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SYSTEMS-LEVEL QUALITY IMPROVEMENT

The Development of a Telemedicine Planning Framework Based on Needs Assessment

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Abstract Providing equitable access to healthcare services in rural and remote communities is an ongoing challenge that faces most governments. By increasing access to specialty expertise, telemedicine may be a potential solution to this problem. Regardless of its potential, many telemedicine initiatives do not progress beyond the research phase, and are not implemented into mainstream practice. One reason may be that some telemedicine services are developed without the appropriate planning to ascertain community needs and clinical requirements. The aim of this paper is to report the development of a planning framework for telemedicine services based on needs assessment. The presented framework is based on the key processes in needs assessment, Penchansky and Thomas's dimensions of access, and Bradshaw's types of need. This proposed planning framework consists of two phases. Phase one comprises data collection and needs assessment, and includes assessment of availability and expressed needs; accessibility; perception and affordability. Phase two involves prioritising the demand for health services, balanced against the known limitations of supply, and the implementation of an appropriate telemedicine service that reflects and meets the needs of the community. Using a structured framework for the planning of telemedicine services, based on need assessment, may help with the identification and prioritisation of community health needs.

Keywords Telemedicine · Telehealth · Hospital services · Needs assessment · Planning · Framework

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Background

Governments around the world are facing the challenge of providing equitable healthcare services to all its citizens. Typically, people living in rural and remote communities receive poorer access to specialist services compared to people living in larger cities [1–5]. In rural and remote area, services that are not locally available to the community can be provided through: 1) Specialist outreach where physicians travel to see the patients; 2) Patients having to travel to receive care; 3) Emergency retrieval where a team goes to the patient location and then transport them to the appropriate care facility outside of their community; and 4) Telemedicine where care is provided remotely. Telemedicine can offer benefits by delivering specialist healthcare services to these areas, leading to an improvement in the access to healthcare services with reduced need for travel [1, 6]. Telemedicine is defined broadly as 'the use of information communication technology (ICT) to deliver medical services at a distance" [7].

Regardless of its potential, telemedicine uptake in the mainstream health system has been much slower than expected [8–11]. Many telemedicine initiatives do not progress

beyond the research phase or they fail to become sustainable following implementation [8–10]. This might be caused by the complex, and often underestimated, process of telemedicine implementation. The known factors which influence the success of implementation are numerous such as the technological infrastructure, financial business models and legislation [10, 12, 13]. The literature offers various reasons for the limited adoption and the lack of sustainable telemedicine services. One of the main causes of failure in reaching a sustainable service model is the lack of sufficient planning prior to the implementation of a telemedicine service [11, 14]. A systematic review that identified deployed telemedicine service in hospital facilities (n = 137), found that while few papers (18.2%) gave a brief description of their service, including how it was established, no reference to need assessment as a part of structured planning was made. Some of the reported telemedicine service implementation was founded on the success of a pilot study or research project, as a replacement for an existing outreach clinic or an awareness of the need for an additional service (for example, as the result of a long waiting list.) [15].

To overcome this problem, the National Rural Health Association have recommended seven steps of telehealth planning for program success [14]. These steps were arranged in a sequential order in relation to their occurrence as the telemedicine program progresses. They are: Evaluating needs, developing a care services plan, developing a business plan, planning technology, training personnel, testing care and technology plans and evaluating outcomes [14].

The first step for planning a successful implementation is evaluating needs, adequate time should be dedicated to this process as complex interventions usually require attention to this phase [13]. Telemedicine should be driven by the needs of patients and clinicians rather than technology [16]. Each community has its own unique requirements that should be addressed accordingly. This process in not new to the healthcare sector, and it is a part of Health Service Planning which is defined as the "Health service planning that appraises the overall health needs of a geographic area or population and determined how these needs can be met in the most effective manner through the allocation of existing and anticipated future resources" [17]. This process is usually investigated by conducting a health needs assessment.

