CHAPTER 4
PROPOSED RURAL HEALTHCARE SYSTEM FOR DEVELOPMENT

4.1 Introduction

A Remote Patient Monitoring (RPM) system is perceived to be more convenient and cost effective than traditional care, since it enables healthcare organizations to monitor and manage patients remotely; provisions of the right information, in the right place, at the right time are the fundamental in RPM.

However, the current uses of wired sensing devices as well as their connections to network systems are not suitable for long-term RPM, as their usage restricts patients’ mobility.

Advances in biomedical sensors and wireless network technologies have made it possible to develop a wireless RPM system.

4.1.1 Introduction: Evaluation of Sensors for RPM

Vital sign measurement is the initial and the most important task in RPM. The existing instruments are commonly equipped with cable-based sensors, which make them bulky, intrusive and inconvenient.

These sensors may not suit for long-term monitoring of vital sign in RPM on general wards.

To improve comfort and mobility of patients, wireless biomedical sensors are considered. They are normally small in size and have wireless communication capability. This section evaluates sensors that can be used to measure vital signs in RPM on general hospital wards.
4.2 Sensors for Heart Rate Monitoring

Heart rate is very important in patient monitoring. In traditional medicine, heart examination and monitoring was carried out by stethoscopes, through which medical personnel listened to a patient’s heart sound and made decisions based on their knowledge and experience.

The development of electronics and digital signals processing techniques have made it possible to use a small microphone to record cardiac sound and use a computer to analyse it. However noise cancellation is yet under research to ensure the accuracy of heart sound monitoring.

The heart rate can also be measured by electrical waveform as well as pressure detection and electromagnetic flow. In this section, some sensors that can be used to measure heart rate are evaluated; they are ECG and Ox meter.

4.2.1 Electrocardiograph (ECG) sensor

ECG is basically an instrument for examination of heart infections. An ECG sensing apparatus regularly comprises of a gathering of cathodes to identify electrical occasions of a heart.

The most pervasive ECG sensor includes the association of 12 terminals (additionally implied as leads) to a patient's midsection, arms and right leg by means of
cement froth cushions. The sensor records a short testing (no more than thirty seconds) of the heart's electrical action between distinctive matches of leads.

Figure-4.2.1: A wireless 12-leads ECG

4.2.2 Pulse Ox meter

The pulse Ox meter was invented for patient monitoring in the early 1970s. It can be used to examine two types of vital signs: heart rate and blood oxygen saturation (also referred to as SpO2).

With advanced warning, patients could get treatments to avoid hypoxemia before they manifests physical symptoms.

Figure-4.2.1: a wireless Ox meter based RPM system

A beat Ox meter normally consolidates a plastic lodging, which holds a cluster of LEDs and an optoelectronic sensor inverse.
By distinguishing the measure of light retained by haemoglobin in blood with two diverse wavelengths (normally 650nm and 805nm), the level of oxygen immersion could be measured. Likewise, heart rate might be dead set from the example of light assimilation as time marches onward, since veins contract and grow with the patient's beat.

Calculation of heart rate and SpO2 from the light transmission waveforms might be performed utilizing standard computerized indicator handling strategies. There are two types of Ox meter, transmittance pulse Ox meter and reflectance Ox meter Duvall (2010). The applied position of transmittance pulse Ox meter is limited to the peripheral tissue, such as the fingertip, ear lobe, or toe. On the other hand a reflectance Ox meter can measure SpO2 from various parts of the body such as the forehead, cheek, wrist, etc.

Nevertheless transmittance pulse Ox meter is popularly applied in patient monitoring to obtain highly precise arterial oxygen saturation measurements. The pulse Ox meter has advantages to be preferred for using in RPM. The major advantage is that one sensor provides two types of vital signs at a time.

Hence it would offer more flexibility and convenience in RPM. An Ox meter can be simply placed on a patient’s finger for monitoring professional skill is not required for placement compared to ECG sensors. Supported by an appropriate wireless technology, pulse Ox meter can be utilized in RPM on general hospital wards.

4.3 Sensors for Measuring Blood Pressure

There are five common methods for measuring blood pressure: auscultation, palpation, flush, oscillation, and transcutaneous Doppler”. Typical blood pressure sensors used in clinical are designed to measure systolic and diastolic blood pressures utilizing the oscillometric technique. A blood pressure sensor is usually used together with a pump bulb and a standard adult size adjustable cuff (typically 25 to 40 cm) that can inflate and deflate automatically (Omron 2010). In addition, wrist-worn blood pressure measuring device, which is portable and user-friendly, has already been utilized in current practice of patient monitoring.
This type of device includes a memory storage that makes recording measurements easy, but they do not include communication capability for RPM. Some efforts have been made to design a wireless sensing device for remote monitoring of blood pressure.

A prototype has been built on a large wristwatch to measure blood pressure by IBM. It can measure blood pressure and send it via Bluetooth to a mobile phone or a laptop of medical professional for RPM.

