



“Telemedicine and its Importance in the Control of Asthma and COPD”

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- I have no financial interest or other forms of relationships that could be considered a conflict of interest by participants.
- I will not be discussing any information about a product/procedure/technique that is considered research and is not yet approved for any purpose.



Topics

- Background - Telemedicine
- Internet-Based Home Monitoring
 - Literature Review
 - Commercial Monitoring Systems
- Role of Cell phones in health (mHealth)
- Wireless Body Area Networks
- Selected R&D
- Conclusions



Definition

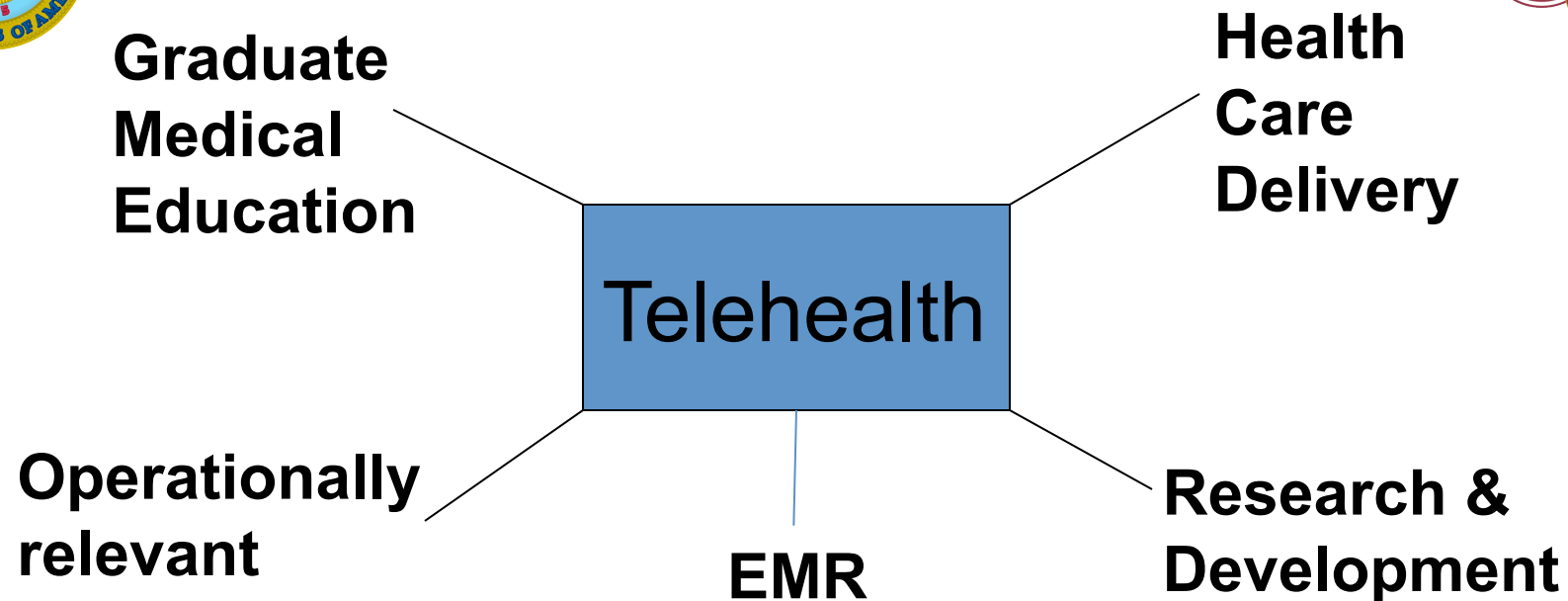


Telemedicine

Use of communications and information technologies
for the delivery of clinical care



Telemedicine – an enabling technology



Desirable Characteristics

- Applied regionally
- Defined outcome metrics
- Self-sustaining
- Technically feasible

