africa which is desperate, with many of the 48 sub-Saharan African countries having 20 doctors or less per 100,000 people, and an average in the WHO Africa Region of just 26 physicians per 100,000 people.3,4 The Health Systems Trust identifies in South Africa that nearly one half of health related professional positions (physicians and nurses) are unfilled in that country.5 Furthermore, in Zambia not only is the health sector operating at 50% of its intended complement, but in addition almost 45% of rural health centres are being run by unqualified health workers.6 This renders such health systems all but incapable of providing even basic health care services to their population. Compounding this circumstance is the pressure to adopt various eHealth solutions, which represent a profound opportunity cost, and for which solid evidence of benefit and value is sparse.

Health Region Management and Telehealth
There are few telehealth implementations in sub-Saharan Africa, and most are pilot projects.7 There
is little evidence of adequate planning involving needs assessment, business plans, implementation plans, and change management approaches to secure sustainability. Similarly, few telehealth implementations receive post-implementation assessment in order to inform policy-makers (Ministers) or decision-makers (region / hospital managers) and help them appreciate the status and impact of various undertakings that are their responsibility. Such assessments would permit evidence-based response, e.g., understanding the need to intervene with mid-course corrections, to discontinue, or to scale the solutions. This need becomes especially relevant when policy- or decision-makers find themselves inheriting a setting where a number of disparate eHealth activities have been initiated with unclear rationale or history, without consideration for accepted critical factors for success, or without elements of economic judgement, and are now perceived to be poor ‘opportunity costs’. By default, these people also inherit the responsibility to determine what is successful, and what should be focused upon (or otherwise), re-allocating already scarce resources to only successful initiatives that address defined needs. Yet within the telehealth field, there is currently no tool available to facilitate such post-implementation assessments, and guide decision support.

This study fills this gap by utilising recognised management approaches, plus expert opinion and experience, to develop a simple decision support tool that uses a minimum set of metrics against which to assess current eHealth initiatives. The tool was developed to provide the Mpumalanga Province Department of Health in South Africa with information on their current eHealth initiatives (including telehealth) and inform planning and resource allocation.

**Historical context**

South Africa is moving towards a National Health Insurance (NHI) scheme, but currently the healthcare system consists of a large public sector (which serves most of the population but is chronically underfunded and understaffed), and a large private sector in which, proportionately by population served, most clinicians work. The National Department of Health (NDoH) implemented Phase 1 of a National Telemedicine System (NTS) in 6 Provinces across the country, including Mpumalanga Province, in 1999. This exercise proved futile and failed, although some limited successes were achieved by Health Departments in KwaZulu-Natal, Eastern Cape, and Limpopo. There is no consolidated review of Telehealth activities over the years, but retrospective appraisal suggests reasons for failure were many and varied. They included poor project management (no proper project plans, methodologies, or development cycles applied), lack of documentation (problems not systematically documented for the benefit of future project managers), technical problems, human organisational issues, environmental troubles (difficulties maintaining ISDN lines as a result of persistent floods and cable theft), lack of user satisfaction, lack of buy-in (exemplified by reports continuing to be sent back to sending sites by fax or email and not through the reporting software), lack of training, lack of change management, and ‘dumping’ of equipment (sometimes never used or even unpacked).

Particular causes of project failure appear to be two-fold. First, decentralization of political responsibility from central (national) planning to distributed (provincial) planning without concomitant budget transfer of funds or human resources. Second; random implementation of several projects concurrently without prioritization, which stretched resources and prevented any single project reaching maturity or proving value. As a result, telehealth stagnated.

Recently however a National eHealth Strategy was released with clearly defined goals, objectives, and guidelines pertaining to the successful implementation of eHealth. The Strategy aligns with the NHI Scheme towards which South Africa is moving. Similarly, draft national telemedicine and mhealth strategies are in development. This is re-stimulating cautious interest.

The Province of Mpumalanga has a population of just over 4 million people, 66% of whom live in rural areas. Some 88% are uninsured and depend on the public healthcare system, and are served by 14.3 ‘medical officers’ per 100,000 people. Within the Province, there have been several attempts to establish telehealth (telemedicine). However, of 13 sites where telemedicine had been planned and implemented, recent evidence indicates only two
telemedicine sites were functional and that 14 telemedicine units installed at clinics were not yet operational because of incomplete installation and poor network coverage.\textsuperscript{16} 

Despite past failures, and although regulatory hurdles remain, Mpumalanga Province recognises the inherent benefits of appropriately implemented and managed telehealth solutions.\textsuperscript{17} Most critically, a recently approved Provincial Service Transformation Plan has called for an eHealth / telehealth assessment and analysis to be performed before further investment is committed.

