

Telemedicine Technologies for Neglected Tropical Disease Management

-Nirmal Punjabi, Ph.D.
Adjunct Faculty, KCDH

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Presentation Outline

- Telemedicine / TeleHealth / mHealth / eHealth
 - Terminology, History
 - Scope
 - Framework / Modalities
 - Application in Disease Management
- Neglected Tropical Disease
 - Types
 - Diagnosis & Monitoring
- Integration of Telemedicine and mHealth technologies in NTD management
 - Diagnosis
 - Tracking
 - Application
 - WHO Skin NTD
 - Other apps
- Limitations/Challenges

Telemedicine / TeleHealth / mHealth / eHealth

- Remote delivery of healthcare
- Telemedicine: ‘The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.’ Registered medical practitioner (RMP)
- TeleHealth: ‘The delivery and facilitation of health and health-related services including medical care, provider and patient education, health information services, and self-care via telecommunications and digital communication technologies.’
- eHealth: electronic / digitalization of health data
- mHealth: using mobile phone to deliver TeleHealth/Telemedicine

Telemedicine Ecosystem



**Patient /
Care-giver**

Interaction Device
Laptop / Smartphone

Front-end Interface
Sensors
Storage
Analysis
Communication

Lab Tests / Reports



Database
Physical device
Cloud Storage

Interaction Device
Laptop / Smartphone

Front-end Interface
Storage
Analysis
Communication

**Medical
Practitioner**

Medical Devices
Conventional
Wearable
Consumer grade
Medical Grade



Backup Database
Computing Server

Telemedicine Landscape

- Types

- Mode of Communication
 - Video
 - Audio
 - Text based
- Timings of information transmitted
 - Real Time
 - Asynchronous
- Purpose of consultation
 - Non-Emergency
 - Emergency

- Types

- Individual Involved/Connected
 - Patient & RMP
 - Caregiver and RMP
 - RMP to RMP
 - Health worker to RMP

Telemedicine: Benefits

- Remote Monitoring
 - Accessibility
- Minimal loss of time due to no/limited travel
- Efficient use of resources
- Faster turn-around time
- Data collection in a defined format
- Digitalization
- Easy integration with a clinical trial

Telemedicine : Additional Benefits

- Direct Digitalization
 - Direct data entry to digital form (Ideal)
 - Inbuilt Case-Report Form
 - No Parsing

PATIENT DETAILS: RKN ^{PK 03/12/2012}

Initials: <u>R R N</u> <small>(e.g. SKN for S.K.Nagraj)</small>	Serial No: <u>01</u>	Gender: <input checked="" type="checkbox"/> M <input type="checkbox"/> F	Age (Yr): <u>25</u>
Diagnosis: <u>Tinea Corporis</u>			
Duration of illness: -----			

- Acceptable abbreviations are the following:
 - Unknown: UNK or UK
 - Not Done: ND
 - Not Applicable: NA.
- In questions where some of the possible options listed has/have to be selected, it should be Ticked (as shown below).

Gender	Male <input checked="" type="checkbox"/>	Female <input type="checkbox"/>
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Adverse Reaction Description: DESC Date of Onset of Reaction: 29/11/06

Patient with a NON ST ELEVATION MI HAD DIAGNOSTIC ANGIOGRAM SHOWING SEVERE STENOSIS IN LAD. THE SAME DAY HAD PCI TO LAD DURING WHICH EXPERIENCED PROFOUND AND SUSTAINED HYPOTENSION NOT BELIEVED WITH ANARMIN 6mg (SEVERAL 0.5mg BOLUSES) AND IABP. IMPROVED AFTER HYDROCORISONE 200mg + PHENERGAN GIVEN. ??ALLERGIC REACTION TO CONTRAST (ISOUVE 370)

All Drug Therapy Prior to Reaction <small>Asterisk Suspected Drug(s) (please use trade names)</small>	Daily Dosage and Route	Date Begun	Date Stopped	Reason for Use
<u>ASPIRIN</u>	300mg o	29/1/06	—	NSTEMI
<u>CLOPIROGREL</u>	300mg o	29/1/06	—	NSTEMI
<u>TEMAREPAM</u>	10mg o	29/1/06	—	SEDAHIN
<u>TINIDAZOLE</u>	1V bolus + 1V infusion	29/1/06	29/1/06	NSTEMI
<u>METOPROLOL</u>	2mg IV	29/1/06	29/1/06	SEDAHIN
<u>AMALGAM</u>	90ml IC	29/1/06	29/1/06	ANGIOGRAM
<u>ISOUVE 370</u>		29/1/06	29/1/06	ANGIOGRAM

Treatment (of reaction): ANARMIN, HYDROCORISONE, PHENERGAN

Outcome: Recovered Not Yet Recovered Unknown Fatal Date of Death 1/1

Sequelae: No Yes (describe) MYOCARDIAL INFARCTION


Comments (eg. relevant history, allergies, previous exposure to this drug):
NO KNOWN ALLERGIES BEFORE THE EPISODE. HAD ANGIOGRAM IN ANOTHER HOSPITAL. THEN PCI SAME DAY. REACTION DURING PCI.

