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Interoperability Event 2015**
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NICT, Japan

**AFFORDABLE BAN PORTABLE HEALTH CLINIC AND ITS
ENHANCEMENT**

Contact: DR. MASAHIRO KURODA
NICT, Japan

Email:

Affordable BAN Portable Health Clinic and its Enhancement

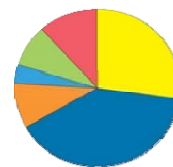
Masahiro Kuroda
National Institute of Information and
Communications Technology, Japan
marsh@nict.go.jp

Health: Benefit to Personal & Public Health

- Nearly 80% of NCD deaths (29 million) occur in low- and middle-income countries and lead to catastrophic medical expenditures

Global NCD deaths under age 70 by cause of death, 2008

- More than 9 million of all deaths attributed to NCDs occur before the age of 60; 90% of these "premature" deaths occurred in low- and middle-income countries

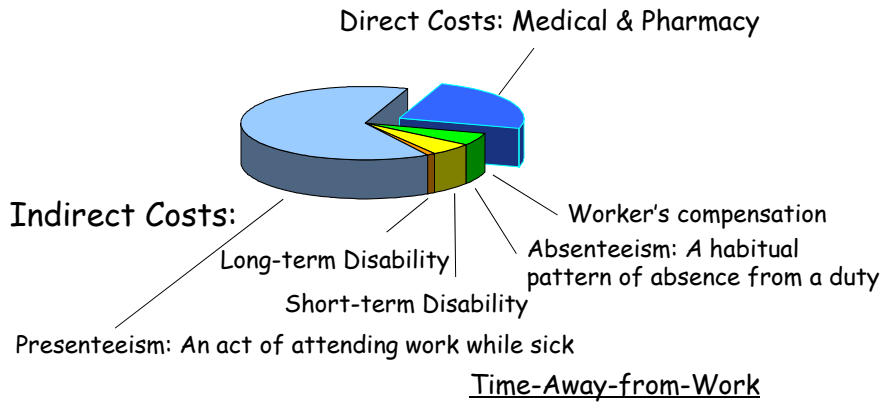


■ Cancers
■ Cardiovascular disease
■ Chronic respiratory diseases
■ Diabetes
■ Digestive diseases
■ Other noncommunicable diseases

NCDs: Non Communicable Diseases

- Affordable e-health keeps healthy workers and national interest

Relative Costs of Poor Health: Total Value of Health



Edington, Burton. A Practical Approach to Occupational and Environmental Medicine (McCunney). 140-152. 2003

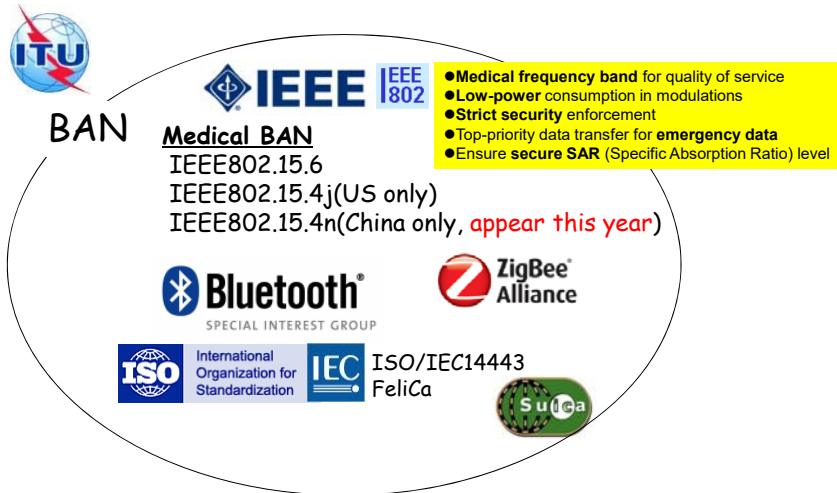
BAN in BAN Portable Health Clinic

- Body Area Network (BAN) offers a wired communication or short range radio communication capability for sensors to exchange data with a gateway around a person's body (From ITU-T Focus Group on M2M service layer: *M2M enabled ecosystems: e-health*)
- BAN is not limited to the space around a person, but depends on the distance reachable by cables and radios