A framework that can provide a general sense of direction and guidance to assess the health services needed prior to the implementation of a telemedicine service delivery model does not exist or, at least, is not published in the literature. Therefore, the aim of this paper is to describe the development of a framework to assess the health services needed in a community setting prior to the implementation of telemedicine services. This paper provides 1) a brief overview for planning a healthcare service using health needs assessment; 2) an outline of the key process in needs assessment, definitions and notable theories regarding needs and access; and 3) presentation of a planning framework for telemedicine health services, as an approach to enhance telemedicine services delivery.

Planning a healthcare service using health needs assessment

Studying and analysing data regarding the utilisation of healthcare services, the availability, accessibility, cost and affordability of services can provide an understanding of the current status of healthcare services. This information can then be used to identify the requirements, investigate the available options and identify whether telemedicine might play a role in improving access to healthcare services.

The appropriateness of different data collection methods should be considered carefully, so that the results reflect the community's health needs. The choice of the data collection method and the data sources is heavily dependent on the availability of data in the community of interest. Quantitative or qualitative data collection methods or a combination of both (often the choice of demographers), can be used. Analysing routinely collected data and combining it with other sources of information such as surveys, questionnaires, suggestion boxes, focus groups, participant observation and interviews are useful methods for gaining insight into the community's health service needs [18].

Health needs assessment

Health needs assessment is an evidence-based method of planning for health services to ensure a health service uses its resources to improve or maintain—in an efficient manner—the public health, by gathering the required information and the allocation of resources distributed to reduce inequalities. It has evolved into a valid method of tailoring health services [19, 20].

Health needs assessment is an integral component of health service planning. The period that truly influenced needs assessment and established it as a critical part of the healthcare process, was the transition from the 1980s to the 1990s [21]. Historically, service provision was service led at the convenience of providers rather than focusing on the needs of the patients. This changed when the National Health Service (NHS) made patients and their needs the center of needs assessment [22]. However, in the literature far too little attention has been paid to applying health needs assessment as a main element for planning telemedicine services.

Key process in needs assessment, definitions and notable theories regarding needs and access

Key processes in needs assessment

The essential steps for conducting a needs assessment are: consultation with key stakeholders; data collection (quantitative and qualitative); priority setting; analysis of health problems and providing possible solutions [23].

Collaboration and consultation with key stakeholders

This is the first process in needs assessment. This process usually includes key stakeholders groups such as people who are living in the community, healthcare service providers and managers. Usually they have a clear impression of health needs in their community and can be a rich source of help and information. The aim of this process is to obtain stakeholders' opinions on the major healthcare issues in their community and their concerns [22, 23].

Collect and use quantitative data

Data that are routinely collected can be a powerful tool to assess the use of health services and needs. A range of databases can be used to assess the needs for health services. However, it is also important to acknowledge that data on the utilisation and structure of health services can be unexpectedly difficult to attain. The value of many databases is limited by the incomplete recording of activities and lack of common disease definitions [19, 23, 24].

Collect and use qualitative data

Collecting and analysing qualitative data is essential component in studying health community needs, since not all information can be captured through collecting quantitative data. Qualitative data can cover issues as unmet needs, perceived risk and satisfaction. The aim is to move the analysis from describing the healthcare status of a community or their issues, to understanding it [23].

Determine strategic issues and priorities

Strategic issues will manifest after the process of analysis and consultations, and these issues should be prioritised. Methods to determine strategic issues and priorities include a consensus ranking from the community about the most important issue to be resolved, or involve economic analysis to inform the process such as cost-effectiveness and cost–benefit [22, 23].

Review the evidence on the priority issues

After identifying the priority issues, it is important to review the literature for interventions that have been tested and shown to address these issues. This step will ensure that resources are not wasted on untested or ineffective interventions [23].