4.4 Sensors for Measuring Body Temperature

Body temperature can be measured by three types of sensors: resistance thermometer, thermocouple and thermistor. Among them, thermistors are widely used for portable devices in patient monitoring. They are resistance elements with a high negative coefficient of resistance.

Some wireless body temperature sensors are based on it. When attached to a patient, it can measure the patient’s temperature and send the measurement to a nearby instrument for display and monitoring.
4.5 Sensors for Measuring Body Weight

Weight can be measured either by spring balance or electronic balance. Between these electronic balance is used for remote patient monitoring. It has Bluetooth through which we can send sensor reading to gateway devices via particular interface.

It works by piezoelectric substance, when weight is applied on this piezoelectric crystal, it produces electric current. This current is transformed in digital signal. Weight is sensed using a transducer.

A weighing machine transducer is usually a spring/piezoelectric component. The resistance of it varies as the weight changes. So does the current through it. This current is sensed, and is converted suitably to output weight McNamara and Kerry Steven (2000).
4.6 Sensors for blood glucose measurement

Blood glucose checking is a route of testing the convergence of glucose in the blood (glycaemia). Particularly essential being taken care of by diabetes mellitus, a blood glucose test is performed by puncturing the skin (regularly, on the finger) to draw blood, then applying the blood to a synthetically engaged disposable 'test-strip'. Distinctive producers utilize diverse engineering, yet most frameworks measure an electrical trademark, and utilize this to verify the glucose level in the blood.

The test is generally implied as hair like blood glucose and off and on again mistakenly called BM Styx. A blood glucose meter is an electronic unit for measuring the blood glucose level. A moderately modest drop of guilt is put on a disposable test strip which interfaces with a computerized meter.

Figure-4.6.1 Blood glucose Measuring instrument

4.7 Wireless Network Technologies for RPM

The advance of wireless technologies has led to the design, development and deployment of different types of wireless networks. These networks are usually classified by their capabilities and properties. Based on their characteristics, wireless network technologies can be used for specific applications.
Low-power wireless network technologies were introduced to serve a more specialized purpose such as networking battery-powered sensing devices in healthcare. This type of technology permits short-distance communication.

Therefore it is referred to as Wireless Personal Area Network (WPAN) technology. The application of WPAN technology in RPM has received increasing interest in recent years. It empowers patients to be monitored with enhanced mobility and comfort. In this chapter, three types of wireless network technologies are discussed. They include Bluetooth, ZigBee and Wi-Fi.

4.7.1 Bluetooth

Bluetooth is an industry standard developed by Ericsson, which later was adopted by the IEEE 802.15 work group as a WPAN standard, IEEE 802.15.1. It can enable several devices to communicate with each other, overcoming problems of synchronization. Bluetooth is specifically aimed at short-range ad-hoc networking without the need for a pre-determined infrastructure.

A summary of some key features of Bluetooth is provided in Table 3.1, which is extracted from IEEE 802.15.1 specifications National Science Institute Nulens, Gert (2001).

4.7.2 Bluetooth protocol stack

According to IEEE 802.15.1 (2003), the devices set up links, which are then managed by the Link Manager (LM) layer. This layer operates above the baseband layer and physical layer (PHY). It uses Link Manager Protocol (LMP) to negotiate features, and administer connections between users.

The data sent by user needs to be reformatted into small packets before transition over the Bluetooth link, which is one of the main responsibility of the Logical Link Communication and Adaptation
Information exchange within the Picante is accomplished by sending packets back and forth between Bluetooth-enabled devices (IEEE 802.15.1 2003). Full duplex communication is accomplished using a time division duplex mechanism.

The master node within each Picante determines which device can have access to the communication channel by addressing a slave. This slave will then have the right to send its data in the next time slot. Bluetooth Picante permits only master-to-slave and slave-to-master communication. Slave-to-slave traffic must go through a master.

4.8 ZigBee

ZigBee conforms to IEEE 802.15.4 standard. The ZigBee alliance was formed prior to the formation of the IEEE 802.15.4 group. Later, the ZigBee Alliance and the IEEE 802.15.4 aggregate chose to unite and utilize ZigBee as the business name for this engineering. Notwithstanding, the two assemblies still tackle distinctive parts of the innovation.

The IEEE 802.15.4 bunch has institutionalized the physical-(PHY) and the medium access control (MAC) layers (IEEE 802.15.4 2003), while the ZigBee cooperation fixates on the improvement of the upper layers and the generally speaking advancement. Fig 4.9.1 shows the ZigBee methodology stack and the relations between IEEE 802.15.4 and the ZigBee Alliance regarding the methodology.
IEEE 802.15.4 defines two types of devices, Full Function Device (FFD) or a Reduced Function Device (RFD). An FFD can be configured to operate in three different modes: a coordinator, a router or an end device (IEEE 802.15.4 2003). An RFD on the other hand can only be used as an end device.