Current Home Telehealth Overview

- Automatically processes vital signs and simultaneously informs caregivers or/and family members if the patient needs immediate medical attentions
- Centralized real-time data collection allows vital signals processing automatically in real-time or near-real-time with alert features
- Web Interface enables physicians, caregivers and family members to monitor patients' health status anywhere anytime





Internet-Based Home Monitoring



- Success of in-home monitoring for cardiac conditions & diabetes applied to asthma
- Evolved from:
 - spirometry & home phone to central server
 - Asthma nurse: management/education
 - Internet-based home monitoring
- Research
 - Pilot trials/ Feasibility studies
 - Randomized studies emerging



Dis Manage Health Outcomes 2003; 11:557-563



Asthma In-Home Monitoring



“Internet-based home monitoring and education of children with asthma is comparable to ideal office-based care: Results of a 1-year asthma in-home monitoring trial”

- Prospective, randomized study
- n=60; ages 6-17; 12 month study
- Home asthma tele-monitoring compared to in-person, office based visits (traditional education/management)
- Study group
 - Home computer/camera/Internet used to video record use of inhalers, peak flow meters and uploaded to secure server
 - Case managers view videos/data/on-line symptoms; available 24/7 to patient
- Results
 - “Virtual” patients had better metered dose inhaler technique (94 vs. 89%)
 - Better adherence to daily asthma symptom diary submission (35 vs. 21%)
 - Both groups experienced an increase in quality of life/asthma knowledge score

Pediatrics 2007; 119:569-578



Role of Telemedicine in Schools



“The Use of Telemedicine Access to Schools to Facilitate Expert Assessment of Children with Asthma”

- Prospective, cohort study in 3 urban schools in San Francisco
- n=83; ages 5-12; 8 month study
- Hypothesis: Access to expert asthma care can improve through a telemedicine link between an asthma specialist & a school-based asthma program
- Study group
 - Each subject was seen by an asthma expert at 0, 8, 16 and 32 weeks.
 - Assessment & recommendations for care were sent to the primary care physician (PCP) & parents were told to contact their physician for follow-up care.
- Results
 - Subjects experienced improvement ($P < .05$) in family social activities and the number of asthma attacks.
 - 94% of subjects rated the program as good or excellent.



Int J Telemed Appl. 2008:159276

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Asthma In-Home Monitoring



3 Additional Studies & Conclusions

- “An Internet-based interactive telemonitoring system for improving childhood asthma outcomes in Taiwan”
 - Telemed J E Health 2007; 13:257-268
 - The Internet-based asthma telemonitoring program increases self-management skills, improves asthma outcomes, and appears to be an effective and well-accepted technology for the care of children with asthma and their caregivers.
- “Internet-based monitoring of asthma: A long term randomized clinical study of 300 asthmatic subjects”
 - J Allergy Clin Immunol 2005; 115:1137-1142
 - When physicians and patients used an interactive Internet-based asthma monitoring tool, better asthma control was achieved.
- “Internet-based home asthma telemonitoring: Can patients handle the technology?”
 - Chest 2000; 117:148-155
 - Internet-based home asthma telemonitoring can be successfully implemented in a group of patients with no computer background.



COPD In-home monitoring



- **“Cost-minimization analysis of a telehomecare program for patients with chronic obstructive pulmonary disease”**
 - Telemed J E Health. 2006 Apr;12(2):114-21
 - Patients were found to easily accept the idea of using the technology, and the telehomecare program demonstrated significant clinical benefits. Financial advantages of the program could have been more pronounced had it not been for the cost of technology that effectively erased a good portion of the savings.
- **Randomized controlled trial of an internet-based versus face-to-face dyspnea self-management program for patients with chronic obstructive pulmonary disease: pilot study**
 - J Med Internet Res. 2008 Apr 16;10(2):e9
 - Although there were numerous technical challenges with the eDSMP, both dyspnea self-management programs were effective in reducing dyspnea with ADL in the short term. Our findings will need to be confirmed in a larger randomized trial with more mature Web and personal digital assistant tools, use of a control group, and longer follow-up.