DESC

Telemedicine: Example


eSanjeevani - National Telemedicine Service

 92,645,630
Patients served

 220,195
Providers onboarded

 112,987
Spokes operationalized

 15,465
Hubs established

 1147
OPDs hosted

17 Jan. 2023



Cloud-based telemedicine system



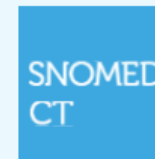
स्वस्थ भारत



Assisted Telemedicine



Ayushman Bharat Digital Mission (ABDM)
Compliant



SNOMED CT Compliant

Telemedicine: mHealth

- mHealth: Potential of doing work of all/any blocks in telehealth
- Electronic
 - Digitalization of information
- Storage Space
 - Data accumulation
- Computing Power
 - Data Transformation / Analysis / Visualization
- Communication
 - Share Data: Locally or Distant
 - Voice calling, Video calling
- Tracking
 - Date / Time linking
 - Location



Telemedicine: mHealth

- Additional information
 - Internal sensor or modules
 - External attachment



Reference : FLIR

Telemedicine: mHealth

• mHealth: Common Sensor and Communication Modules

- **Accelerometer**
 - Acceleration
- **Magnetometer**
 - Magnetic Field Sensor
- **Gyroscope**
 - Angular Velocity
- **Temperature Sensor**
- **Light Sensor**
 - Proximity
- **Camera Module**
- **Microphones**
- **Humidity Sensor**
- **Touch Sensor**
- **Finger print**
- **Pressure Sensor**
- **Sim Card**
 - 2G, 3G, 4G & 5G
- **Bluetooth**
- **NFC**
- **Wi-Fi**
- **GPS**
 - Position

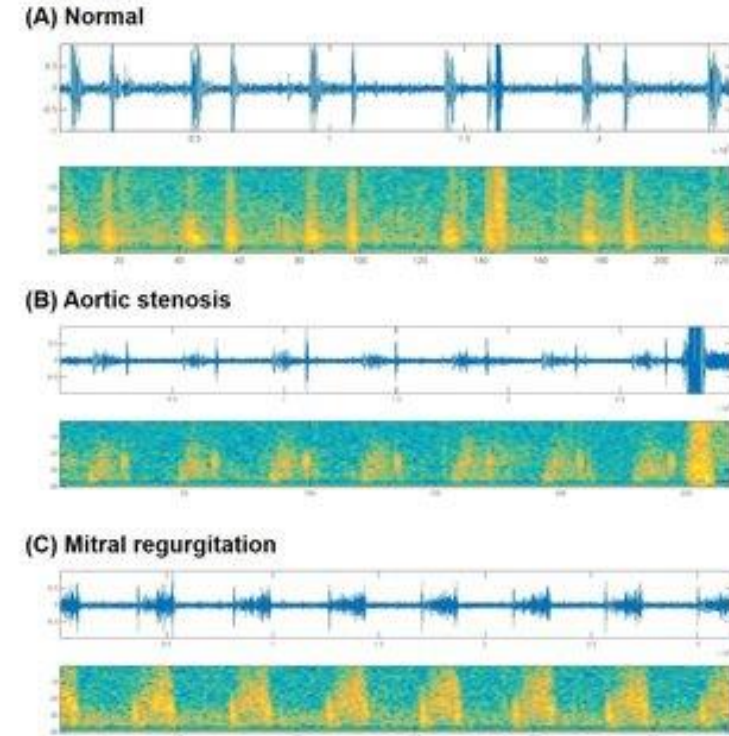
Telemedicine: mHealth

- mHealth: What all can we monitor?
- Location
- Image
 - Color: Change
 - Appearance / Detection
 - Size/Area/Location estimation
- Video
 - Dynamic changes
 - Functional
 - Changes during activity
 - Example: Gait / Facial Expression



Telemedicine: mHealth

- mHealth: What all can we monitor?
- Audio
 - Speech
 - Sounds
 - Heart sounds
 - Joints
 - Lungs
- Physical dimension
 - Sensors
 - Camera
- Manual Input