Overview of key functional components in the e-health ecosystem for Remote patient monitoring/assisted living from ITU-T M2M FG report

BAN and Medical BAN Technologies

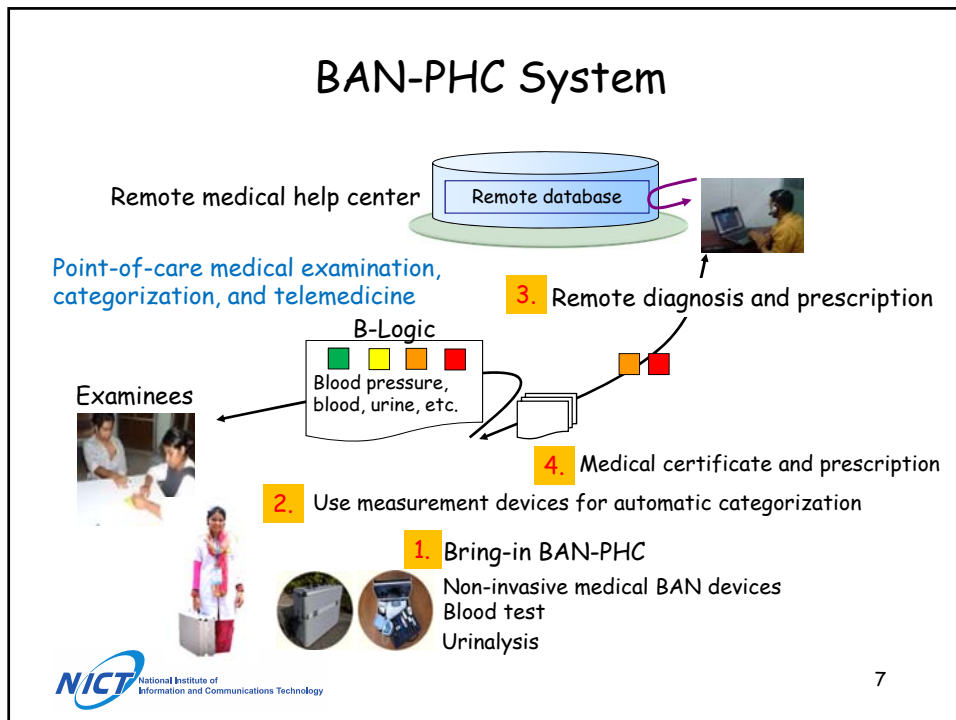


Affordable Checkup and Telemedicine

- **BAN Portable Health Clinic (BAN-PHC):** Health check-up and telemedicine on sites, such as factories in urban areas and villages in rural areas
- Continuous use in areas where power supply is unstable, easy-to-use interfaces to users, such as paramedics, easy network maintenance and ease of carrying



An international joint-research project "portable health clinic": *Kyushu university hospital, Graduate school of IS and EE, and Grameen Communications, Bangladesh, NICT* cooperation: Provide low-power & secure BAN standard technologies both for medical/healthcare devices and for the coordinator based on Android