In a ZigBee network, there is only one coordinator acting as a master node; all the other nodes including routers and end devices are slaves. The expert junction is responsible for channel choice and distribution to slave junctions.

The explanation for why being that a specific radio transceiver is ordinarily utilized, which can't synchronously work with more than one channel. To create association with close junctions or routers, the expert junction checks for channels that are not being utilized by other ace junctions. Provided that all channels have been
possessed, the particular case that has the minimum vigour level will be chosen (IEEE802.15.4 2006). This channel will then be allotted for correspondence with the close junctions or the routers inside the system.

Accordingly to impart, the junctions in a ZigBee system utilize a lone channel. Because of controversy inside the channel, transmission delay and information misfortune might happen. Subsequently, it is paramount to utmost the amount of junctions in the system.

4.8.1 Topologies

They are Peer-to-Peer or Star. Based on Peer-to-Peer topology, ZigBee defines Mesh topology and Cluster Tree topology... Star topology is commonly used in RPM. A star-based ZigBee network uses the master (coordinator) and slaver (end devices) mode. The master node is usually put in the centre of a WPAN. It initiates the WPAN and control communication within the WPAN.

Each WPAN has a unique WPAN Identifier (ID), which is used to distinguish data from other WPANs. A WPAN based on star topology is commonly assisted by other communication networks like Ethernet to delivery information across distance.

![Figure-4.8.3: Network topologies of ZigBee](image)
4.9 IEEE802.11 Wireless Local Area Network (WLAN)

In contrast with technologies which use WPAN, wireless LANs have been used in a range of applications for many years. The IEEE 802.11 WLAN, also known as Wireless Fidelity (Wi-Fi), is mostly deployed for WLAN applications. A WLAN may either consist only of so called stations (STAs) running in ad-hoc mode, or it may consist of STAs and access points (AP) in infrastructure mode.

These two modes are distinguished by the use of an access point (AP). An infrastructure Basic Service Set (BSS) networks has an AP to provide access to a wired LAN and distribution services like association within the WLAN. The AP is used for all communications within the network, including communications between mobile nodes in the same service area.

Since the 802.11 has been standardized by IEEE, a number of task groups have been formed to add functionalities and improve performance of 802.11 WLAN. IEEE 802.11b, 802.11a, 802.11g and 802.11n are currently used for WLAN applications.

### Table 4.9.1 Summarized IEEE 802.11 standards

<table>
<thead>
<tr>
<th>Spectrum</th>
<th>802.11b</th>
<th>802.11a</th>
<th>802.11g</th>
<th>802.11n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max data rate</td>
<td>11Mbps</td>
<td>54Mbps</td>
<td>54Mbps</td>
<td>144/300Mbps</td>
</tr>
<tr>
<td>Typical Power</td>
<td>30mW</td>
<td>25mW</td>
<td>30mW</td>
<td>30 mW</td>
</tr>
<tr>
<td>Protocol for Transmission</td>
<td>DSSS</td>
<td>OFDM</td>
<td>OFDM</td>
<td>MIMO-OFDM</td>
</tr>
<tr>
<td>Backward compatibility</td>
<td>With 802.11</td>
<td>None</td>
<td>With 802.11 and 802.11b</td>
<td>With 802.11a/b/g</td>
</tr>
<tr>
<td>Typical radius</td>
<td>38m</td>
<td>25m</td>
<td>38m</td>
<td>70m</td>
</tr>
<tr>
<td>Major advantage</td>
<td>Widely deployed High transmission range</td>
<td>Higher bit rate in a less crowded spectrum</td>
<td>Higher bit rate in 2.4 GHz/ Higher range than 802.11a</td>
<td>Highest bit rate 5 GHz mode enabled benefit low interference</td>
</tr>
<tr>
<td>Major disadvantage</td>
<td>Bit rate not enough for emerging applications</td>
<td>Smallest range of all 802.11 standards</td>
<td>Limited number of co-located wireless LANs</td>
<td>N/A</td>
</tr>
<tr>
<td>Current status</td>
<td>Widely Used</td>
<td>Limited use</td>
<td>Widely Used</td>
<td>Emerging</td>
</tr>
</tbody>
</table>
In this document, the focus is on the high bit rate extension, 802.11g IEEE Std. 802.11g (2003), which allows for data rates of up to 54Mbps. The data rate is defined in terms of available bit rate, i.e. no overhead in the form of encapsulation of data, collisions in the wireless media or processing delays in WLAN equipment are taken into account.

The higher bit rates of 802.11g are achieved by using more advanced frequency modulation schemes, Orthogonal Frequency Division Multiplexing (OFDM). This scheme utilized multi-carrier modulation methods.

A number of orthogonal sub-carriers are used to carry data to cope with severe channel conditions (e.g. narrowband interference, frequency-selective fading, etc.) It offers significant increase in the maximum raw data rate from 54Mbps to 600 Mbps by using Multiple Input and Multiple Output (MIMO) and 40 MHz channels.