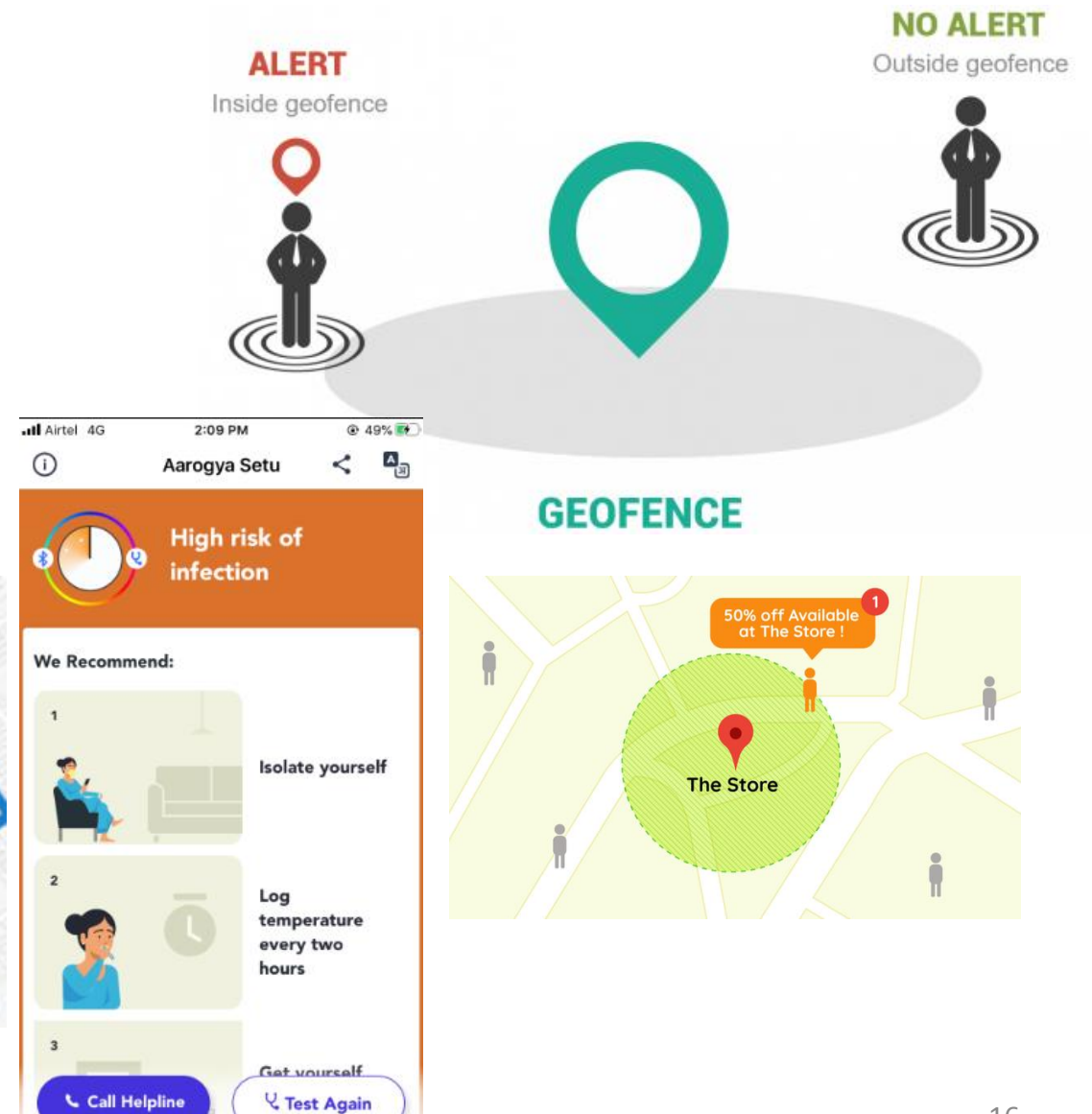
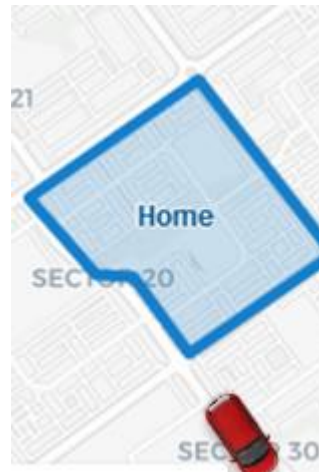


Telemedicine: mHealth

- mHealth: Use case
 - Digital Data Collection
 - Case Report Form
 - Electronic Data Capture
 - Multi-parameter capturing and linking
 - Chatbot
 - Sequential asking of questions and feedback







Telemedicine: mHealth

- mHealth: Use case
 - Geofencing
 - A geofence is a virtual geographic boundary around a physical location
 - Conventional Use case:
 - Marketing
 - Tracking
 - Security
 - Tracking in Healthcare
 - Infectious diseases
 - Elderly Care



Telemedicine/mHealth in disease management

- Disease Management

	Awareness	<ul style="list-style-type: none"> • Health promoting habits • Disease and risk factor awareness • Patient education
	Screening	<ul style="list-style-type: none"> • Screening for disease and comorbi • Risk assessment
	Diagnosis	<ul style="list-style-type: none"> • Diagnosis by clinician • Treatment decision
	Treatment	<ul style="list-style-type: none"> • Treatment experience • Monitoring treatment response • Access to treatment
	Adherence	<ul style="list-style-type: none"> • Compliance to therapy • Chronic disease management
	Control or Remission	<ul style="list-style-type: none"> • Improvement in disease symptoms • Improvement in quality of life

