

Mobile Health

Architecture, Applications, Security

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Introduction

Mobile Telephony . . .

- High rate of expansion ^a
- Introduction of new generation mobile networks (3G, 4G, LTE ; etc.) ^b
- Primary alternate solution for rural environment.

a. 5% in 1998, 50% in 2008 and one can estimate to 99% in 2018.

b. With a penetration rate of 0 % in 1998, 19% in 2008 and one can estimate to 90% en 2018.

Innovative mobile Services

All new services that can take advantage from the rapid growing of mobile telephony and mobile internet :

- 1 Mobile Money or mMoney
- 2 Mobile Education or mEducation
- 3 Mobile Agriculture or mAgriculture
- 4 Mobile Health ou mHealth

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Objective

- How to use ICT to improve care delivery efficiency in health domain ?

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mHealth

—→ A new EHealth approach to increase means and efficiency of care delivery : diagnosis, remote monitoring of chronic diseases ^a(including diabete, COPD) care/medicine prescription, advice etc.

a. 63% of mortality in 2010 according to WHO.

mHealth eco-system

Roles and components of a mHealth system :

mHealth eco-system

Roles and components of a mHealth system :

Patient : is a person with some kind of health problem.

Clinician : is a healthcare professional who is treating or helping the Patient with the health problem, ie a nurse, a General Practitioner, or a specialised physician.

HealthCare Provider (HCP) : is the entity that is utilizing a mobile health Service in the monitoring, diagnosis and treatment of the Patient.

mobile Health Service (mHS) : is the service that connects the Patient to the Clinician, and ensures data measures, transport and protection.

mHealth eco-system

Roles and components of a mHealth system :

mobile Health Service provider (mHSP) : is the entity providing the mHS through a mobile health Platform (mHP).

mobile Health Platform (mHP) : is the IT system connected to the mobile network to provide all necessary functionality.

mobile Health Device (mHD) : is a device needed to use the mHS and to connect to the mHP.

Use cases for mHealth

The use cases investigated in this presentation are :

- ① Consumer purchases mobile health service.
- ② Healthcare Provider prescribes mobile health service.
 - (a) Prescribed mobile health service with a mobile health Gateway Device.
 - (b) Mobile health service connected to Healthcare IT system.
- ③ Prescribed mobile health service for Disease Management.

Note that, health problems considered in this presentation and the use cases are all low risk..

Use case 1 : Consumer purchases mHS

This use case describes a system that allows remote monitoring of a patient by a subscriber (parent, insurance company, etc.) :

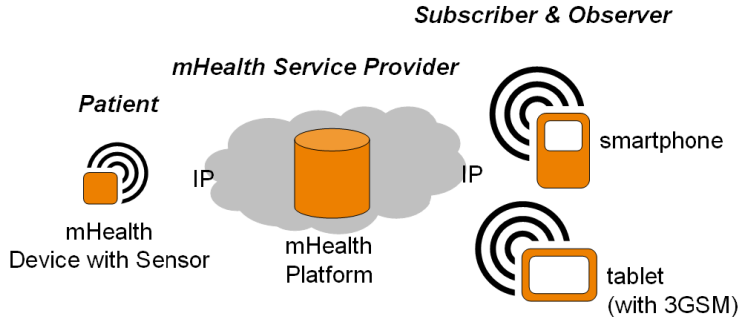


FIGURE 1: Consumer purchases mHS

Use case 2 : Healthcare Provider prescribes mHS

This use case includes intervention of HCP for measuring and remote monitoring¹.