In addition, IEEE 802.11n can operate at 5GHz frequency band, which may benefit its usage in present of other wireless system using 2.4GHz, such as Bluetooth and ZigBee.

Table 4.9.2 Comparison among Bluetooth, ZigBee and Wi-Fi

<table>
<thead>
<tr>
<th>Technology</th>
<th>Bluetooth</th>
<th>ZigBee</th>
<th>Wi-Fi (802.11g based)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Specifications</td>
<td>802.15.1</td>
<td>802.15.4</td>
<td>802.11</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>2.4 GHz</td>
<td>868/915 MHz, 2.4 GHz</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>Supported data rate</td>
<td>1 Mb/s</td>
<td>250 Kb/s</td>
<td>54 Mb/s</td>
</tr>
<tr>
<td>Range (Indoor)</td>
<td>2-10 m</td>
<td>10-30m</td>
<td>38m</td>
</tr>
<tr>
<td>Support communication</td>
<td>data and voice</td>
<td>data</td>
<td>Mainly for data</td>
</tr>
<tr>
<td>Typical transmit power in mW</td>
<td>10</td>
<td>0.01-3.2</td>
<td>32-100</td>
</tr>
<tr>
<td>Size of stack</td>
<td>250kbits</td>
<td>4-32kbits</td>
<td>n/a</td>
</tr>
<tr>
<td>Basic cell</td>
<td>Picante</td>
<td>Star</td>
<td>BSS</td>
</tr>
<tr>
<td>Max number of cell Nodes</td>
<td>8</td>
<td>255</td>
<td>n/a</td>
</tr>
</tbody>
</table>
4.10 Introduction RPM components

This architecture comprises of medical sensors, an application hosting device, health record device (database), doctor and various interfaces and protocols. Detailed description is given below.

![Components of Remote Patient Monitoring](image)

Figure-4.10.1: Components of Remote Patient Monitoring

4.10.1 Medical Sensors

These devices measure the vital signals of human body like blood pressure, heart rate, body temperature etc. and have the capability to transfer them via wireless communication method i.e. Bluetooth or ZigBee. Vital signs from the sensors are transmitted to application hosting device via PAN Sensors.

4.10.2 Application Hosting Devices

The patient parameters like patient identification number (PID), temperature, heartbeat, sugar, inhale, exhale and blood pressure can be transmitted to the server from the application hosting device.
General application hosting devices are Laptop, Personal Computer, Tablets, Smartphone’s or any other device that can interact with sensors and transmit data over WAN.

### 4.11 RPM Architecture and Services

In this section we are proposing architecture and associated services for transmission of vital signs (data) from patient to the doctor, vice-versa, data from doctor to pharmaceutical company and data transmission between insurance company and doctor.

**Hospital/Ambulatory services:** Patients vital signs will be transmitted to an attached Hospital where a doctor can analyse the received data from patient and prescribe patient accordingly. Hospital shall also provide ambulatory services in case of emergency.

**Pharmacy:** After medicines prescribed by the doctor, electronic prescription will be automatically routed to pharmaceutical companies attached in network and drugs shall be allotted to concerned patient with his/her consent.

**Drug Delivery:** Medicines shall be delivered to patient’s home after pharmacist allots the drug. For this service additional 3rd party integration is required in network so that medicines could be transferred as per defined timelines.

**Call Centre:** We can also setup a 24x7 operational call centre for emergency services like ambulatory services, drug delivery, billing and other general enquiries.

**Billing:** Patient would be charged according to predefined charging scheme and amount would be deducted from his account. Billing and charging schemes need to be defined as online or offline.

**Insurance:** If the patient is covered under insurance then the relevant information is sent to the company and billing is done accordingly.

ICT for rural healthcare:
The Tele-clinics approach aid service is one amongst the necessary basic desires. Pathological state may have an effect on the living standards directly and indirectly. Aid service within the rural areas wherever quite seventy maximize Indians live, is abhorrently inadequate. Bundelkhand region in Central Asian country, which incorporates districts of Madhya Pradesh and state, is that the most backward region in Asian country with a scarcity of correct aid infrastructure.

A majority of illness in Bundelkhand villages is treated by undisciplined personnel. This is often a general development in several of the villages in rural Madhya Pradesh (M.P.) and state (U.P.). It’s a categorization to visualize an amazing of extremely technology primarily based hospitals and dispensaries in urban areas whereas the agricultural villages don't even have basic minimum public health facilities. Even inside cities the poor don't have access to high school aid facilities owing to numerous reasons, chiefly money limitations.

Many of the general public aid services like Public Health Centres (PHCs) and sub-centres in rural areas don't seem to be equipped and staffed to produce quality aid to the agricultural poor. This means the yawning divide between rural and concrete aid services, between the agricultural poor and therefore the well to do.