Analyse the health problem or issue

The final step in needs assessment requires analysing the health issue and the potential solution more thoroughly. This involves a more detailed identification of the population being studied, examining the factors that are influencing the issue, identification of priorities and clarification of the resources needed to address the issue [23].

Needs theories

Many definitions have been suggested for the concept of "need", each a means to improve the delivery of health services to the population. Assessing needs is used as a trigger to change and improve the healthcare services [25]. In the following section different theoretical approaches to the concept of need are described.

Bradshaw's typology of need (1972)

Bradshaw (1972) considered four types of needs: felt need, expressed need, normative need and comparative need; each of which provides valuable information that contributes to planning for healthcare services. None of these perceptions can stand on its own, but together they are appropriate for the planning of service delivery [23, 26, 27].

Felt need: describes what people say they want. Bradshaw suggested that felt need is usually not taken into account, although hearing the views of the people themselves is an important aspect of assessing the need for a service. However, deciding to provide specific care based only on felt need is risky. People's perception might be founded on a limited knowledge of services and therefore they will not feel the need for a service that they do not know exists [23, 25–27].

Expressed need: is determined by people's use of services. It is felt need translated into action. Economists call it demand. Expressed need is commonly used as a measure of need by health service planners, for example a surgical waiting list. The limitations of expressed need is that it only considers already existing services, and does not capture the community's need for new services. Furthermore it does not deduct the pre-symptomatic conditions when people do not feel or express a need [23, 26, 27].

Normative need: is the expert's evidence-based opinion on what is needed in a particular area. Normative needs are not absolute, they are changeable as a result of change in

knowledge and values. While an expert's opinion may be less subjective, the objective nature of the opinion does not necessarily make it 'more right' and they sometimes do not consider the needs of different groups or the evolving nature of healthcare services [23, 25, 27].

Comparative need: Comparative need at the population level is founded by comparing needs and services provided in different locations to recipients who share the same characteristics. This comparison can indicate that recipients with similar characteristics have the same needs and therefore should receive similar services. Comparative need "is about equal provision for equal need and unequal provision for unequal need" [28]. It can be useful as a basis for an argument for additional resources. Two difficulties arise in establishing this comparison. First, it is difficult to articulate which significant characteristics ought to be considered when assessing comparative needs. Secondly, the services which are provided (the supply) may still not correspond with need [23, 25–28].

Doyal and Gough: The objective basis of the concept of need (1992–1993)

Doyal and Gough's theory of need have represented a very different view to the majority of the perspectives on need, they stated that 'need' is an objective concept, and that there are indeed universal needs that are common to everyone [28, 29]. Two basic needs were identified by Doyal & Gough: 1) the need for physical health; and 2) the need for autonomy. However, Doyal & Gough acknowledged that their approach raises problems. The first problem relies on how to decide on the level or standard of need satisfaction that should be set in order to measure the deficiency in the actual level achieved. The second problem is in answering the question of who is to decide whether or not a given policy is meeting basic needs [28, 30].

Economist view on health care needs (1992–1993)

The most favoured definition of need, used widely by economists is "*the ability of people to benefit from health care provision*" [19]. Which means that need exists only if there is an opportunity to benefit from a healthcare service whether through effective treatment or health gain. By applying this definition, a greater importance should be placed on the outcome of health interventions [29]. This approach can be addressed by two questions: 1) is the health care service under study beneficial? and 2) if so, what is the best way to provide it? Answering these questions will affect how much more, or less, a particular health service will be provided [29, 31, 32].

Access theories

A healthcare systems performance is strongly influenced by access to healthcare. Access has been used as a measurement of service delivery and has shown to have a notable role in the health policy [33, 34]. Access in healthcare can be perceived as "the opportunity to reach and obtain appropriate health care services in situations of perceived need for care" [33]. Since access is a multi-dimensional concept and a complex notion, reaching a unified, agreed upon definition have proven to be difficult [33, 35]. In the subsequent paragraphs different theories and concept regrading access are presented.