Telemedicine in disease modelling

- Data
- Surveillance
 - Tracking
 - Mapping
- Information for Models
 - Data : Case Rate
 - Interaction
 - Proximity
 - Additional Data for helping with sub-grouping / stratification
 - Additional Data to normalize for other parameters

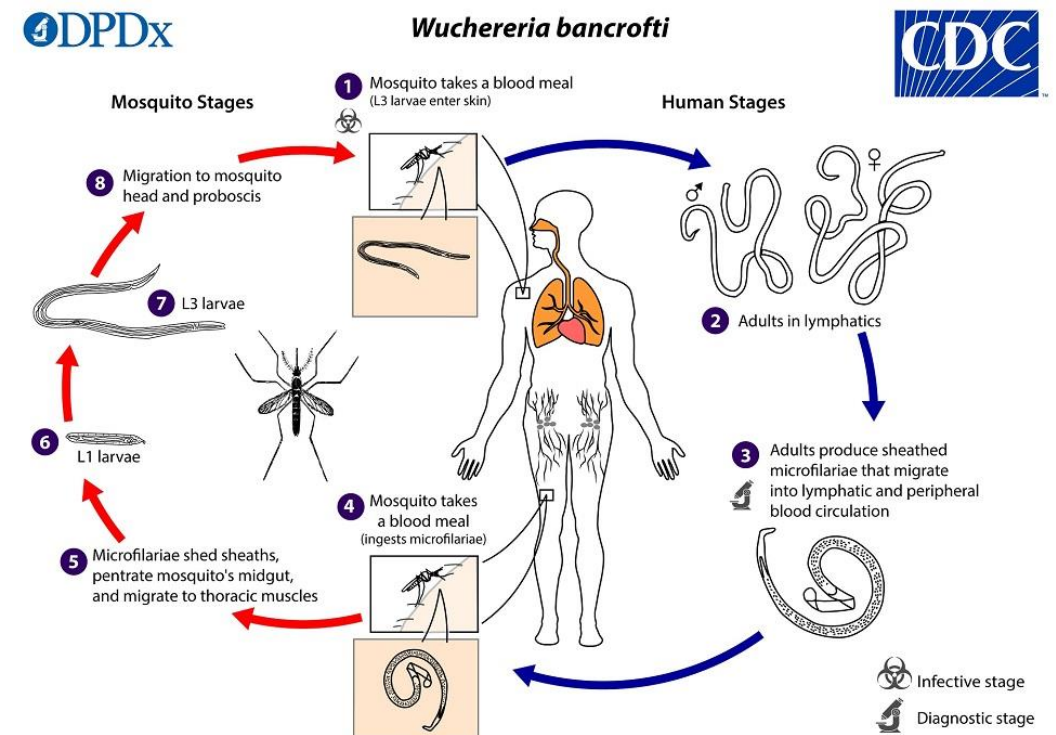


Neglected Tropical Diseases

- As per WHO
 - Buruli ulcer
 - Chagas disease
 - Dengue and chikungunya
 - Dracunculiasis
 - Echinococcosis
 - Foodborne trematodiasis
 - Human African trypanosomiasis
 - Leishmaniasis
 - Leprosy
 - Lymphatic filariasis
 - Mycetoma, chromoblastomycosis and other deep mycoses
 - Onchocerciasis
 - Rabies
 - Scabies and other ectoparasitoses
 - Schistosomiasis
 - Soil-transmitted helminthiasis
 - Snakebite envenoming
 - Taeniasis and cysticercosis
 - Trachoma
 - Yaws

Neglected Tropical Diseases

- Lymphatic filariasis (LF)
 - Filarial parasites: *Wuchereria bancrofti*, *Brugia malayi* and *B. Timori*
 - Parasitic Nematodes
 - Thread like
 - Lives in lymph system
 - Timeline:
 - Larva to adult: ~6+ months
 - Blocks lymphatic drainage
 - Can live: 5 to 7 years
 - Microfilariae
 - Can be intermediate
 - Nocturnal manifestation in circulation



Neglected Tropical Diseases

- Lymphatic filariasis (LF)
 - Early Symptoms
 - Eosinophilia: More white blood cells
 - Cough, wheezing, shortness of breath
 - Lymphangitis: Inflammation of lymphatic channels
 - Fever and chills.
 - General ill feeling (malaise), Headache, Loss of appetite, Muscle aches,
 - Enlarged and tender lymph nodes (glands) -- usually in the elbow, armpit, or groin.
 - Red streaks from the infected area to the armpit or groin (may be faint or obvious)
 - Throbbing pain along the affected area.
 - Lymphadenopathy : Abnormal lymph nodes
- Clinical Features
 - Lymphedema of limbs: swollen limbs
 - Hydrocele: fluid in scrotum
 - Skin: Thick and pitted