The new developments in aid haven't percolated to the agricultural areas and this is often a matter of nice concern. Whereas public aid system in Asian country has the simplest professionals and one amongst the simplest systems (decentralized up to the sub centre level) there's a requirement to explore the ways in which and means that to bring equity in access to health professionals and establishments.

This article is an outline of the health-care services within the rural villages in Bundelkhand. The lacuna within the public supply system within the poorest regions of M.P has been examined. It additional suggests however the agricultural aid service delivery may well be improved through the employment of knowledge and Communication Technologies (ICT) with the instance of the Tele-clinics of the Christian Hospital, Chhatarpur (a member of Emmanuel Hospital Association), wherever telephones square measure accustomed offer access to quality health (information and care).
Tele-clinic could be a pioneering aid service delivery project that addresses the health desires of the agricultural poor with the employment of knowledge Technology. Price of pathological state is one amongst the most important maladies that have an effect on the support and welfare of the poor.

Therefore policies that shield the health of the poor square measure essential in making certain their well-being. Inadequate public health and safety measures may lead to the shortcoming of the poor voters in investment their title reserves for economic replica. Table-1 Health infrastructure handiness per a thousand sq. kilometres (1993) Source: South Asian country Human Development Report 2003, North Asian country Human Development Report 2003, NCAER

The use of entitlements to fulfil consumption desires may have an effect on a family’s reserves negatively within the long-standing time and will have an effect on the power of a family to face uncertainties. although it's encouraging to notice that some efforts square measure created to produce social protection to the poor through insurance policies offered (public non-public partnerships) by some company insurance firms (even although a results of operational compulsion by government) and a few state governments, these schemes square measure nonetheless to achieve the bulk living within the rural areas. Health standing affects human development in many ways. In line with the Noble Laureate professor.

Amerada subunit, health is one amongst the necessary human capabilities that confirm access to wealth.

Rural aid in Bundelkhand – Current state of affairs

The public aid in Bundelkhand has the subsequent challenges;

a) Healthcare Access.

b) Healthcare Quality.

c) Healthcare price.

a) Healthcare access:

When folks become unwell, low-income households in rural areas still use home remedies, consult ancient healers and native suppliers United Nations agency square measure usually outside the formal aid system. It’s conjointly necessary to mention that
a sick man is healthier attended than a sick lady. Poor girls square measure most at risk of diseases and pathological state as they sleep in insanitary conditions, carry serious kid bearing burden, place very little stress on their own aid desires, and encounter severe constraints in seeking aid for them.

Table one suggests the standing of health infrastructure in 3 states in Asian country, that conjointly embody Figs for M.P. It suggests that the state of M.P. is extremely poor in health infrastructure handiness. As an example the PHC accessible per thousand sq. clicks is zero.27 that is way below the developed state of Kerala (average two.28). The districts in Bundelkhand have the worst aid facilities. This implies urgency in rural aid provision.

b) Healthcare quality:

The standard of aid within the rural and concrete areas conjointly differs. Whereas the urban localities have aid choices from 5 star medical schools to little non-public dispensaries pass by trained doctors, the agricultural square measures usually are left with the sole possibility of undisciplined non-public practitioners. Table two suggests the supply of health care personnel in M.P., U.P. and points to the actual fact that the amount of medical professionals accessible in M.P. is way inadequate as compared to Kerala.

It conjointly shows that a major variety of the deliveries in these states square measure conducted by undisciplined (traditional) practitioners. This to an outsized extent affects the standard of maternity care and impacts maternal mortality rates.

c) Healthcare cost:

Providing aid services to the poor at an inexpensive price needs a major quantity of grant, either through government or non-government supply. The study of the many of the insurance schemes enforced in Africa, Asia and geographical region points to the current conclusion (Community Health Fund Tanzania and Nkoranza Community finance insurance theme, Republic of Ghana square measure a number of the
examples). Moreover, access must consider different viable and value effective alternatives.

Thus, Associate in nursing assessment of aid facilities accessible for the agricultural poor in Bundelkhand suggests the following:

• The health standing in Bundelkhand villages generally is insufficient and doesn't obey even with the minimum public health necessities.

• the most aid suppliers for quite eightieth population living in rural Bundelkhand square measure undisciplined non-public ‘practitioners’.

• the govt. PHCs don't seem to be regular and don't seem to be economical in accomplishing its mission of facilitating quality medical stretch to the poor within the rural localities, each because of poor infrastructure, equipment’s and inadequate personnel.

• Emergency aid services square measure nearly nothing in rural areas. Accessing health services at odd times could be a Herculean task for the folks in rural areas.

ICT kiosks and public health:

Information and conveyance engineering incorporates a paramount part to play in aiding value help to the farming underprivileged in an exceptionally cost adequate way.

In Associate in nursing time period characterized by howdy tech medicine, those prohibited from the musing support administration might well be given the preferences of restorative experts through the occupation of Associate in nursing appropriate ICT stall. This yearnings a joint responsibility from every non-open and open part.