Global, national, and provincial pressure to adopt eHealth initiatives in every healthcare setting is increasing. Yet an internationally recognised method or tool for post-implementation assessment, that would enable policy-makers or regional healthcare managers to understand which option to continue to invest in, is not available. Such decisions are not academic exercises, but significant social and political investment issues. A simple pragmatic tool is needed to guide decision-making and prioritization.

The Telehealth Assessment Tool for Health was developed within the Mpumalanga DoH to leverage available, or readily accessible, administrative level data or local expert input to permit data-driven decision making leading to corrective measures (that allow mid-course correction to rectify an identified issue). TeATH allows judgements to be made that facilitate successful prioritisation and implementation of current and future telehealth applications.

**Common management tools**

Healthcare is a complex entity and requires managers to be disciplined and structured in their approach to assessing and responding to the web of real world issues. Principles and concepts from several management tools and approaches were reviewed and subsequently applied. These included: systems thinking; People, Process, and Technology; Balanced Score Cards; and e-readiness.

**Systems thinking.** A system is a complex and dynamic entity. It can be described as a set of components (collectively and independently demarcated by spatial and temporal boundaries), integrated to form a whole but also influenced by its surrounding environment (e.g., a community within a Region). Precise structure and purpose of any system differs, and is expressed in its functioning. Systems thinking, derived from General System Theory of the 1940’s and 50’s, is a form of problem solving.\textsuperscript{19,20} Unintended and distal consequences can occur when looking at one component of a system (e.g., a department) and seeking the problem and solution within that single component. Systems thinking therefore practices a set of habits that examines a process in its entirety in an iterative and cyclical cause and effect manner. It looks holistically at all components in the context of their relationships and interactions with each other, and with other systems.

**People, process, and technology.** The precise origin of the tripartite combination of people, process, and technology (PPT) is unclear. It may have had its origins in customer relationship management (CRM), which aligned PPT in the context of an enterprise-wide, customer-driven, technology-integrated, and cross-functional organization (a complex system).\textsuperscript{21} However, more recently other authors have implied ownership of iterations of PPT.\textsuperscript{22-24} Regardless, it is the realisation of the intimate interaction of people, process, and technology in modern business that characterises the framework of this thinking. People bring knowledge, skills, and competencies to bear on a process. Process describes the ‘business’ needs and resources required to meet the needs of those people (workforce). Technology addresses the tools and techniques used to make the process efficient and to communicate the results.

**Balanced score card.** The balanced scorecard (BSC) is a performance management tool introduced in the 1990’s that can be used to provide regular and standardized reports for monitoring actual performance of organizational activities.\textsuperscript{25} When performance deviates from expectations, remedial action can be instigated to quickly return performance to desired levels.

Now in its third ‘generation’, the BSC has been widely adopted. It is one of the top five management tools used globally, and is also well used in the healthcare sector.\textsuperscript{25-28} Critical characteristics of a BSC have been described: focus is on a clear strategic goal of the organisation concerned; only a small number of measures are selected to monitor; and a mix of financial and non-financial measures are included. The BSC is not intended to be complex, with no more than about 20
easily reported measures. Although somewhat subjective, weighting using input from subject matter experts can allow those measures considered more predictive of successful performance to be favourably weighted, compared to measures less predictive, although care must be taken to avoid introduction of bias.  

**eReadiness.** Technological ‘readiness’ has repeatedly been demonstrated to be a crucial factor in the implementation of successful telehealth initiatives. Overall eHealth readiness has been described as the state of preparedness of healthcare institutions or communities for anticipated change brought about by programs related to Information and Communication Technologies (ICT), and encompasses telehealth readiness. Recognition of any lack in readiness requires implementation of appropriate change management initiatives. A number of tools have been developed to measure readiness at different levels (e.g., communities, organizations, management, and individuals). For example, one tool - the Technology Readiness Index (TRI) - was developed to measure people’s general beliefs and some thinking on technology, and comprises four sub-dimensions: optimism, innovativeness, discomfort, and insecurity. In developing metrics for this study’s framework, principles of e-Readiness were employed. In addition, aspects examined during telehealth accreditation were also considered.

**Developing the TeATH Tool**

The resources and insight gathered from the literature were synthesised into a new decision tool through a process of refinement, expert review, and application. The focus was on ‘what works’, rather than the promotion of any particular theory. By combining the principles and approaches from these recognised assessment and management methods, TeATH was developed to allow quantitative measurement of select, simple elements of telehealth implementations and progress made to date.