NIRMAL PUNJABI



Neglected Tropical Diseases

- Lymphatic filariasis (LF)
 - Diagnosis
 - Blood smear: To detect microfilariae
 - Antibody Test: Brugia Rapid Test
 - Antigen Test: Alere Filariasis Test Strip
 - For children: Ultrasound lymph nodes
 - Treatment
 - Anti-parasitic drugs
 - Ivermectin, Diethylcarbamazine and Albendazole
 - Slow/Limit the progress of lymphedema
 - Hygiene, Exercise, Skin and wound care, etc.
 - Surgery

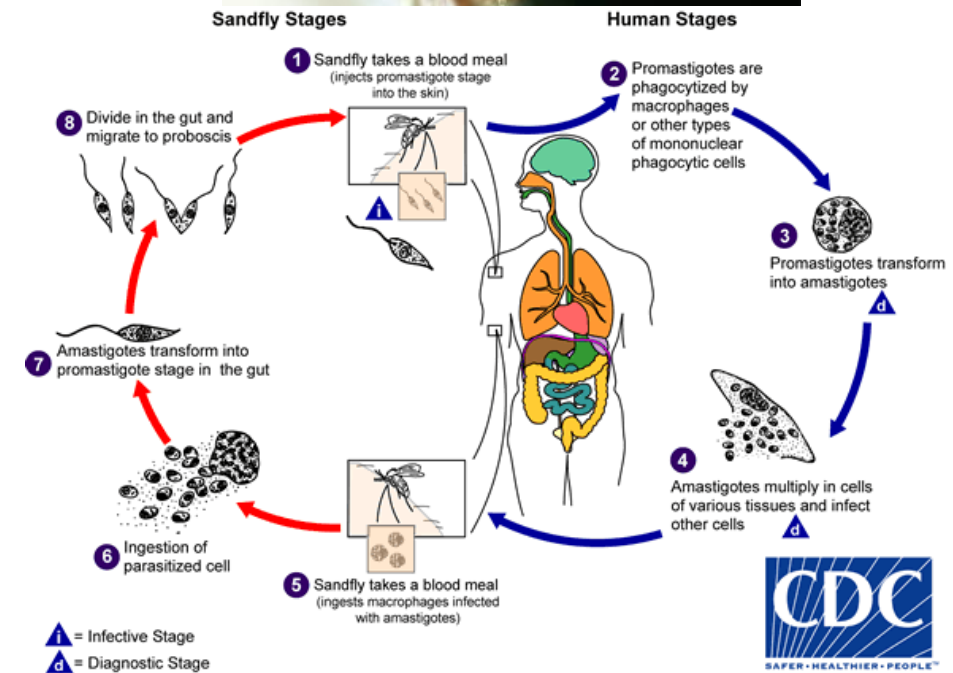


Neglected Tropical Diseases

- Visceral Leishmaniasis (VL)
 - Protozoa parasite Leishmania (20)
 - Vector: female phlebotomine sandflies



- Types:
 - Visceral (kala-azar)
 - Affect organs
 - Cutaneous
 - Skin sores
 - Mucocutaneous



Neglected Tropical Diseases

- Visceral Leishmaniasis (VL)

- Early Symptoms

- Fever, weight loss, enlargement (swelling) of the spleen and liver, and abnormal blood tests.
 - Low blood counts: low red blood cell count (anemia), low white blood cell count (leukopenia), and low platelet count (thrombocytopenia).
 - Manifestations: few weeks or months

- Clinical Features

- Skin Sores
 - Swelling of spleen / liver
 - Mucosal sores: nose, mouth, throat

- Diagnosis

- Tissue specimens
 - recombinant K39 protein IgG
 - PCR

Neglected Tropical Diseases: PKDL

- Post Kala-azar dermal leishmaniasis (PKDL)
 - Complication of kala-azar
 - Typically associated with *Leishmania donovani* parasite
- Manifestations
 - Skin rash/papules for weeks / months
 - Face / mouth
- Diagnosis
 - Biopsies from rash
 - History of VL
 - recombinant K39 protein IgG
- Treatment
 - Sodium stibogluconate or meglumine antimoniate
 - liposomal amphotericin B