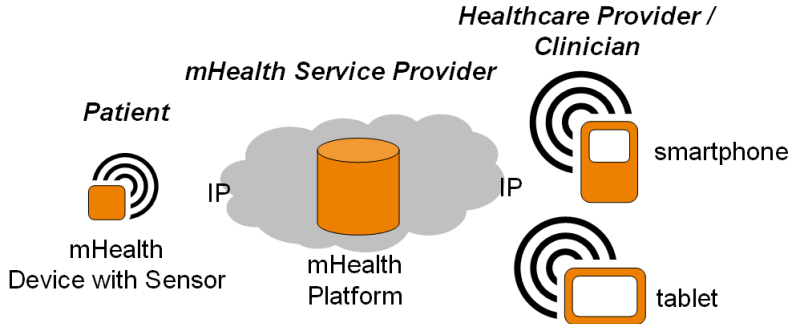


FIGURE 2: HCP prescribes mHS

1. For instance a GP may need to monitor daily records of blood sugar level for a patient suffering of diabetes

Use case 2a : Prescribed mobile health service with a mHGD

This use case differs from the previous with the introduction of a gateway : mHGD that aggregates data from different sensors.

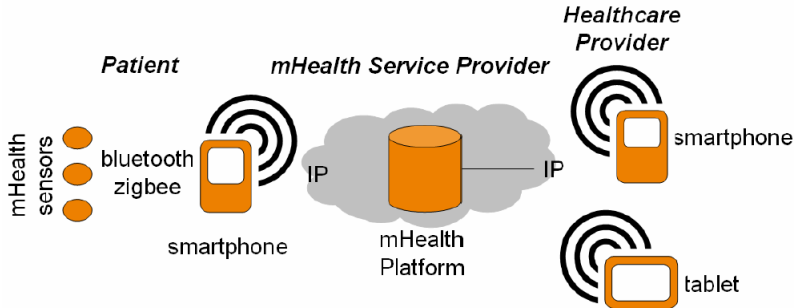


FIGURE 3: Use case 2a : Prescribed mobile health service with a mHGD

Use case 2b : mHS connected to Healthcare IT system

This use case introduces new devices at the HCP side, such as EHR et PHR² servers :

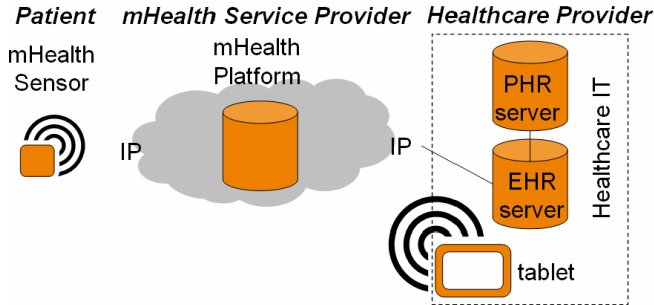


FIGURE 4: mHS connected to Healthcare IT system

Use case 3 : Prescribed mHS for Disease Management

Use case 3 is the most complex³ :

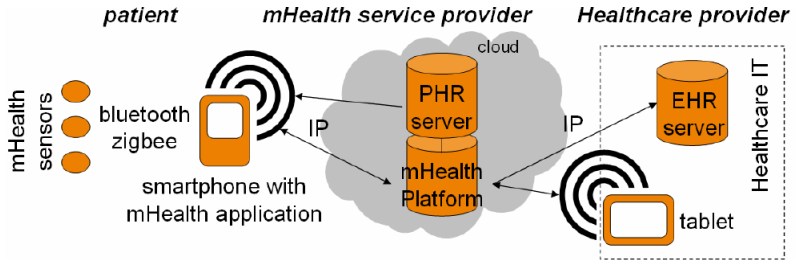


FIGURE 5: Prescribed mHS for Disease Management

3. It is unlikely to find or implement such a system in developing countries because it requires important infrastructures, high knowledge, development and user experiences in mHealth domain.

Use case 3 : Prescribed mHS for Disease Management

- Educative system
- Patient : reacts and adjusts his insulin level himself.
- HCP : modify the Patient self management level according to seen improvements.

Requirements overview

- Scalability
- Interoperability
- Security

Fonctionnalités of the mHD

- ① Easy to use according to the target group.
- ② Unique ID.
- ③ GSM connectivity.
- ④ Secure.