Commercial Monitoring systems



- Measure peak flow at home
 - Upload to cell phone/Web site
- Review PEF/symptoms graph
- Discuss with provider
- Adjust therapy in person or on-line
- Examples
 - Avalis Healthcare Systems AG (Switzerland)
 - “Go Asthma” - Worry free, self-management
 - t+Medical Americas, Inc.; (Chapel Hill, NC)
 - TelehealthLink (Irvine, CA)
 - MedApps (Scottsdale, AZ)
 - mobile wireless monitoring





Home Health Monitoring



Home health monitoring and telemedicine will grow to a \$7.7 billion market by 2012 from a \$3 billion market in 2009

Planned products: a house that monitors your every move, from bedside to bathroom and from medicine cabinet to fridge. Aim is to help the elderly to lead safe and independent lives.

“Health House” tracks everyday habits, but also check weight and blood pressure and predict whether a person is at risk of a serious fall.

Examples - how many times a person opens the fridge door or uses the faucet: Repeat trips to the fridge could signal mental impairment, and a failure to use the faucet might suggest an increased risk of dehydration.

The next generation of sensors also studies activity such as bathroom use, time spent sleeping and when medicine is taken, plus vital signs such as blood pressure, weight and blood-oxygen levels.



Intel, GE Form Health-Care Alliance



Intel Corp. and General Electric Co. announced an alliance to develop and sell technology to help care for the elderly and chronically ill in their homes - "Health House"

Companies pledged to invest more than \$250 million over five years on R&D

GE sells and markets a system called the Intel Health Guide, which is designed to help patients track their health and provide data about their conditions over the Internet to doctors.



APRIL 2, 2009 – The Wall Street Journal
By DON CLARK and PAUL GLADER



How can Health IT reach people?

What technology do people already use?

- Internet Access:

- 73% of adults have Internet access (Source: Pew Internet & American Life Project. Degrees of Access (May 2008 data))
- Only 50% of people with chronic conditions have Internet access (Source: Pew Internet & American Life Project. Degrees of Access (May 2008 data))
- Average Internet use <1 hour per day (Source: Nielsen. Record High TV Use, Despite Online/Mobile Video Gains. November 24th, 2008)



- Mobile phones

- Nearly 90% of Americans have mobile phones. (Source: Harris Interactive, "Cell Phone Usage Continues to Increase." April 2008)
- 18% of households only have a mobile phone. (Source: US Centers for Disease Control: Wireless-Only Phone Use Varies Widely Across United States)
- 1 trillion SMS text messages sent in 2008. (Source: CTIA http://www.ctia.org/media/industry_info/index.cfm/AID/10323)





Mobile Health (mHealth)



Cell Phone Applications

- Clinical consultation
- Education
- Research
- Biosurveillance
- Disease Management