Telemedicine is utilized as a path to process health access to people worldwide through the work of various booths. On the other hand, this has not ended up being in style near the agrarian unfortunate owing to deficient capability on the work of various booths.
The nations in Asia have however ten online clients and fewer than twenty the telephone clients in their rustic territories, inasmuch as in Asian nation the job of net in rustic ranges is a littler sum than a hundred and twenty fifth. In an exceptionally state of undertakings wherever imposing scale innovation ignorance exists, it’s vital to prod appropriate innovation booths that might be straightforward for the unfortunate to utilize.

Utilization of phones may well be a spot to start for rustic ranges. Surprisingly, operation of a telephone is refined for some living in country zones. Tele-centre Project of Christian Hospital is Associate in nursing example wherever a phone is employed to provide access to quality treatment. Medical expert’s square measure trained to form the communication additional qualitative to alter the doctor to raise diagnose and advise treatment.

**Tele-clinics: Combination of ICT and social protection:**

Tele-clinic initiated by Christian Hospital in Bundelkhand is one amongst the innovative mixtures of technology and health protection supplement. It’s a shot to introduce ICT in aid to boost the access to specialty care to those living in remote rural areas. The communication between a doctor and a patient is enabled through the employment of a phone.

Tele-centre could be a telephone empowered shut system of rustic people, prepared therapeutic specialists and restorative experts of Christian Hospital. This system allows correspondence between specialist and a patient in an exceptionally remote country village with the support of a telephone. A prepared medicinal master expedites the conveyance between a specialist and a patient through a WLL telephone furnished by the BSNL (government under control telecommunication office).

A prepared restorative master is selected everything considered the choice centres. The aforementioned choice centres offer administrations like essential support, machine administration, telephone interview, crisis drug and then on. One call focus blankets 3 to 5 including villages.
Tele-clinic: Aims and objectives:

The on top of mentioned project is innovative and could be an initial with this distinctive combination within the whole world, particularly in Asian country. It’s a mix of economic protection and aid access. The most goals and objectives of Tele-clinic square measure as follows.

**Aim:** Develop sound and monetarily beneficial rustic citizenship through helping shoddy, solid and top value health information to the agrarian abject victimisation ICT.

**Targets:**

- To handle crisis help to the rural unfortunate.
- To verify safe conveyance and family relationship in provincial zones.
- To process access to health information and making support receptive to the unfortunate.
- To aid value medication to the unfortunate in remote provincial villages.
- To transform open health wellbeing web to the agrarian downtrodden. Tele-clinic components:

**Village decision Centres:** decision centres square measure an awfully necessary part of the Tele-clinic. These centres square measure established within the villages wherever Tele-clinic project is initiated. The centre is presently running in a much rented space within the village. A trained medical expert mans the decision centres. The medical expert is named Tele-health employee (THW), United Nations agency is given a phone, basic diagnostic equipment’s and emergency medication. All the medical experts square measure trained by St. Johns machine Service and Comprehensive Rural Health Project Jamkhed (Maharashtra). Decision centres offer the subsequent main services:

a) Phone counsel with a specialist at Christian Hospital.
b) Emergency medicine.

c) Clinical underpin through attendant run facilities.

d) Health consciousness through periodical fights.

2. Machine Service:

An all day and all night machine administration has been begun by the Tele-facility Project to process access to the healing centres. A particular sign is given to enter the rescue vehicle and this administration is available at whatever time of the day or night. Further, this administration may well be acclimated visit any doctor's facility inside the city occasionally of crisis.

**Medical helps arrange (MAP):** Medical helps arrange is comparable to an insurance and is a vital part of Tele-clinic Project.

People who square measure in MAP pays associate in Nursing advance membership fee to avail medical (In-patient and Out-patient) facilities at the Christian Hospital, at a prefixed rate. MAP has membership fee starting from USD one.33 to USD twelve.79 with coverage of USD twenty two.25 to USD 222.45. Presently there square measure around fifty villages coated through fifteen totally different decision centres. One call centre serves four to six villages.

The population per call centre ranges from 3000 – ten thousand. The present MAP membership varies from a hundred to 250 per call centre. There square measure a complete of quite 1500 members registered during this theme.

The project presently serves a complete population of thirty. All the target villages square measure at terribly remote locations and square measure far away from the most roads. Whereas choosing a village access is one amongst the necessary criteria. Those villages with minimum access square measure elite as a result of it might facilitate in effective implementation of the project.
Tele-clinic: Levels of treatment:

Tele-centre utilization a 3 tier support benefit through utilization of information and Communication Technology (at blessing telephone is being utilized)

a) Call Centre level is therapeutic help manned by a therapeutic master.
b) Weekly referral facilities at call focus Level – manned by medical attendant & research facility technician.
c) Hospital level – auxiliary mind

Whatever the aforementioned levels the meeting of an expert polishing / a master is essential. All medications square measure furnished once authority counsel over telephone, with the exception of simply if there should be an occurrence of causalities wherever medicinal master regulate crisis pharmaceutical / point the patient to the clinic.