Fonctionnalités de mHS

- ① Online Helpdesk.
- ② Web portal.
- ③ Easy setting of parameters⁴.
- ④ Use of international standards for messaging and communication.

4. Especially threshold values that match therapy goals

Security requirements

- ① End to end security using a unique asset of MNO.
- ② Users authentication.
- ③ Registration of users and mHD to HCP (billing).

Overall, mHS continuity levels must match the level of medical risk associated with it.

Interoperability

- ① Use of international standards and messaging formats : HL7, IEEE11073, etc.
- ② mH application must be able to communicate with the IT system of the HCP.
- ③ Technology to be used : Bluetooth, Zigbee or USB between sensors and gateway.

Interoperability

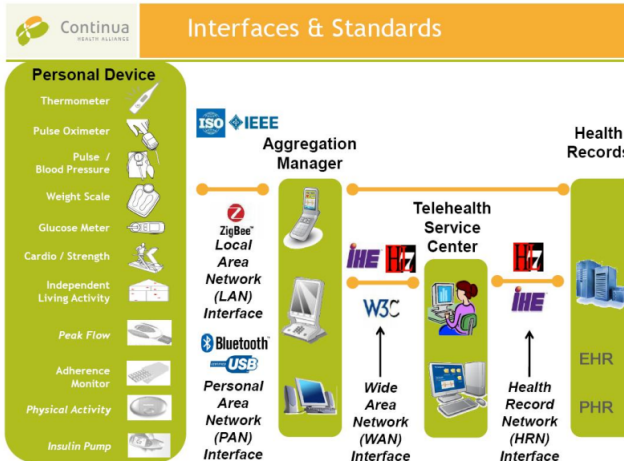


FIGURE 6: Interfaces and Standards. (Source : Continua Health Alliance)