B-Logic: Automatic Categorization

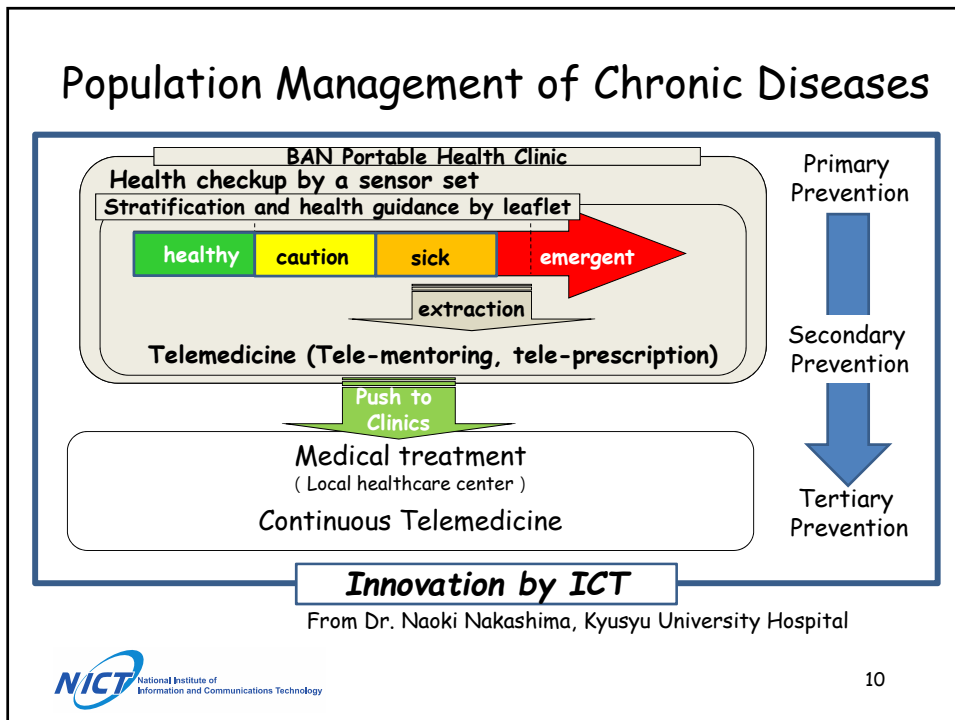
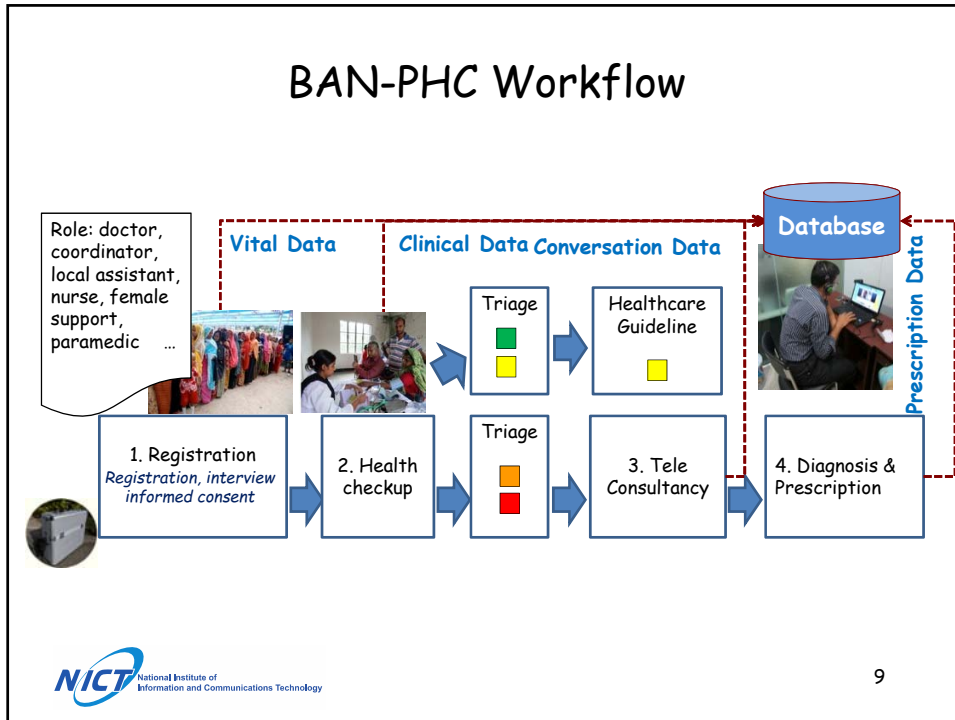
	Green	Yellow	Orange	Red
Blood Pressure (mmHg)	< 140 mmHg < 90 mmHg	140 ≤ < 160 mmHg 90 ≤ < 100 mmHg	160 ≤ < 180 100 ≤ < 110	180 ≤ 110 ≤
Blood Sugar	< 100mg/dl	100 ≤ < 126mg/dl	126 ≤ < 200mg/dl	≥ 200mg/dl
Postprandial Blood Sugar	< 140mg/dl	140 ≤ < 200mg/dl	200 ≤ < 300mg/dl	≥ 300mg/dl
Urine test				
...				
SpO2	≥ 96%	93 ≤ < 96%	90 ≤ < 93%	< 90%

