Digital Health

An Introduction to Telemedicine

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Introduction

Telemedicine is defined as "means to connect a Healthcare provider to a care-recipient through one or more channels of Telecommunication without an in-person meeting between them." In short, Telemedicine implies as a Virtual Medical Consultation over the Internet with a care receiver and a caregiver not required to be present at the same physical location.

Essential Elements of a Live Teleconsultation

The basic elements of any Live Medical Teleconsultation can be summed as below, although with increasing level of sophistication, further layers are added:

- History Taking Interface
- Visual Medical Examination Window
- Medical Notes and Investigation Folders
- Clinical Decision Support System
- Auto-summary of the Patient-Clinician Encounter

History Taking Interface

An integral part of any patient-clinician interaction is the medical history-taking where a clinician assesses various symptoms of a patient to form a qualified medical opinion. Taking medical history involves asking questions about the present complaint, establishing its description, exploring relevant the past medical history of illnesses and surgical operations, the current medications the patient is taking, and other relevant critical individual information.

Visual Medical Examination Window

For common day-to-day medical practices, many conditions have nothing to show except for pain and discomfort. However, several conditions present with overt physical markers and are visible on the patient's skin or mucosa. At times, such findings can be one of the variety of physical signs such as muscle wasting, bony deformities, swelling of body parts, discolouration, pigmentation, particular patterns etc.

Several common medical conditions can be more closely examined by asking the patient to upload images before their appointment or by instantly using a mobile phone camera during the Teleconsultation. The overt clinical findings such as a painful mole, skin rash or pigmentation, swelling or deformity of a limb can be examined over a live webcam video by the examining doctor over live webcam to form a qualified medical opinion.

Visual examination can safely substitute for most of the physical examination requirements for several specialities, particularly in Psychiatry and Dermatology. With experience, a tactfully conducted visual examination can replace a physical examination to gain sufficient information for reaching a clinical opinion or differential diagnosis.
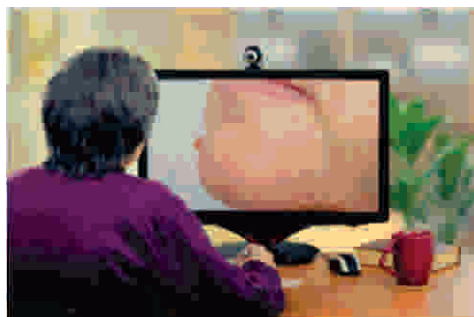
In specialities like Orthopaedics and Rheumatology, the active joint movements can be checked without needing to touch a patient and instructions given to a patient verbally, supported by self-demonstration usually would suffice, e.g., a doctor putting hand behind head asking patient to follow the same to assess external rotation of a shoulder joint.

The gap of information can be filled in by patients providing self-checked blood pressure, temperature, and blood glucose readings. A large number of smart gadgets are now available for patients to use at home or through a Practice Assistant at a Telemedicine Spoke to provide additional medical information such as heart and lung sounds, live ECG, and even live ultrasound scanning, as well as high-definition imaging of skin, ear, nose, and throat or inside the eye.

Medical Notes and Investigation Folders

Advanced scientific developments empower clinicians to be supported by advanced medical investigations like MRI scans, nerve conduction studies and echocardiogram. These investigations are non-invasive and are of enormous value in diagnosing medical conditions to confirm or rule out several pathological entities.

The scientific evolution in the domain of medical investigations, have necessitated amendment of classifications of injuries taught in medical schools. In some cases, previously well-established classification of injury required to be abolished as they presented no additional value to the diagnosis.

Quoting Pott's classification for ankle fractures serves to explain well here. This classification is no longer applicable due to the presence of X-ray facilities which were not available when Pott's classification was conceived.

Legal sector pressures on the Personal Injury Assessment industry have enforced need of objective confirmation of physical findings before taking a patient to operation theatre. Taking example of operating for Anterior Cruciate Ligament (ACL) damage (a common sports knee injury) would be a good one to quote here

as now it is mandatory in several western countries to have an MRI scan before operating on a ruptured ACL since physical findings such as a positive anterior draw sign being an operator dependent method can have a varying degree of inaccuracy.

Clinical Decision Support System

After taking the medical history, the clinician should review the medical notes and investigations followed by the carrying out of a visual medical examination. Then further tests might need to be ordered, or a prescription provided for the patient. In some cases, referral to another relevant medical colleague may be necessary, a facility which an efficient Telemedicine system should be designed to provide. MRI Scan support before operating on a ruptured ACL gives a surgeon a grounds to defend upon on the accuracy of need to operate.

A well-designed Clinical Telemedicine System has an embedded auto-dispatch screen with option to choose from several Labs for the speedy transit of requested investigations.

Auto-summary of the Patient-Clinician Encounter

Telemedicine software should have this embedded feature integrated using AI for various elements of the observations and comments recorded by the clinician during or after the consultation, creating an auto-summary of the patient-clinician encounter.

Such an auto-summary of the Teleconsultation should then be kept as a record of the patient-clinician encounter for future reference.

An efficient Telemedicine System for General Teleconsultation

The above elements complete the anatomy of a basic Telemedicine system, as long as they are embedded in a single and secure interface, the idea of providing remote medical care can be well served.

Difference between Telehealth, Telemedicine and Telecare

What is Telehealth?

Telehealth implies delivery of Healthcare Services over Telecommunications Technology channels. Telehealth can be broadly defined as "a hardware and software based medical facilitation system that enables transmission of patient data such as documents, images, audio & video across multiple physical locations with a view to assess, diagnose and establish a therapeutic intervention for suitable medical conditions remotely". Telehealth is a term widely used for a variety of software and hardware portals,

operating in sync to assist healthcare delivery, preventive health advice, health education via Telecommunications Technologies.