TeATH is based on the following principles:

- Telehealth initiatives are just one element within a system (clinic; hospital; health system) and therefore should be evaluated using a systems approach.
- The alignment and balance of four quadrants are essential for the success of telehealth initiatives; People, Process, Technology, and Infrastructure. The rationale for supplementing with ‘Infrastructure’ was that in the complex web of healthcare the local setting must provide adequate support to enable the telehealth technology to perform adequately. This created an innovative quadripartite model - People, Process, Technology, and Infrastructure - which was applied as the base concept in development of the desired tool, and also satisfied the four-quadrant principle of Balanced Score Cards.
- Also in keeping with BSC principles, each quadrant was populated with just three measures (related to readiness, economic, and non-economic parameters) (Table 1). The subgroups’ scoring and weighting were determined through Subject Matter Experts, and discussion and consensus with local telehealth users. Each subgroup is scored from 1 to 10, but the metrics are not equally weighted. Weighting of the subgroups varies from 6 to 16%. Greatest weight is given to ‘awareness and use’ (Process) and ‘available bandwidth’ (Technology), as these were identified as critical to success. Also identified of importance were ‘attitude’ and ‘user training’ (People). All other parameters are equally rated (6%). Scores are reverted to percentage scores for easy reference.

**Table 1.** Aspects addressed by the twelve TeATH metrics (three for each of PPTI components).

<table>
<thead>
<tr>
<th>TeATH Metrics</th>
<th>People</th>
<th>Process</th>
<th>Technology</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Scheduling of sessions</td>
<td>Connectivity - rate</td>
<td>Venue - appropriateness</td>
<td></td>
</tr>
<tr>
<td>User training</td>
<td>Frequency of use</td>
<td>Connectivity - quality</td>
<td>Room design and décor</td>
<td></td>
</tr>
<tr>
<td>Capacity of personnel</td>
<td>Planning and management</td>
<td>Technical support</td>
<td>Furnishing and equipment</td>
<td></td>
</tr>
</tbody>
</table>
Applying the TeATH Tool

The information needed for completion of TeATH is derived during on-site visits and completion of a survey by relevant staff. Findings are entered into a spreadsheet and presented as a BSC of performance. The tool establishes a baseline which can be used for planning and subsequent measurement of improvement.

Three hospitals within Mpumalanga had existing teleradiology activities. No evaluation or other assessment of their efficacy had been made and it was decided to apply the TeATH tool to these initiatives in order to test its utility and process. The total TeATH scores for each of the 12 metrics measured at these three hospitals with teleradiology services is shown in Table 2.

Review of the findings shows that none of the hospitals are performing well, with an average score of 42% (29-51%), Each hospital shows adequate Technology, but requires attention in the areas of People and Process, in particular. Analysis of results for individual hospitals shows hospital 2 is struggling almost across the board, and especially requires remedial action in Process and Infrastructure.

Discussion

The Telehealth Assessment Tool for Health (TeATH) was specifically developed for post-implementation of telehealth systems. It is based on the principle that telehealth itself is a system, a group of interrelated or interacting elements forming a unified whole, that should be evaluated using a systems approach.

Implementation of systems is an important management function and responsibility; so too is post-implementation assessment. Available telehealth assessment tools typically focus on evaluation during pre-implementation or implementation phases, fail to treat telehealth as an ICT ‘system’, and ignore the basics of system implementation and often project management procedures. When following a ‘system’ approach, intended outcomes are properly documented and a clear paper trail with responsibilities and achievements are indicated. Many telehealth implementations focus on acquisition and instalment, with no testing and documentation of results. Implementation processes for ICT related projects should include the stages of investigation, analysis, design, and maintenance as part of the development cycle.

TeATH allows easy identification of weak and lagging telehealth implementations supporting evidence-informed remedial action and project prioritisation. Plans can then be developed and costed to improve weak implementations, turn-around failing projects, or prioritise competing implementations. TeATH is a simple, generic tool that provides essential guidance to health planners and will reduce wasteful expenditure and facilitate implementation and uptake of telemedicine wherever it is applied. Further development is planned, for example linking the tools to department of health personnel and financial databases to improve costing aspects.

Table 2. TeATH scores for the 12 metrics recorded at the three teleradiology hospitals.

<table>
<thead>
<tr>
<th>HOSPITAL</th>
<th>PEOPLE</th>
<th>PROCESSES</th>
<th>TECHNOLOGY</th>
<th>INFRASTRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ATTITUDE</td>
<td>USER TRAINING</td>
<td>PERSONNEL</td>
<td>SCHEDULING AND SET UP</td>
</tr>
<tr>
<td>Weight</td>
<td>12%</td>
<td>8%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Avg.</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Conclusions

TeATH is based upon recognised management tools and approaches, plus explicit and detailed thinking from a local Provincial setting perplexed by past telehealth decisions. Through measurement and presentation of key factors, this tool provides clear guidance on required remedial or developmental action. It has now been accepted and adopted by senior management withinMpumalanga Province as a decision support tool, and has already influenced local policy decisions around telehealth implementations. Demonstration of its ongoing performance and its measure of impact is being pursued.

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