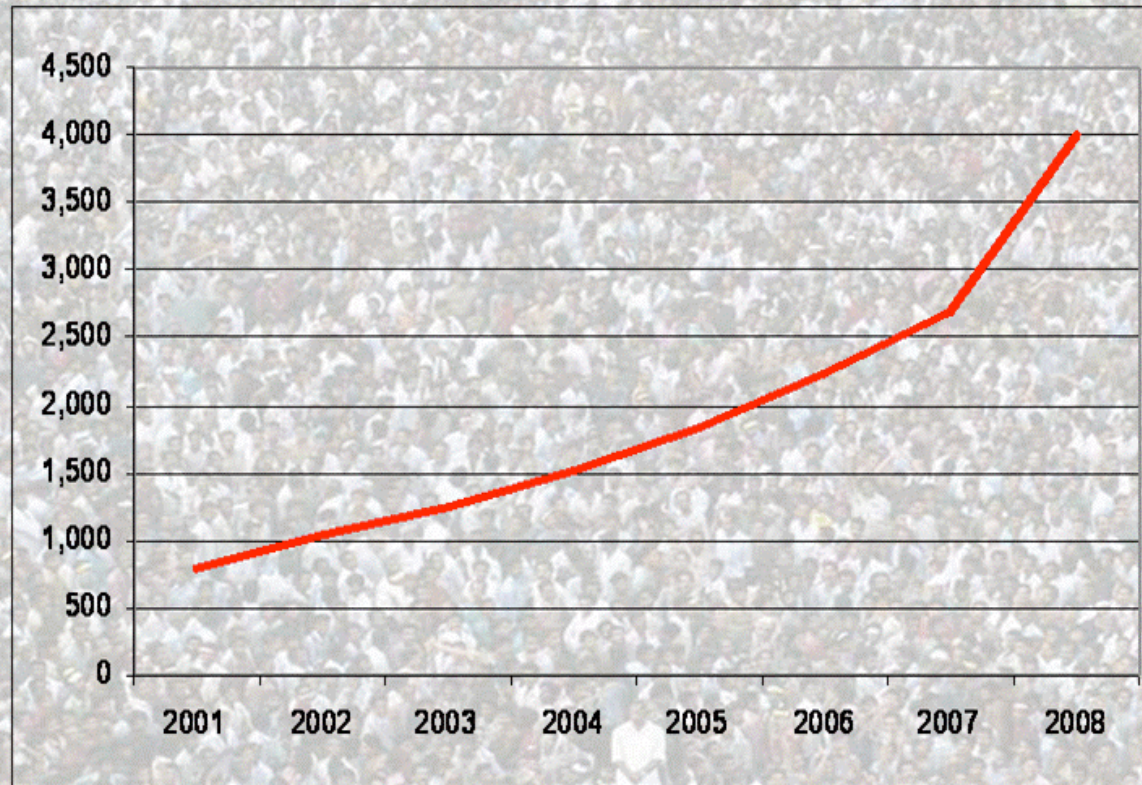
mHealth Evidence

Agents for Behavior Change

- Smoking Cessation: 28% of smokers receiving SMS messages quit vs. 13% of control group. (A. Rogers et.al. Do u smoke after txt? *Tobacco Control* 2005;14:255-261).
- Diabetes: For patients using interactive SMS support service, mean HbA1c improved from $7.5 \pm 1.5\%$ to $7.0 \pm 1.1\%$ ($P = 0.003$). Hyuk-Sang Kwon, et. al. *Diabetes Research and Clinical Practice* Volume 66, December 2004: Pages S133-S137
- Diabetes: The web-based intervention using SMS messaging improved levels of HbA1c in type-2 diabetic patients for the six-month duration of the trial. *Journal of Clinical Nursing*, June, 2007, Vol. 16 No. 6, pp 1082-1087 Hee-Seung Kim, Ph.D., RN; Hye-Sun Jeong PhD, RN
- Appointment Attendance. SMS reminders improved primary care attendance from 48% to 59%. The use of text messaging to improve attendance in primary care: a randomized controlled trial. *Family Practice* 2006 23(6):699-705