mHealth network Architecture

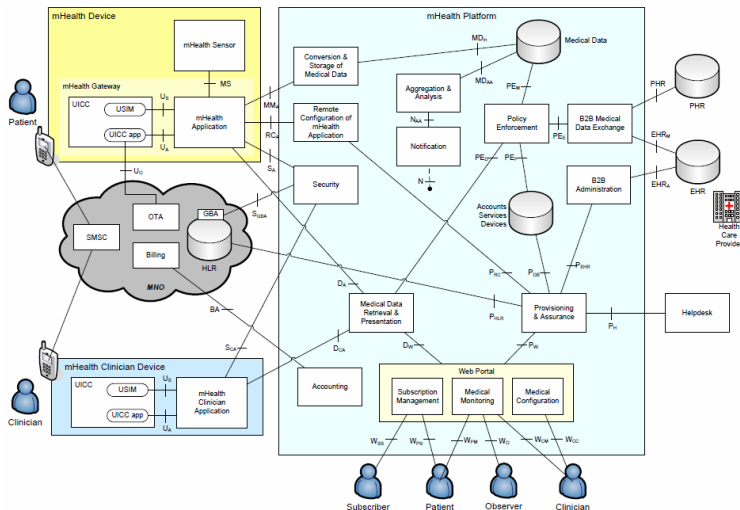


FIGURE 7: mHealth Reference network Architecture

mHealth network protocols suite

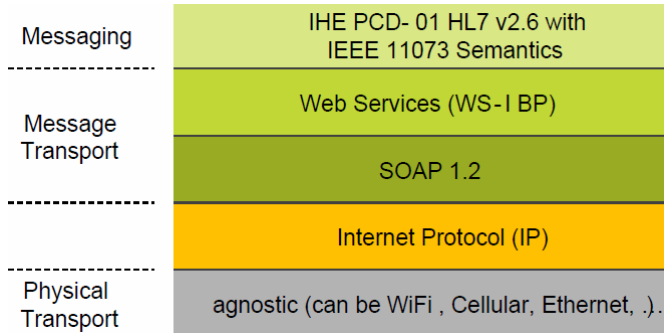


FIGURE 8: Continua certified WAN interfaces

Examples

Examples

Category	Sub-category	Client / Beneficiary Profile	Focus Area	Content type	Key Platforms	Key Players
Solutions across the Patient Pathway	Wellness	<ul style="list-style-type: none"> Individuals 	<ul style="list-style-type: none"> Obesity Management Healthy Living Elderly Care Child Care Pregnancy Tips Smoking De-addiction 	<ul style="list-style-type: none"> Information Tips / Interactive Services Fitness Monitoring 	<ul style="list-style-type: none"> ISMS (including USSD) IVR Apps Devices 	<ul style="list-style-type: none"> Mobile Operators Device Vendors Content Developers
	Prevention	<ul style="list-style-type: none"> Individuals exposed to Diseases / Epidemics / Other Health Concerns 	<ul style="list-style-type: none"> Infectious Diseases Drug Abuse Prevention Reproductive Health Child Health 	<ul style="list-style-type: none"> Information Tips 	<ul style="list-style-type: none"> SMS (including USSD) IVR 	<ul style="list-style-type: none"> Mobile Operators
	Diagnosis	<ul style="list-style-type: none"> Individuals -Low Income / Low Reach -Primarily Rural Areas 	<ul style="list-style-type: none"> Health call-centers / help-lines Tele-medicine 	<ul style="list-style-type: none"> Interactive Consultation 	<ul style="list-style-type: none"> Voice / IVR / SMS Telemedicine Centers 	<ul style="list-style-type: none"> Healthcare Providers Mobile Operators
	Treatment	<ul style="list-style-type: none"> Individuals 	<ul style="list-style-type: none"> Treatment Compliance 	<ul style="list-style-type: none"> Reminders / Compliance Trackers 	<ul style="list-style-type: none"> SMS (including USSD) IVR Apps 	<ul style="list-style-type: none"> Content Developers Mobile Operators

FIGURE 9: Applications and services mHealth

Examples

	Monitoring	<ul style="list-style-type: none"> Individuals suffering from chronic diseases or recovering from acute conditions Elderly 	<ul style="list-style-type: none"> Chronic Disease Management Independent Aging Post Acute Care 	<ul style="list-style-type: none"> Trackers for Body Vitals and Activities Reporting and Alert Messages 	<ul style="list-style-type: none"> Device-linked 	<ul style="list-style-type: none"> Mobile Operators Device Vendors
Healthcare Systems Strengthening	Emergency Response	<ul style="list-style-type: none"> Institutional – Hospitals 	<ul style="list-style-type: none"> Ambulance based Solutions 	<ul style="list-style-type: none"> Trackers for Body Vitals Interactive Consultation 	<ul style="list-style-type: none"> Device-linked 	<ul style="list-style-type: none"> Device Vendors Mobile Operators
	Healthcare Practitioner Support	<ul style="list-style-type: none"> Institutional – Hospitals Physicians 	<ul style="list-style-type: none"> Information Lookup and Decision Support Systems 	<ul style="list-style-type: none"> Medical Information 	<ul style="list-style-type: none"> Apps Internet-based 	<ul style="list-style-type: none"> Content Developers Mobile Operators
	Healthcare Surveillance	<ul style="list-style-type: none"> Institutional - Government - NGOs Healthcare Workers 	<ul style="list-style-type: none"> Health Surveys & Surveillance 	<ul style="list-style-type: none"> Data Collection and Reporting Support 	<ul style="list-style-type: none"> Apps Internet-based 	<ul style="list-style-type: none"> Mobile Operators Content Developers
	Administration	<ul style="list-style-type: none"> Institutional – Hospitals Physicians 	<ul style="list-style-type: none"> Appointment Reminders 	<ul style="list-style-type: none"> Reminders 	<ul style="list-style-type: none"> SMS (including USSD) 	<ul style="list-style-type: none"> Content Developers Mobile Operators

FIGURE 10: mHealth Applications and services

Security overview

Security requirements are an important aspect of mobile health system :

- ① Device and data security
 - (a) In memory
 - (b) Processing
 - (c) Transmission
- ② Confidentiality and integrity of information
- ③ User authentication
- ④ System availability and access to ressources
- ⑤ Non repudiation (useful in case of medical prescription)

Security overview

There are different ways to achieve⁵ security requirements in a mHS :

- Focus on mHD-mHP connection.
- Use of available unique asset of MNO (IMSI, IMEI, PIN, etc.).