NIRMAL PUNJABI

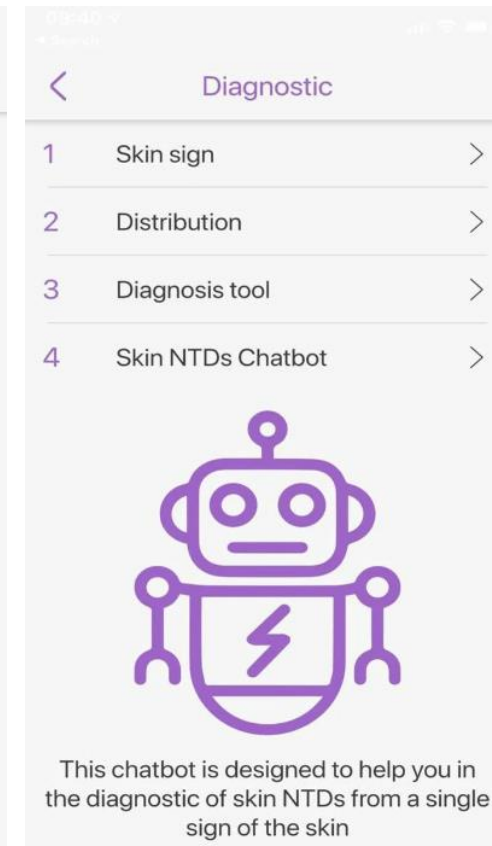
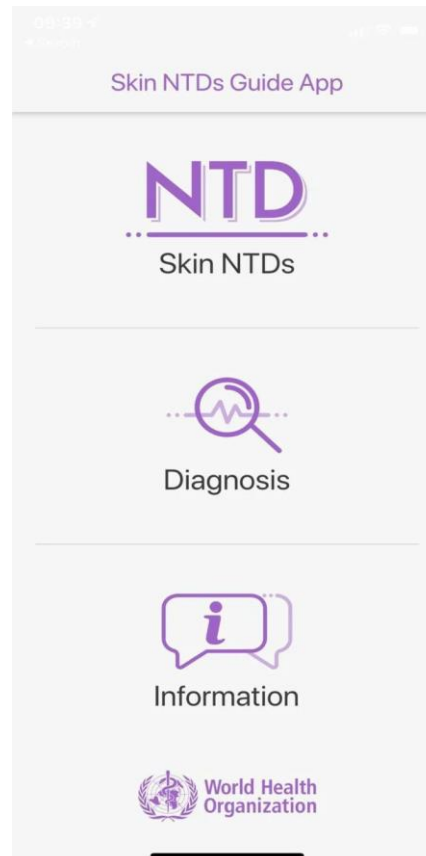


Neglected Tropical Diseases Management: mHealth for skin NTD

- Diagnosis
 - Image based
 - Symptoms based
 - Combination of both

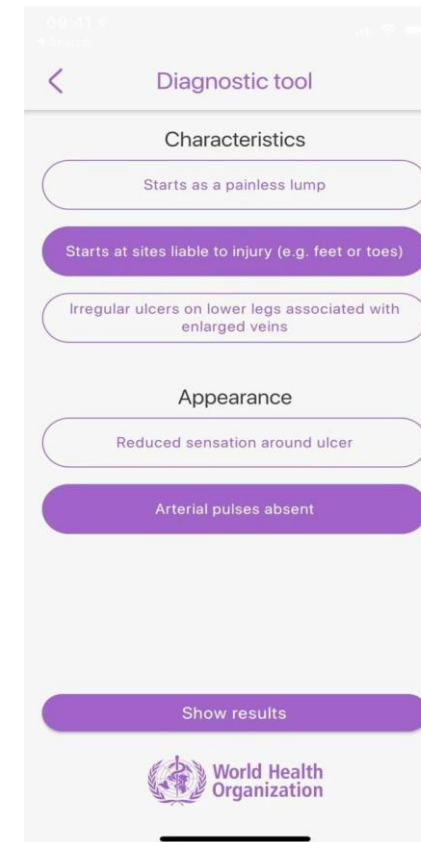
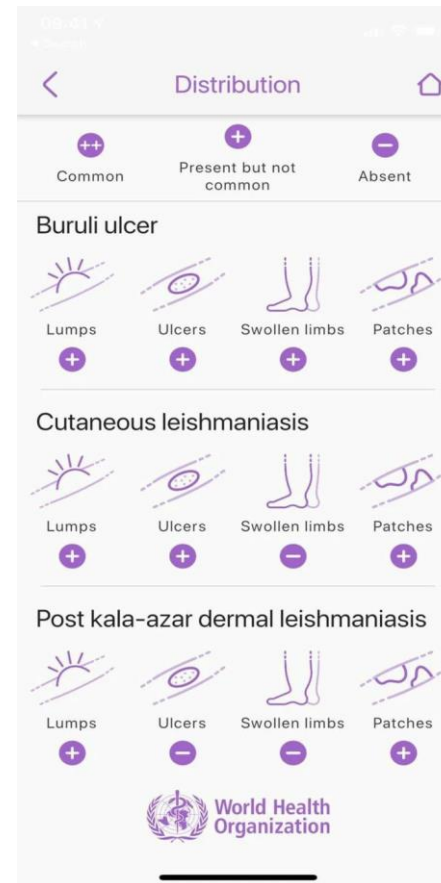
Neglected Tropical Diseases Management