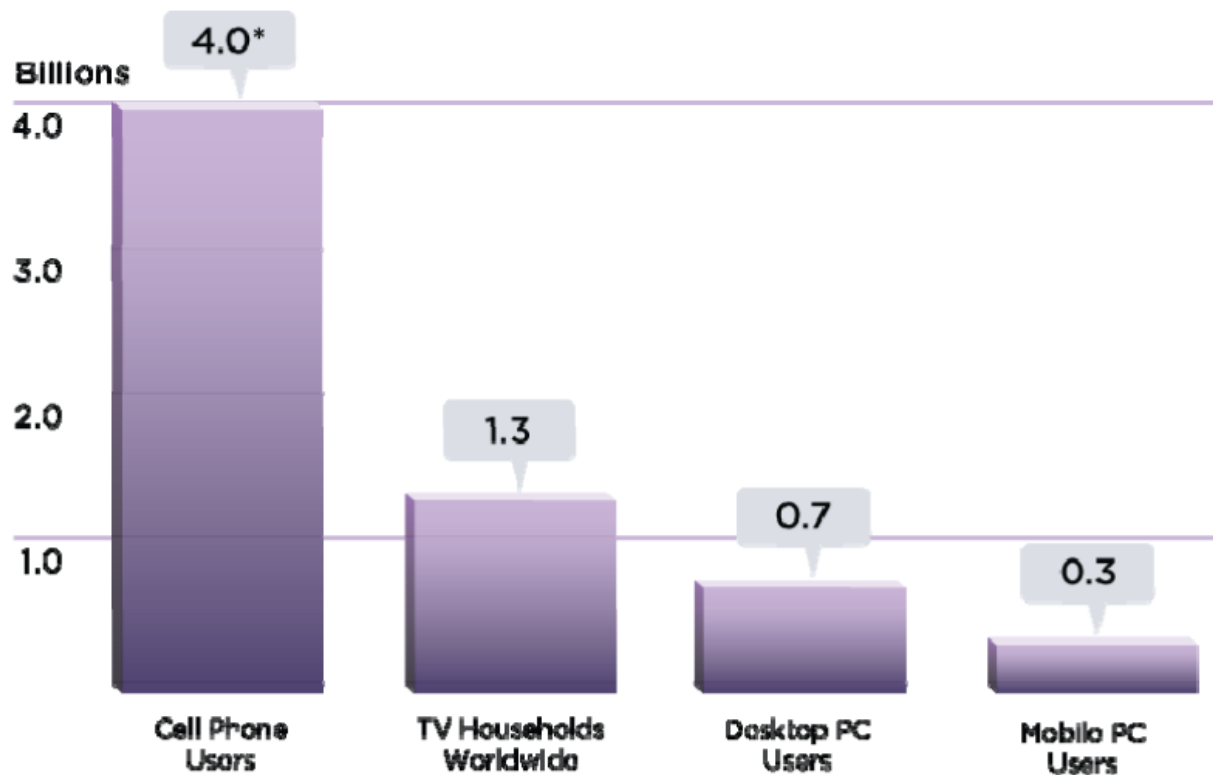
4 billion mobile phones at end of 2008



Source: ITU



More than 3 Billion More Devices Than Any Other Computing or Consumer Electronics Device - Globally





How is US Health Care industry leveraging the 280m mobile phones in this country?





What are we using SMS applications for?





The intelligent connection to health

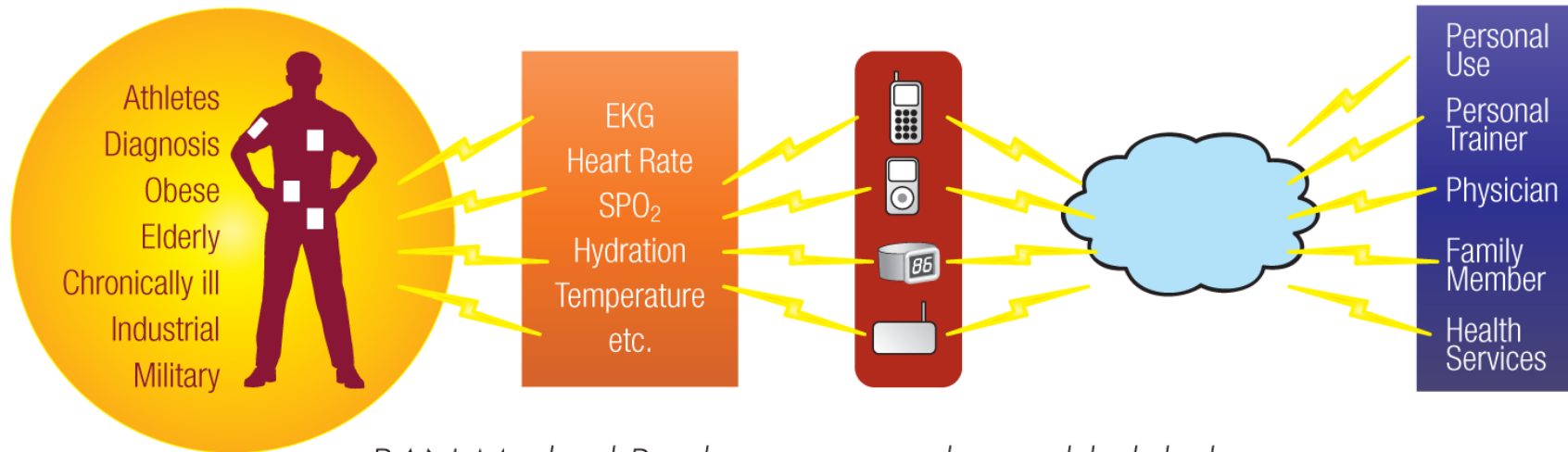
Multimedia communication between patients and physicians by mobile phone video chat, instant messaging, email and text messaging