Andersen & Aday behavioural model (BM) for access (1974–1995)

Andersen and Aday noted that the focus of the earlier perceptions of the use of healthcare was on two major dimensions, the population characteristics versus the delivery system characteristics. They suggested that 'it is perhaps most meaningful to consider access in terms of whether those who need care get into the system or not' [35]. They also clarified that access can be measured by the utilisation of services and the outcome of the use process. This structure was then expanded to include five components. The five components are: 1) health policy; [5] the health delivery system characteristics; 3) the population characteristics; 4) health services utilisation and 5) consumer satisfaction. The users of this concept tried to create access indicators that focus on both the process and the outcome [35, 36].

Penchansky and Thomas dimensions of access (1981)

Penchansky and Thomas (1981) discuss access as general concept that contains a set of dimensions illustrating the fit between the healthcare system and patients. Their perception of access has extended the concept beyond service availability, to cover the financial, personal, and organisational barriers to service use. They suggested that this fit could be measured across five dimensions: availability, accessibility, accommodation, affordability and acceptability [35, 36]. Availability matches the volume and type of existing services to the users' volume and types of needs; accessibility is the location of supply and the location of the users, which takes into account the users' travel time, distance, transportation resources and cost; affordability is the users' perception of value in relation to its cost and the population financial ability to use the healthcare services provided by the system; accommodation is the relationship between the manner in which the supply resources are organised to serve the users (including hours of operation and appointment systems) and the users' ability to adjust to these factors and their opinion on their suitability; and acceptability is the association between the users'

perceptions on the practice and personal characteristics of the providers and the actual characteristics of the existing providers, as well as the provider attitudes about acceptable personal characteristics of users [37, 38].

Julio Frank extended work on Penchansky and Thomas Elements of access (1985–1992)

The work of Penchansky and Thomas was extended by Julio Frenk, he noted a problem with using terms that are not clearly defined and attempted to resolve this by creating domains for access. He outlined three domains: a narrow domain, an intermediate domain and a broad domain. The narrow domain involves the process of seeking healthcare services; it often starts from the period of searching for care until the initiation of care. It only involves the process of entering the health care system. The intermediate domain adds the aspect of continuing care, for a particular period of health care. Finally, the broad domain involves the delay between the desire for care and the actual search for care (including aspects such as knowledge about services, trust towards the health care system) [33, 36].

After reviewing different theories and definitions of the concepts of "Need" and "Access" the following need theory and access model were adopted to develop the framework for telemedicine health services based on needs assessment.

The most suitable need theory to be adopted in developing this framework was found to be Bradshaw's typology of needs. His work sheds light on the different definitions of need identified by different groups in society. His work also represents a useful and clear model for the different theoretical domains of need, and provides an important instrument for considering the critical issue of whom should the need be identified from.

While other access models can be applied to develop this framework, Penchansky and Thomas' dimensions take a comprehensive approach to the access concept and provide a structured and clear way of assessing access. In addition, these dimensions are driven by the concept of fit between the healthcare system and the patients, and are well aligned with Bradshaw's typology of needs. Together with the needs assessment process, they can be adopted in developing a planning framework for telemedicine health services based on needs assessment.

The proposed planning framework for telemedicine health services includes the following dimensions of Penchansky and Thomas' theory of access: availability, accessibility, and affordability, while acceptability and accommodation dimensions were excluded. These two excluded dimensions are out of the framework scope as they are focused on issues related to cultural factors (acceptability) or current service quality and adequacy (accommodations). These two excluded dimensions of access, however, can be studied after providing telemedicine to these rural areas in order to measure their acceptance of the service.

From Bradshaw's typology of need; felt need, expressed need and normative need were included in the proposed framework and only one type of need was excluded which is comparative needs. Applying comparative need at this stage of needs assessment will not be relevant since rural areas in countries such as Australia or Canada for instance, have a known shortage of specialist in rural areas compared to the city. Therefore, comparing the level of services between a rural area and urban area (the city) will only provide a long list of unavailable services that will not add any useful information to the needs assessment process.

