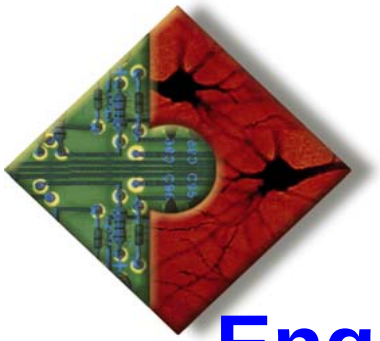

Drexel BIOMED Symposium

1 October, 2010

Engineering 21st Century Healthcare

New Horizons for *Health Systems Engineering*

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My Bio Brief

- 35+ years in the medical technology and IT/HIT fields, as a technology/engineering expert and consumer/safety advocate
  - *Biomedical and Clinical Engineering core plus an Information Systems and Sciences doctorate*
  - 25 years as a CIO, COO, CTO, CRO in the medical technology industry (ECRI Institute & MEDIQ, Inc)
  - 10+ years in business schools, MIS, CS, BME
- Since Nov, 2009 ***Director*** of ***Health Systems Engineering and Research Professor*** at Drexel University, Philadelphia, USA
  - Specialization interests: electronic health records, medical devices, privacy, security, and patient safety, wireless in healthcare, ***eHealth, mHealth, pHealth, and uHealth*** TeleHealth,and related technical standards and policies
  - Recent NSF grant recipient for national Health IT Curriculum and Certification
  - Developing an innovative university-based Wireless Medical Device Interoperability Laboratory for teaching and research
- Since mid-2008, **president and co-founder of CHIRP**, a 501(c)(3) charitable non-profit agency
  - *Technology and policy research for personalized health care,*
  - *Initial source of funds for the Wireless Medical Device Interoperability Lab at Drexel*

Presentation Outline

- The Healthcare Landscape
- Health Systems Engineering's Role
- US Healthcare Reform
- The Role of Interoperable Medical Device and Medical Device Systems
- Business as usual?

This is what global medical expenditures looked like in 2007

(Based on 2010 data, by the way!)

What's the situation today?

- The US government displays a report card at http://www1.cms.gov/NationalHealthExpendData/25_NHE_Fact_Sheet.asp
- **Historical NHE, 2008:**
  - NHE grew 4.4% to ***$2.3 trillion in 2008***, or $7,681 per person, and accounted for ***16.2% of Gross Domestic Product (GDP).***
  - Medicare spending grew 8.6% to $469.2 billion in 2008, or 20 percent of total NHE.
  - Medicaid spending grew 4.7% to $344.3 billion in 2008, or 15 percent of total NHE.
  - Private spending grew 2.6% to $1.2 trillion in 2008, or 53 percent of total NHE.

Further, the current forecast at the government's web site today:

- **Projected National Health Expenditures, 2009-2019:**
  - Growth in NHE is expected to increase 5.7 percent in 2009 and average 6.1 percent per year over the projection period (2009-2019).
    - $2.3 Trillion (2008)
    - $2.4 Trillion (2009)
    - $2.6 Trillion (2010)
    - $2.7 Trillion (2011)
    - $2.9 Trillion (2012)
    - $3.1 Trillion (2013)
    - $3.3 Trillion (2014)
    - …etc (At 6%/yr increase, costs double every 11 years; so we'll hit $4.6 Trillion annual healthcare costs around 2019)
  - The health share of GDP is projected to reach ***17.3 percent in 2009 and 19.3 percent by 2019.***

The US is "between a rock and a hard place."

We have a VERY rapidly aging population, and cannot afford decent healthcare without MAJOR innovation.

Older Population by Age: 1900 to 2050 (Numbers)