Tele-facility: worth expansion in country social insurance:

• Promotion of brilliant practices in support in country territories: there's a spurring correction inside the practices connected with help inside the villages once the presentation of Tele-centres. Some of the parts enrolled in MAP have not been to an expert polishing / a clinic. The people looking for this new arrangement square an indication of their revision in viewpoint towards support.

• Improved access to masters through a telecommunication system: Tele-clinic where established has been winning in presenting a reliable aid various to the agricultural poor (in spite of issues with property and electricity sometimes). Folks although consult the native practitioners for minor ailments; now and then of medical emergency they use the MAP membership and consult the doctors at Christian Hospital.

• Improved access to hospitals through an around the clock machine service: machine service considerably wedged the health seeking behaviour of individuals
within the villages wherever decision centres square measure established. This service is that the solely transport facility accessible at a telephone call to the folks within the target villages.

**Tele-clinic in a very district public health:**

Replicating Tele-clinic in district aid system – A model rural health service arrange. The Tele-clinic project may well be replicated within the District Public Health System (DPHS) to boost the public health delivery system. Numerous public health hierarchies may well be networked through the employment of a phone (or by venture with ISRO – Indian area analysis Organization and DPHS).

This might in a very approach improve the potency of assorted hierarchies and conjointly would create them additional responsible to each the general public and to the DPHS. Moreover, such a network may create public health observation price effective and economical. The subsequent must be done before truly replica-ting the system.

- Bunch levels of aid centres – Lead centre at different levels.
- Distinctive interested practitioners – non-commissioned practitioners /specialists
- Partnering with Telecommunications Department / non-public Telecommunication firms establishing communication network.
- Establishing Tele-clinic data management units the least bit the district offices
Figure-4.10.1: Architecture and Services

Figure-4.10.2: Periodic monitoring of patient
Figure-4.10.3: Architecture for Insurance Provider

Remote Patient Monitoring E2E Architecture

Figure-4.10.4 Remote Patient Monitoring E2E Architecture
ICT kiosks and public health:

Information and correspondence innovation incorporates a paramount part to play in aiding value help to the horticultural unfortunate in an extremely cost adequate way. In Associate in nurturing time period characterized by greetings tech medicine, those prohibited from the consideration help administration might well be given the points of interest of restorative experts through the livelihood of Associate in nursing material ICT corner.

This cravings a joint responsibility from every non-open and open area. Telemedicine is employed as a way to produce health access to folks worldwide through the employment of assorted kiosks. However, this has not become in style among the agricultural poor owing to inadequate ability on the employment of assorted kiosks Grow (2003). The countries in Asia have but ten online users and fewer than twenty the phone users in their rural localities, whereas in Asian country the employment of net in rural areas is a smaller amount than a hundred and twenty fifth.

In a very state of affairs wherever large-scale technology illiteracy exists, it's necessary to push applicable technology kiosks that would be straightforward for the poor to use. Use of telephones may well be a place to begin for rural areas. Even operation of a phone is sophisticated for several living in rural areas.

Tele-clinic Project of Christian Hospital is Associate in nursing example wherever a phone is employed to provide access to quality treatment. Medical experts’ square measure trained to form the communication additional qualitative to alter the doctor to diagnose and advise treatment.

Tele-clinics: Combination of ICT and social protection:

Tele-clinic initiated by Christian Hospital in Bundelkhand is one amongst the innovative mixtures of technology and health protection supplement. It’s a shot to introduce ICT in aid to boost the access to specialty care to those living in remote rural areas.
The communication between a doctor and a patient is enabled through the employment of a phone. Tele-clinic could be a phone enabled closed network of rural folks, trained medical experts and medical professionals of Christian Hospital. This network permits communication between doctor and a patient in a very remote rural village with the assistance of a phone.

A trained medical expert facilitates the communication between a doctor and a patient through a WLL phone provided by the BSNL (government in hand telecommunication agency). A trained medical expert is recruited all told the decision centres *Hira (2004)*. These decision centres offer services like primary aid, machine service, phone consultation, emergency medication and then on. One call centre covers 3 to 5 encompassing villages.

**Tele-clinic: Aims and objectives:**

The on top of mentioned project is innovative and could be an initial with this distinctive combination within the whole world, particularly in Asian country. It’s a mix of economic protection and aid access. The most goals and objectives of Tele-clinic square measure as follows.

**Aim:** Develop healthy and economically productive rural citizenship through facilitating cheap, reliable and top quality health data to the agricultural poor victimisation ICT.