A telemedicine planning framework based on need assessment

In this section the key processes of needs assessment, Penchansky and Thomas' dimensions of access and Bradshaw's types of needs, discussed above, will be adopted to the proposed framework that will assess community needs and evaluate the appropriateness of telemedicine.

This proposed planning framework for telemedicine health services based on needs assessment consists of two phases as shown in Fig. 1.

The first phase is data collection and needs assessment comprising:

1. Availability and Expressed Needs
2. Accessibility
3. Perception and Affordability.

The second phase is Priority Setting Analysis, which consists of three stages:

- Determining strategic needs and priorities,
- Reviewing the evidence on the prioritised needs and balance needs against supply,
- Indicate potential telemedicine solutions if appropriate.

The following sections will present and discuss different data collection methods that are required to collect data in order to assess each part of phase one in the framework.

Phase one: Data collection and assessing the needs

Phase one is measured quantitatively and qualitatively and each part is appraised and assessed individually before being combined to provide a comprehensive overview of community needs for healthcare services. Analysis of data from each part will provide an understanding of the current status of healthcare services and the needs of the target population.

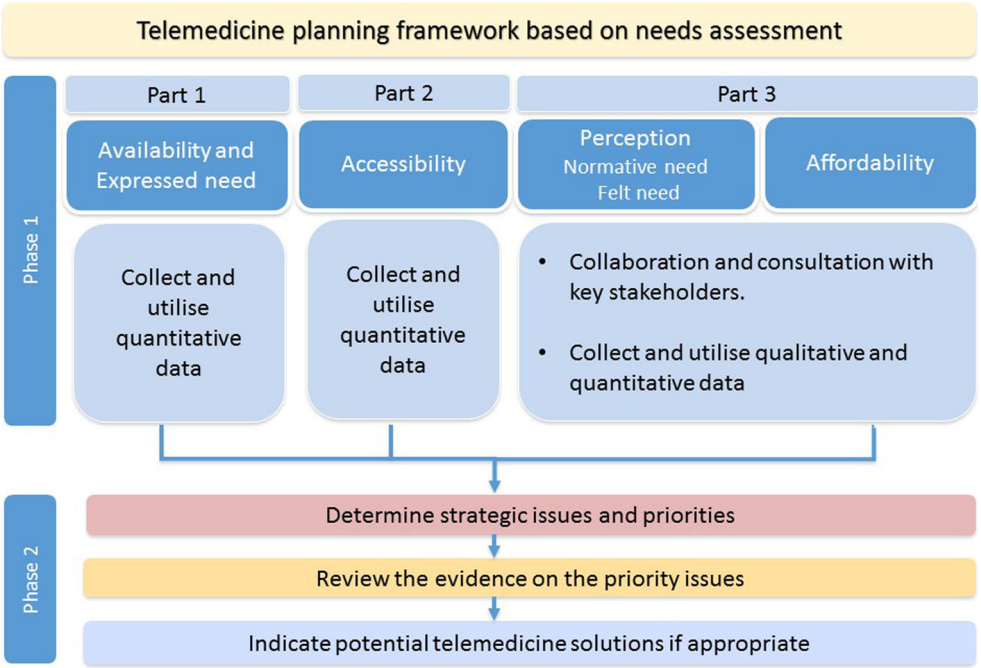

Fig. 1 The developed telemedicine planning framework based on needs assessment

1) Availability and expressed needs

The assessment for this part of the framework will be conducted using an objective indicator, quantitative data, collected to show the available specialist health services as well as services that patients needed and had to travel outside their area to receive.

The source of data for this part can be extracted from routinely collected data, within hospitals or the health department. When health services are offered, these data are collected routinely for administrative purposes. These data can serve as a rich source of information on the available healthcare services. However, poor documentation, the absences of common disease definitions, and a lack of consistent classification systems, can lead to difficulties in attaining quality utilisation data on the local health services [17, 19].