- Skin NTDs Guide Application
 - WHO



Neglected Tropical Diseases Management

- Skin NTDs Guide Application
 - WHO



<https://www.who.int/publications/i/item/9789241513531>

Neglected Tropical Diseases Management

- Tracking
 - Symptoms
 - Spread of disease
 - Clusters
- Progress
 - VF
 - PKDL



KAMIS

National Vector Borne Disease Control Programme

Current Version : 1.0.0

Category : **Health**

Upload date : 2021-01-21 16:55:42

Last Updated : 2021-01-21 16:55:42.0

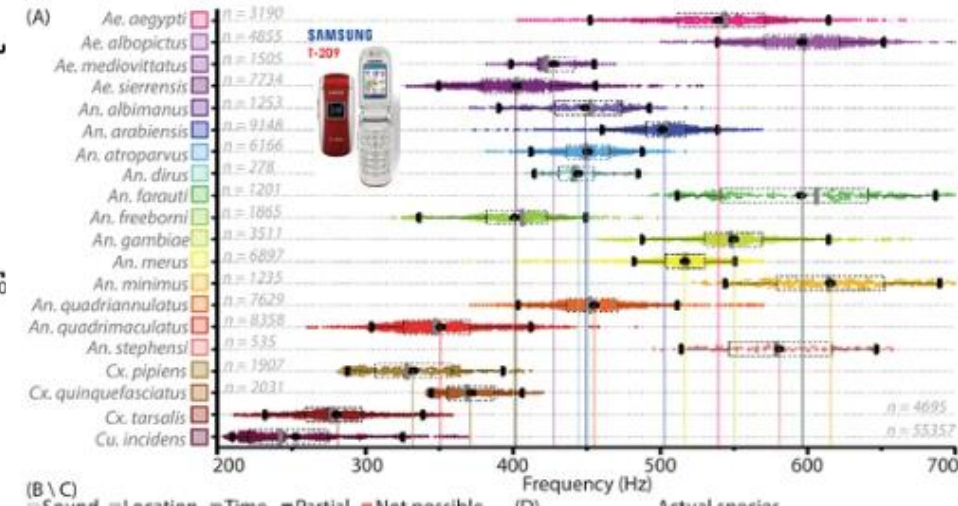
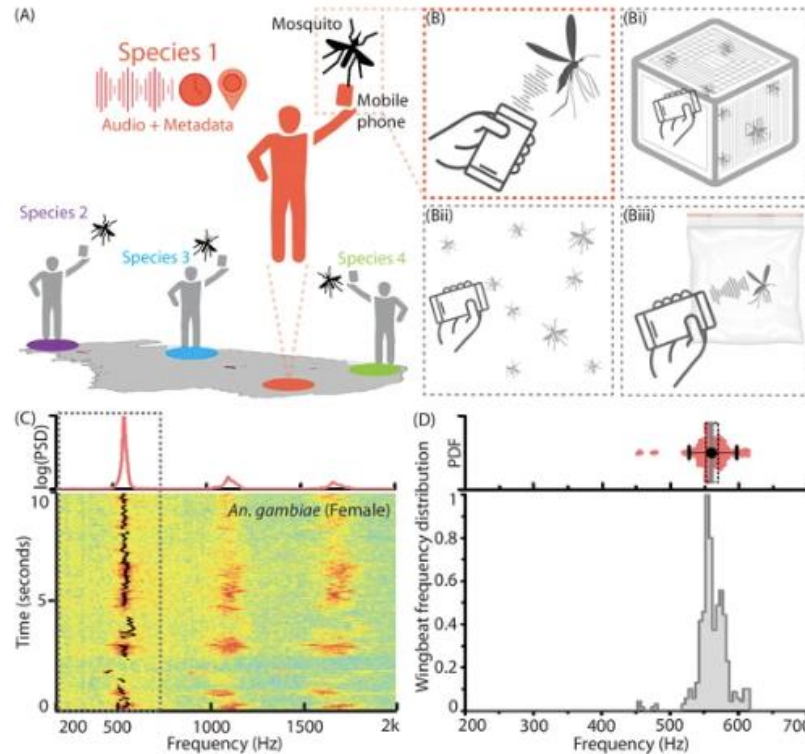
Downloads : 576

Platform : **Android** 🌱

Min. Platform Version : Lollipop 5.0

Neglected Tropical Diseases Management

- Tracking
 - Vector
 - Images
 - Sound: Abuzz Project by Stanford University



Neglected Tropical Diseases Management

- Intervention

- Mass Drug Administration (MDA)
 - Anti-parasitic drugs
 - Ivermectin, Diethylcarbamazine and Albendazole
 - To all eligible people living in endemic areas
 - sentinel and spot-check community surveys, followed by a transmission assessment survey (TAS)
 - mHealth data
 - Planning
 - Implementation
 - Data collection
 - Impact assessment surveys
-