Healthcare - Any Network, Any Device, Anywhere, Anytime

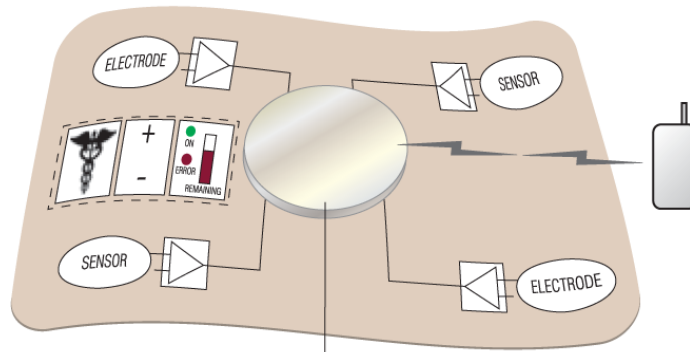




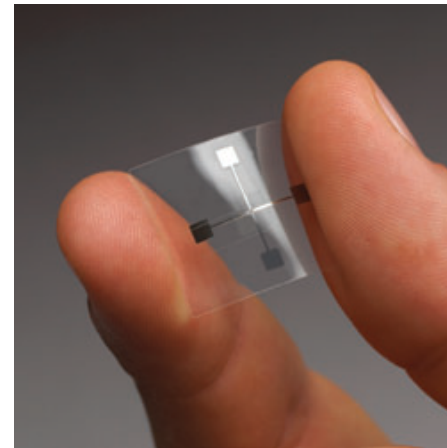
Wireless Body Area Network (wBAN)



BAN Medical Patches as smart disposable labels.