- 1 Standard 3G, GSM radio encryption
- 2 Transport Layer Security (TLS) with Generic Bootstrapping Architecture (GBA)
- 3 Mobile health application embedded on the UICC

5. Any design should also consider risk and regulation

Solutions

Solutions based on a mobile health application on the UICC :

- UICC contains (U)SIM for authentication.
- UICC has enough storage to hold extra applications.
- Experiences of mobile money, mobile banking.
- More efficiency : XML, PKCS#7, S/MIME, OpenPGP encryption with non repudiation required on mHCD.

Solutions

A mobile health application on the UICC⁶ has many advantages including :

- Universality
- Portability
- Accessibility
- Interoperability
- Payment integration, tracking.

But ...

6. There are three ways to do that : pre-loading, loading at a Point of Interaction and OTA

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Introduction

EpharmacyNet (← *Ecare*)

- 1 Aims to reduce issues associated with « **Pharmacy Tourism** »
- 2 Had been tested in Benin in 2010 with 434 patients
- 3 2010 IHI award in Washington DC

Interactions in EpharmacyNet

In an EpharmacyNet system :

- A Patient gets a medical prescription
- EpharmacyNet platform consists in centralized databases
- The Patient connects to EpharmacyNet system
- The user interface displays a list of nearest pharmacies matching the request
- Electronic, online and cash payment
- Home delivery

Interactions in EpharmacyNet

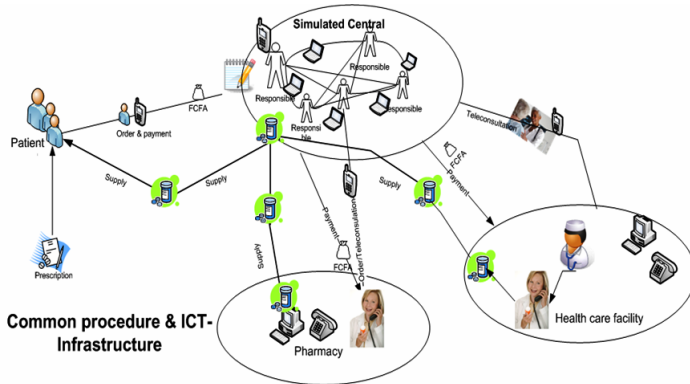


FIGURE 11: EpharmacyNet procedures and actors

Interactions in EpharmacyNet

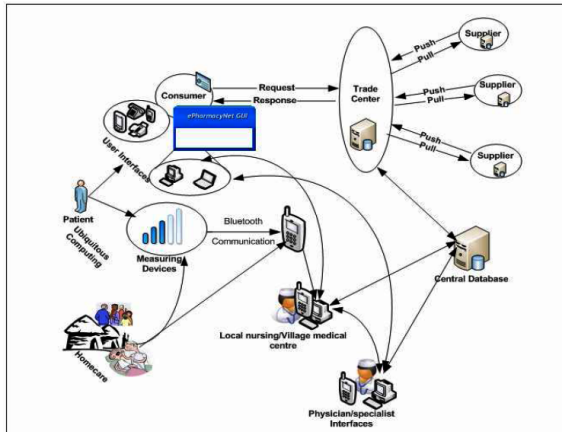


FIGURE 12: Communication in EpharmacyNet

Conclusion

Mobile Health Systems can help to improve care delivery :

Conclusion

Mobile Health Systems can help to improve care delivery :

- Increase of care centres (virtually)
- Reduction of delay associated with medical interventions and medicine delivery
- Increase of social wellness
- Better monitoring and statistics at national level

. . . End.

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