What is Telemedicine?

Telemedicine is defined as "means to connect a Healthcare provider to a care-recipient through one or more channels of Telecommunication without an in-person meeting between them." In short, Telemedicine implies as a Virtual Medical Consultation over the Internet with a care receiver and a caregiver not required to be present at the same physical location.

What is Telecare?

Telecare would imply range of services that facilitate healthcare advice, therapeutic intervention or healthy lifestyle education delivered via specialized gadgets which are usually connected via Internet or Bluetooth technology, to enable remote monitoring. Automation in registering, computing, and archiving of vital signs readings of a patient having ambulatory care after being discharged from hospital is one suitable example where medical probes are connected to patient at one end and are conveying findings to a hospital dashboard. Both ends can be connected via suitable internet interface and at times are assisted by mobile device Bluetooth technology.

Several smart medical gadgets are now available to record BP, Pulse, Blood Glucose, single-lead ECG, etc., and the findings are available to the relevant clinician through a secure portal. Critical value thresholds are setup triggering alarms such as Heart rate lower than 55 for a patient on Beta-blockers or Post-Insulin injection critical drop of Blood Glucose are the examples of Telecare. The documented findings are interpreted during Virtual or Physical Consultations. Telecare can be a standalone service, or it can be part of a Telemedicine portal.

Structural types of Telemedicine

Live or Synchronous Telemedicine enables a patient and a healthcare provider to interact in real-time. In the past, this was typically a telephone conversation between the care staff and the patient. This is now gradually being replaced with the use of a live two-way audio-video interface created with appropriate Telemedicine Software.

Store & Forward or Asynchronous Telemedicine occurs when the patient's health information is forwarded electronically and stored for review by the relevant healthcare provider at a subsequent time, who then sends medical advice back to the patient. The steps of the process are mostly carried out offline, not in real-time.

A Hybrid of the above two types implies conversion

from one to another such as an asynchronous consultation needing a live video consultation necessitated by the results of an investigation such as an MRI scan or a Tissue Biopsy that requires urgent action and counselling for the patient.

Functional types of Telemedicine

Direct Telemedicine involves a patient having a Teleconsultation directly with the healthcare provider without needing a coordinator or an assistant such as creating an account on a Telemedicine website, searching, and connecting with a doctor or healthcare provider.

Assisted Telemedicine, also known as Hub and Spoke Telemedicine typically involves the assistance of a trained Telemedicine Coordinator who would help the patient to register, connect, and be examined over the Teleconsultation after the patient has visited a Telemedicine facility (Telemedicine Spoke) and is then connected to a remotely based clinician (at the Telemedicine Hub).

Automated Telemedicine or Telecare usually entails a patient using smart medical gadgets for recording vital signs like blood pressure, pulse, ECG, blood glucose and blood oxygen that can be transmitted using Bluetooth enabled mobile devices connected as smart gadgets. Once the mobile devices are connected, it is possible to set up an automated transfer of vital signs readings into the Telemedicine interface for subsequent review at the in-person or virtual appointments with the healthcare provider.

Critical value thresholds can be set up such as extremely low blood pressure, low pulse rate or exceedingly high blood sugar, etc., that will then trigger alarms at the doctor or nurse's end to ensure prompt intervention takes place. This method is quite popular for the care of the elderly at home, or a post-operative patient discharged home but needing monitoring till fully recovered.

Mobile Health typically involves the use of healthcare apps on smartphones or tablets to capture medical data and convey the health information two

way within a pre-defined Clinical Decision Support System for managing medical conditions.

Clinical types of Telemedicine

General Telemedicine Service implies an outpatient Teleconsultation interface that fits general history taking and examination for day-to-day common ailments, usually adapted to the needs of primary care physicians.

Specialised Telemedicine Service would imply a specific flow of the patient history, specifically relevant to a particular speciality assisted by an in-built digital tool kit to meet the needs of the speciality Teleconsultation, e.g., Tele-cardiology, Tele-dermatology, Tele-physiotherapy, Tele-psychiatry etc. Specific digital tools are usually embedded within the Teleconsultation interface with or without connected smart medical gadgets such as a pulse-oximeter, a glucometer, etc., to make Teleconsultation as close to an in-person visit as possible.

Super-specialised Telemedicine Service would imply highly specialised Telemedicine software combining an embedded software toolkit and connected specialised smart gadgets such as a Tele-ultrasound device, digital microscope, or ophthalmoscope etc.

This type of highly specialised software can be layered with the relevant interface of artificial intelligence for enhanced functionality to support the accuracy of clinical decision making.

Audio-Video Channels based types of Telemedicine.

Single Channel Telemedicine Software is where the audio and video channels from within the software controls are not switchable. So, a camera or microphone attached to the device (computer/smart phone or tablet) are going to be fixed input devices to assist the clinician in medical examination.

Multi-channel Telemedicine Software is where the audio and video channels from within the software controls are switchable. So, a camera or microphone attached to the device (computer/smart phone or tablet) are NOT going to be fixed input devices to assist the clinician in medical examination.

Any other cameras (like Dermascope, ENT Camera, Ultrasound probe etc) or alternative audio input (Cardiac auscultation device, pre-natal Fetoscope) can be switched from within the Software. The benefit of this sophisticated Telemedicine feature is to provide facility to a Coordinator at a Telemedicine Spoke to switch easily with one click between various cameras and audio medical gadgets to facilitate various specialists at the other end of a Hub and Spoke Telemedicine Clinic.