The most frequently adopted indicators for health services usage are hospital admission (for inpatients) and volume of physician encounters (outpatients) measured by physician office visits. This data can be measured for a specific facility or for the entire community and it can be broken-down into components of utilisation. Admission rates, and physician office visits rate can then be calculated by geographic area, clinical specialty and demographic aspects [17]. Inpatient data such as the top 10 diagnoses made at hospital discharge using, for example, International Classification of Diseases (ICD)- 9 or ICD 10 codes for people who live in a specific area using the postcode of that area can provide a clear picture of the needed service. Outpatient data can be sourced by looking at the referral data, for example, the top 10 specialities patients were referred to from a specific postcode for a specific period of time [22, 39].

As a baseline it is vital to collect data about the available health services as well as data about services that patients had to travel to receive. It is important to understand what to change from, and what to change to [19].

2) Accessibility

Spatial accessibility (SA) is a measure that is used to identify areas with insufficient health services; it refers to the ease with which residents of a certain area can reach healthcare facilities and services [40, 41]. A common approach to defining spatial accessibility is based on travel distance, travel time and the spatial distribution of both consumers and health service providers [38, 40–43]. Geographic information systems (GIS) can be used to conduct spatial accessibility studies to analyse population and health data while focussing on the geographical dimensions of access. GIS is a tool that helps examine the healthcare needs of small geographical areas, enhance the measures of geographical access to health services, and identify new methods for planning and analysing service locations [44–46].

Key datasets for the geographic model based on distance and travel time are the road network and specialist health service locations as well as data and location information from the studied population. One of the known GIS software systems to be used for the assessment of accessibility is from the Environmental Systems Research Institute (ESRI) Aeronautical

Reconnaissance Coverage Geographic Information System (ArcGIS).

A number of input datasets are required to support this application. The datasets will cover the following parameters: 1) Population data; 2) Road network; 3) Health facility locations and their capabilities. Population data can be derived from existing global datasets or from country-specific census data. The road network and population locations form the basis of all GIS modelling. The road network captures the travel potential factor, and the population location captures the travel distances factor. Health facility locations data can be obtained from numerous sources including census data, from the Ministry of Health, or from field-based health facility surveys.

Estimating the travel distance and time to specialist outpatient care services for residents living in a rural area can be done in two steps, first the accessibility to specialist outpatient care services from the studied rural area have to be determined. The end points will be the places of usual referral. Road distances will be calculated for all the mid-points between the place of supply and place of demand, which is the studied area. Second, the appropriate measures for the usual means of transportation will be used to calculate the time and distance from a patient's residence to the specialist care facility. Distance and round-trip time from the point of retrieval to the specialist care service facility will also be calculated.

The cost of travel can be calculated using the output data from part one (Availability and Expressed Need) using the frequency of travel and destination of travel, and part two (Accessibility) using the distance and time for traveling. Reimbursement information from governmental programs such as the "Patient Travel Subsidy Scheme" in Queensland Australia will be used to arrive at the cost for traveling and means of transportation used.

3) Perception and affordability

This part of the framework can be divided into two sections 1) Clinicians perception; 2) Population perception and affordability. This is a subjective measure; where input from clinicians and the public is vital to gain a comprehensive view on what the community needs, this includes the collection of qualitative and quantitative data that can be obtained through interviews, focus groups, and surveys [22].

Interviews are an interaction conducted between a researcher and study participant usually on one- to one basis. This method allows for a detailed exploration of the individual perceptions and experiences The depth of the interview questions differs, it can be categorised as structured, semi structured, and unstructured interviews [47]. More in depth information can be produced by in person interviews (face-to-face), but it can also be time consuming and expensive, particularly when there is a need for traveling to interview the participants. An alternative and a more economical option would be conducting the interview through using telephone or videoconferencing. These two methods are useful for interviewing participants who live in difficult to reach, isolated areas. While being equal in accuracy rates in relation to in person interviews this method will be less time consuming and require less resources to reach these participants, provided that the interviews are kept brief [48, 49].