- Red: Emergent - **Telemedicine** + Encouragement to visit clinic
- Orange: Affected - **Telemedicine**
- Yellow: Caution - **Provide a leaflet** about health care in Bengal
- Green: Normal

Designed by Naoki Nakashima, M.D., Kyushu University Hospital and
Kunihisa Kobayashi, M.D., Fukuoka University Chikushi Hospital

NICT National Institute of Information and Communications Technology

8



Medical Checkup and Remote Diagnosis in Rural Area, Bangladesh

Woman doctor for Women examinees

Doctor's remote exam.

Remote examinee

Wait for remote

Start

Physical examination scene

Measured data on android tablet

Reg. , Interview Informed consent

BAN-PHC Devices on Site

- Support International BAN Standards
- Plug-in any sensors following the open standards

Android terminal + BAN

BAN blood pressure with IHB*

BAN pulse oximeter

BAN blood glucose meter

BAN waist/hip meter

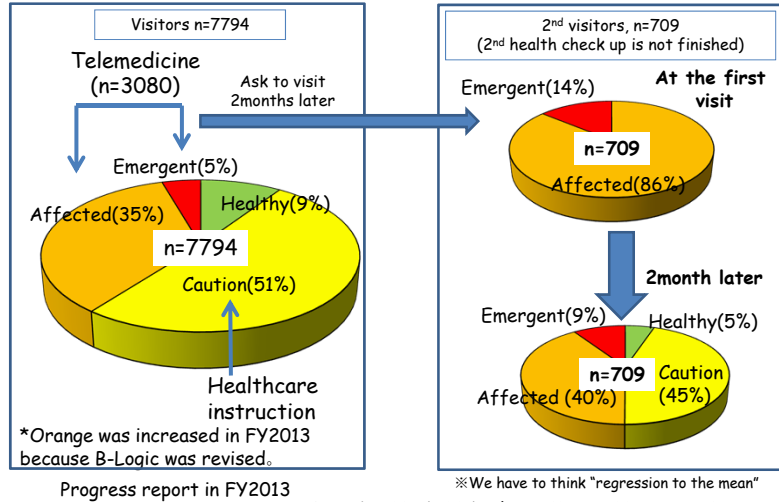
BAN contactless body temperature meter

BAN height meter

BAN weight meter

*IHB: Irregular Heat Beat

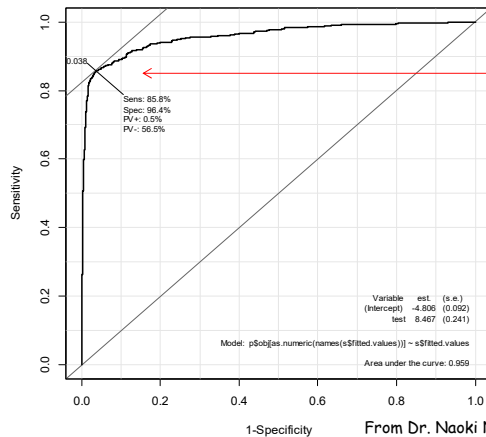
Results of Telemedicine in FY2013



From Dr. Naoki Nakashima, Kyusyu University Hospital

Cost Down of Health Checkup by ROC

Prediction of Blood Sugar by Questionnaire and Health Checkup data except for Blood sugar (the most expensive test)