**Objectives:**

- To produce emergency aid to the agricultural poor.
- To make sure safe delivery and kinship in rural areas.
- To produce access to health data and creating aid accessible to the poor.
- To facilitate quality treatment to the poor in remote rural villages.
- To produce public health safety web to the agricultural poor.
Tele-clinic components:

1. **Village decision Centres**: decision centres square measure an awfully necessary part of the Tele-clinic. These centres square measure established within the villages wherever Tele-clinic project is initiated. The centre is presently running in a much rented space within the village. A trained medical expert mans the decision centres. The medical expert is named Tele-health employee (THW), United Nations agency is given a phone, basic diagnostic equipment’s and emergency medication. All the medical experts square measure trained by St. Johns machine Service and Comprehensive Rural Health Project Jamkhed (Maharashtra).

2. **Decision centres offer the subsequent main services:**
   a) Phone consultation with a doctor at Christian Hospital.
   b) Emergency medication.
   c) Clinical support through nurse-run-clinics.
   d) Health awareness through periodical campaigns.

**Machine Service:**
A around the clock machine service has been started by the Tele-clinic Project to produce access to the hospitals. A separate signal is given to access the ambulance and this service is on the market any time of the day or night. Further, this service may well be accustomed visit any hospital within the city now and then of emergency.

**Medical helps arrange (MAP):**
Medical help arrange is comparable to an insurance and is a vital part of Tele-clinic Project. Presently there square measure around fifty villages coated through fifteen totally different decision centres. One call centre serves four to six villages. The population per call centre ranges from 3000 thousand. The present MAP membership varies from a hundred to 250 per call centre. There square measure a complete of quite 1500 members registered during this theme. The project presently serves a complete population of thirty.
All the target villages square measure at terribly remote locations and square measure far away from the most roads. Whereas choosing a village access is one amongst the necessary criteria. Those villages with minimum access square measure elite as a result of it might facilitate in effective implementation of the project.

**Tele-clinic: Levels of treatment:**

Tele-clinic uses a 3 tier aid service through use of knowledge and Communication Technology (at gift phone is being used)

a) Call Centre level is medical aid manned by a medical expert.
b) Weekly referral clinics at call centre Level – manned by nurse & laboratory technician.
c) Hospital level – secondary care

At all these levels the consultation of a professional practising / a specialist is vital. All treatments square measure provided once specialist consultation over phone, except just in case of causalities wherever medical expert administer emergency medication / refer the patient to the hospital.

**Tele-clinic: worth addition in rural healthcare:**

• Promotion of excellent practices in aid in rural areas: there's a motivating amendment within the practices associated with aid within the villages once the introduction of Tele-clinics. Several of the members registered in MAP have not been to a professional practising / a hospital.

• Improved access to specialists through a telecommunication network: Tele-clinic where established has been winning in presenting a reliable aid various to the agricultural poor (in spite of issues with property and electricity sometimes). Folks although consult the native practitioners for minor ailments; now and then of medical emergency they use the MAP membership and consult the doctors at Hospital.

• Improved access to hospitals through an around the clock machine service: machine service considerably wedged the health seeking behaviour of individuals within the villages wherever decision centres square measure established. This service
is that the solely transport facility accessible at a telephone call to the folks within the target villages.

**Tele-clinic in a very district public health:**

Replicating Tele-clinic in district aid system – A model rural health service arrange. The Tele-clinic project may well be replicated within the District Public Health System (DPHS) to boost the public health delivery system. Moreover, such a network may create public health observation price effective and economical. The subsequent must be done before truly replica-ting the system.

• Bunch levels of aid centres – Lead centre at different levels.
• Distinctive interested practitioners – non-commissioned practitioners /specialists
• Partnering with Telecommunications Department / non-public Telecommunication firms establishing communication network.

**Figure-4.10.6 Patient arrives at the remote Health Unit which has only a paramedic and no doctor**
The Health Unit is LTE-Wi-Fi connected to help link the unit to the central medical centre.
The patient at the remote health unit and the doctor at the central medical centre communicate with each other.
The Doctor orders the following diagnostic tests:

5. Blood Pressure
6. ECG
7. Temperature
8. Oxygen Saturation (SP O2)

• The paramedic helps conduct these tests one by one on the patient.
• Results of each test are conveyed over the LTE network to the doctor. At the same time he is video communicating so that he is able to guide the paramedic and the patient during the diagnostic tests.
• It will also be an option that the doctor views the patient’s medical reports offline.
• The doctor examines the medical reports and keys-in the prescription to the patient at the remote health unit.
• The prescription is printed at the remote unit and handed over to the patient.
• The doctor and patient communicate on video to discuss any outstanding aspect of treatment.
• To ensure that the prescription is honoured by the chemist, there would be a process of authentication including measures such as Identity Management and Digital signatures (not being demonstrated).
• There will be options such as direct communication of prescription to identified chemists as well as obtaining assistance of other services like ambulance in the case of emergencies.
• The entire health care program will be supported and coordinated through backend applications and customer care centre that link hospitals, pharmacists, diagnostic centres, patient homes, doctor’s offices and medical insurance.