Focus groups on the other hand, consist of a small group of participants who share common characteristics related to the studied topic, engaging in a guided discussion. The use of a focus group methodology is appropriate when the aim is to understand different groups' perspectives about the topic and to discover factors that influence their behaviour or opinions [22, 47].

Another method would be Questionnaire survey, which is a data collection method that consists of asking individuals to respond to a written questionnaire. There are a number of advantages for using this tool, it is a rapid way of collecting data, relatively inexpensive to conduct and if performed well, it can provide a representative sample of the population [50, 51].

Phase two: Priority setting analysis

After the comprehensive process of identifying needs (phase one), a list of needed healthcare services will be produced. This list will likely present different, potentially conflicting needs. This is predictable since the collection of data in the first phase is intended to capture quantitative and qualitative data that reflects subjective and objective measures of needs that represent the community as a whole [52].

These different needs should then be weighed against each other and prioritised, since resources are limited and the goal of needs assessment is not just to identify the needs but to identify the prioritised services, which when offered will benefit most people in the studied community and improve their health. Healthcare needs assessments that do not provide adequate attention to implementation will become merely an example of an academic exercise [20, 52].

In this phase the produced needs from phase one will be prioritised in three stages:

- Determination of strategic needs and priorities
- Reviewing the evidence on the priorities needs and balance needs against supply
- Indicate potential telemedicine solutions if appropriate.

Determine strategic needs and priorities

A list of needs will manifest after the process of data collection and assessing the needs, these needs should then be

prioritised. They can be prioritised based on different criteria for example: the frequency of the referral; ranking from the community; using economic analysis to find the most cost beneficial needs to be offered; and consulting with knowledgeable groups [23, 52]. These methods can be combined to produce a shorter list that can then be further studied in the next stage.

Review the evidence on the prioritised needs, and balance needs against supply

After identifying the priority issues, it is important to firstly identify if telemedicine is a suitable, reliable intervention for the identified needs of the community by searching and analysing the literature to insure that telemedicine has been tested and shown to solve these issues, since not every health care need can be met by telemedicine. Then, if telemedicine was shown to be a valid method of delivering the previously identified needed healthcare service, the next step would be to balance the needs against the known limitations of supply by assessing if this healthcare service would be economically viable, available and manageable by the provider. This step will help ensure that resources are not wasted [23].

Indicate potential telemedicine solutions if appropriate

If the telemedicine service is then found to be appropriate means of delivering the healthcare service to the community, the decision will be made to provide it as a tailored service based on needs assessment. Otherwise if the healthcare services needed in the community cannot be offered through telemedicine, a decision of not proceeding will be made by the telemedicine service provider. Other means of delivering the service might be more suitable such as a visiting doctor or providing the studied community with a specialist based on the needs.

By the end of this phase the first step of telehealth planning for program success will be completed and the service provider can then proceed with the next six steps : developing a care services plan, developing a business plan, planning technology, training personnel, testing care and technology plans and evaluating outcomes to insure a successful implementation of their program [14].

Conclusion

The implementation process of telemedicine is complex and often underestimated. The factors that influence the success of telemedicine services are numerous. Careful planning that is based on evaluating needs is an integral element and the first step towards a successful implementation of telemedicine services. This paper describes a telemedicine planning framework which could be used to assess health service needs in a community before implementation. The developed planning framework consists of two phases: [1] data collection and needs assessment, [5] Priority setting analysis. Adopting this framework may contribute to the planning of appropriate combination of services, such as outreach, patient travel, and telemedicine, thus better reflecting the health needs and priorities of a selected community. Now that the planning framework has been established, future work will involve the development of a practical guide which will be important for implementation.

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