- Education

- To support Infected
- To support healthcare worker

Neglected Tropical Diseases Management

Examples of Application developed for skin NTD

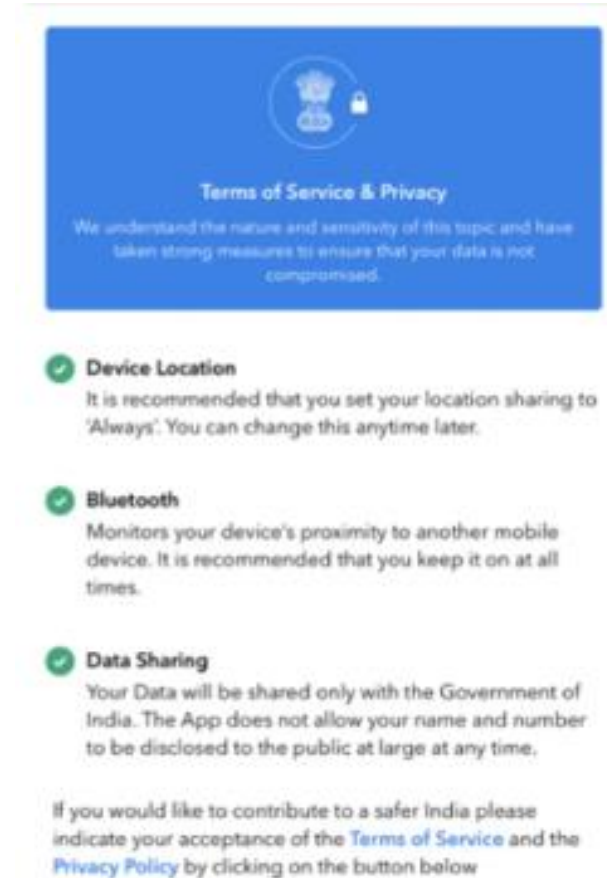
Table 3. Characteristics of apps for skin neglected tropical diseases available from app stores in alphabetical order.

Name (date last updated)	Marketplace (number of downloads)	Objective	Target user	Disease					
EndNTDs App (October 2017)	Google Play Store (+100)	To create a community of champions who are at the forefront in the fight against NTDs ^a in Zimbabwe, Africa, and globally	HCP ^b	NTDs (including skin NTDs)	SkinApp (October 2019)	Google Play Store (+10); Apple App Store	To act as a diagnostic tool and source of information on signs, symptoms, and therapy	HCP	NTD- and HIV-relat- ed skin diseases
Guaral RPC (February 2020)	Google Play Store (+10)	To improve early diagnosis	HCP	CL ^c	Skin NTDs App (July 2020)	Google Play Store (+60); Apple App Store	To diagnose and identify signs and symptoms of sNTDs through their visible characteristics	HCP	Skin NTDs
Lepra Reaction Basic manage- ment guide (October 2017)	Google Play Store (+100)	To conduct classification and quantification of severity to plan for appropriate clinical management	HCP	Leprosy	Task Force Tropical Data (August 2016)	Google Play Store (+1000)	To collect data	Task Force for Global Health members	NTDs (including skin NTDs)
LymEX (July 2019 Google Play Store and January 2020 Apple App Store)	Google Play Store (+50); Apple App Store	To improve self-care	Patients	Lymphoedema	Tropical Diseases (August 2019)	Google Play Store (+1000)	To provide a detailed overview of the etiology, patho- physiology, epidemiology, diagnosis, and treatment of tropical diseases	HCP	TDs ^d including CL, BU ^e , and leprosy
LymVol (September 2019)	Google Play Store (+10)	To measure and calculate limb volume of those affected by edema	HCP	Lymphoedema	Tropical Diseases (December 2019)	Google Play Store (+100)	To provide a detailed overview of the cause, diagnosis, prognosis, risk factors, prevention, and treatment of the stated diseases	HCP	TDs including CL, BU, and leprosy
Recognize Hydrocele disease (September 2019)	Google Play Store (+500)	To improve information about causes, treatment, and complications	Patients	Hydrocele	WIDP (January 2020)	Google Play Store (+10)	To control the epidemiological situation	HCP and WHO ^f staff	Yaws and BU
Recognize scabies (September 2019)	Google Play Store (+100)	To improve knowledge about the disease	Patients	Scabies					
Scabies disease (December 2017)	Google Play Store (+500)	To improve clinical management of the disease	HCP	Scabies					

ABI

Challenges/Limitation

- Privacy / Safety of Data
- Data Accuracy / Reliability
 - Most smartphone devices are Consumer Grade products
- Training for using device/application
- Cloud Infrastructure
 - Cost for setup & maintenance



Thank you

Contact: npunjabi@iitb.ac.in