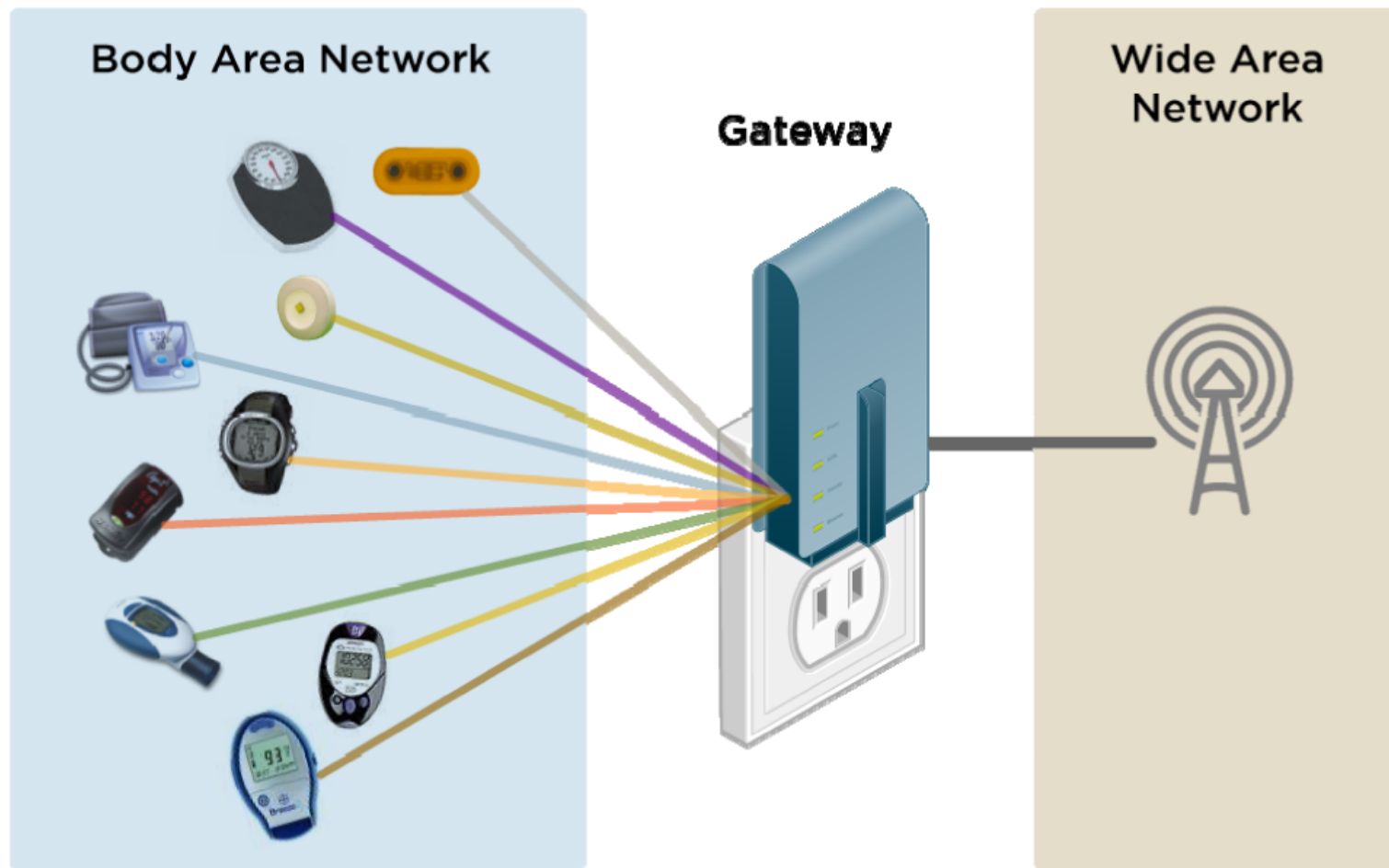


Standardized, detachable, re-usable radio





Low Cost, Easy to Deploy Health Gateway





The tidal wave of data

Will mHealth overwhelm providers with too much data?



Mobile Medical Provider





Personal Health Care





More data, from more sources





Asthma In-Home Monitoring - Research



- Georgia Tech Research Institute have developed a sensor to monitor the air around individuals
 - Wearable device weighs < 1 pound
 - Measures airborne exposure to a wide array of asthma triggers (CO₂, ozone, volatile organic compounds)
 - Pump pulls air through filter for later analysis in a lab
 - Allows analysis of environmental asthma triggers
- Texas Instruments (Bangalore, India) and Indian Institute of Technology in Mumbai collaboration
 - MEMS fabricated pressure sensor/spirometer
 - Internet-enabled for data transmission
 - inexpensive costs to mass produce (a few dollars)





Conclusions

- Internet-based home monitoring and educational programs for asthma and COPD have demonstrated clinical value.
- Data for Remote Monitoring for asthma/COPD research are emerging from longer, randomized trials.
- Telemedicine will continue to play an increasingly critical role in asthma/COPD management, as technology advances.
- mHealth and Body Area Networks hold promise for home monitoring of respiratory diseases
- Challenges of mHealth includes provider availability to monitor and analyze data due to the tsunami of information generated.