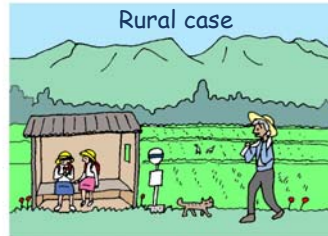


(Ex)
If we select the BER (Balanced Error Rate) point in ROC (Receiver Operating Characteristic) (AUC=0.959) from 15K people, we can omit 96.4% blood sugar test (in this case, we have to allow 14.2 % of positive subjects).

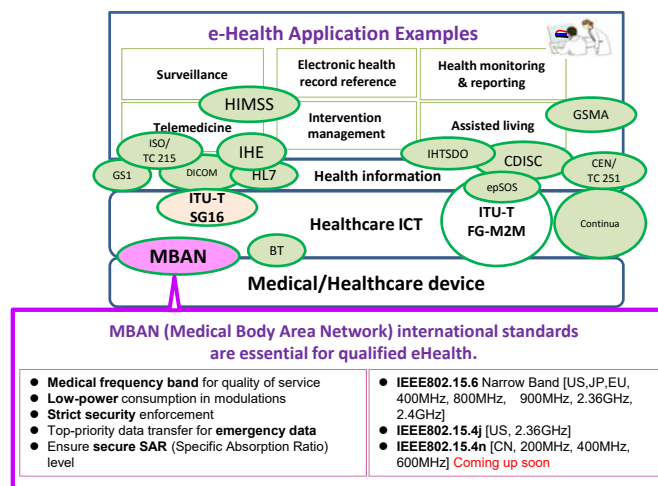
From Dr. Naoki Nakashima, Kyusyu University Hospital

Real Technologies for BAN-PHC

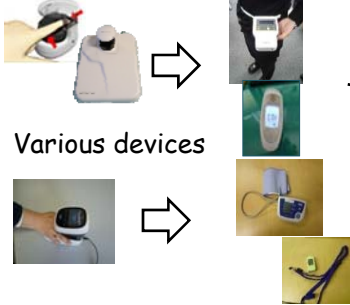
- Under unstable power supply and batteries may not be charged
- Data transfer via cell phone may not be available
- Limited space/location in setting up the clinic
- User-friendly interface for examiners




Standards around E-Health and Medical BAN



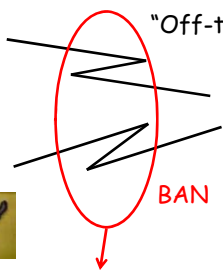
Japan and China worked on common Medical BAN standards



Various devices




"Off-the-shelf" Android tablet




BAN

International standards but depends on radio regulations in each country

- (1) IEEE802.15.6 (US, EU, Japan, China)
- (2) IEEE802.15.4j (US)
- (3) IEEE802.15.4n (China)



Japan, China and US worked together on common BAN standards between IEEE802.15.6 and IEEE802.15.4n




17

Ready for Affordable BAN-PHC business model


Medical doctors

PORTABLE HEALTH CLINIC

Affordable healthcare for unreached and aging community



Portable Health Clinic



Village Healthcare Lady

Rural/Urban Patients

Healthcare Service

Micro entrepreneurs

Bangladesh

System maintenance service

Microfinance

New Social Business Venture

Medical service evaluation

Epidemiologic study using Big data

Researchers

Use at evacuation site in disaster-stricken area

Prime Minister of Malaysia

Global Social Business Summit 2013


7-9 Nov. in Malaysia

<http://www.gsbs2013.com/home.html>

Perniagaan Sosial perkasage

Dr. Muhammad Yunus, a Bangladeshi banker and Nobel Peace Prize recipient, inspects the first portable health clinic.

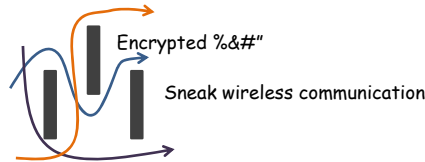
PHC supported by 最先端研究開発支援プログラム「超巨大データベース時代に向けた最高速データベースエンジンの開発と当該エンジンを核とする戦略的社会的サービスの実証・評価」



18

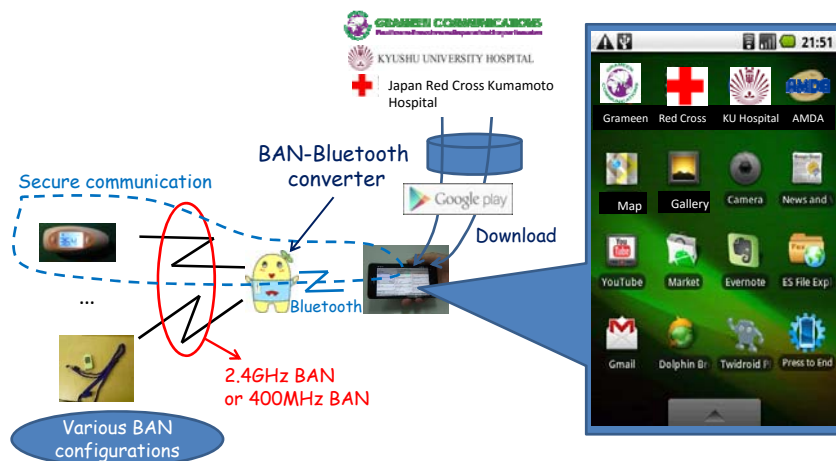
BAN-PHC Enhancements

- Not only 2.4GHz but 400MHz to take advantage of sneak wireless and long-haul communications



- Secure 2.4GHz/400MHz Bluetooth-conduit for smartphone
- All battery-operable by BAN beam switch-over
- Support non-invasive sensors
 - BAN vein authentication to identify a person
 - Coming ... BAN non-invasive blood test

Secure 2.4GHz/400MHz Bluetooth-conduit for smartphone



All Battery-operable by BAN Beam Switch-over

BAN blood pressure with IHB

BAN vein authentication

BAN pulse oximeter

BAN non-invasive blood hemoglobin measurement sensor

BAN blood sugar meter

BAN waist/hip meter

BAN contactless body temperature meter

BAN scale

Compact wireless A6 printer

Android terminal with NFC + BAN

BAN Beam ↓

Transfer data and configuration by one-touch

National Institute of Information and Communications Technology

21

BAN Beam Switch-over

Small video 1

National Institute of Information and Communications Technology

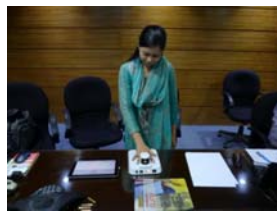
22

Non-invasive Sensors

Easy to use, No worry of infection, Inexpensive comparing to consumables

BAN vein authentication device

- Put 10,000 (20,000 fingers)
- No personal information (Only binary data)
- Off fingerprint by hard outside work
- Various middle names



Support BAN-enabled sensors

Hemoglobin
Red blood cells
White blood cells
Blood sugar
and so on



Start clinical experiment

Non-invasive Blood Hemoglobin Measurement

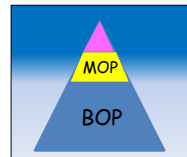
Small video 2

Expansion : Cost-effective Link between Physicians and Rural Pregnant Women



Conclusion

- Begin to provide affordable health checks and telemedicine in a *attache case* suitable for primary health care to BOP/MOP*
- Ready for real-use environment by BAN-PHC enhancements, but it needs to clarify entities involved in the business model
- Another BAN standard (China BAN) which will come up this year may be a trigger of BAN expansions



*BOP: Base of the Pyramid
*MOP: Middle of the Pyramid