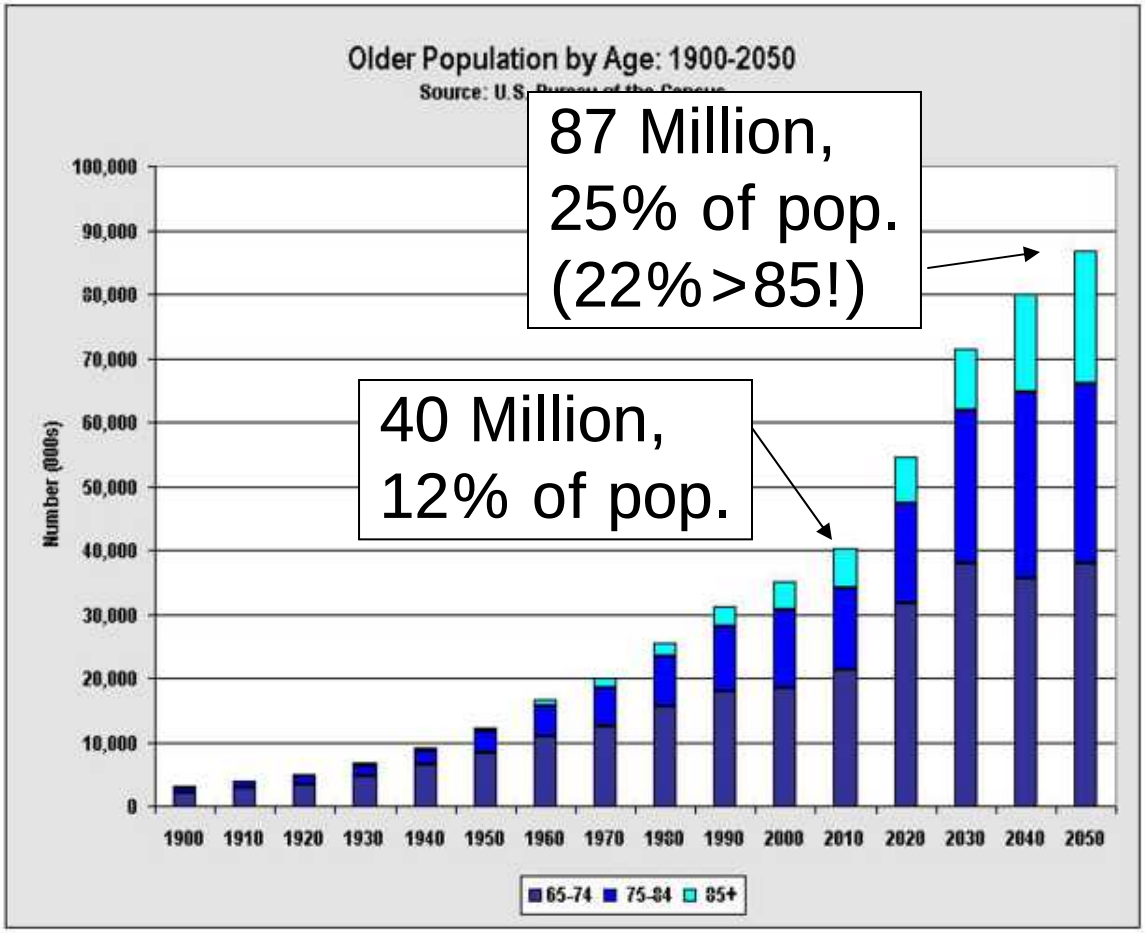

Table compiled by the U.S. Administration on Aging based on data from the U.S. Census Bureau.

– ***In 2005, th*** ***expectancy tables to 110 years.***

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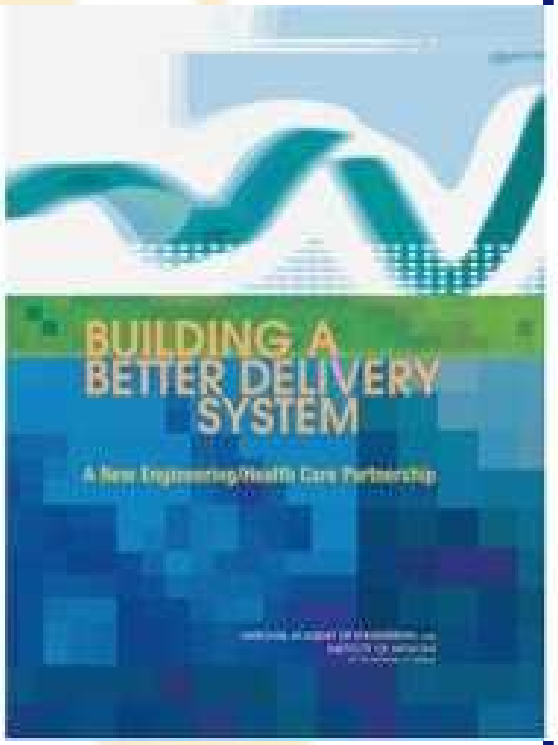
The Institute Of Medicine's has identified only one real solution:

- **"Building a Better Delivery System: A New Engineering/Health Partnership"**
  - November, 2005
  - ISBN: 030909643X
- A joint report by
  - The National Academy of Engineering
  - & The Institute of Medicine (NAE/IOM)



Free Executive Summary:
http://darwin.nap.edu/books/030909643X/html/249.html

How'd we get here? The ALARM BELLS went off in 1999!

- The Institute of Medicine (IOM) published ***"To Err is Human,"*** a frightening report that documented up to 90,000 American patients die or are caused major harm *unnecessarily* due to medical errors!
  - ***HELLO!*** **That's equal to a FULL Boeing 747 crashing each and every day (and that's just in the US!)**
- IOM has published 6 major reports since 1999, and the US has made virtually NO progress yet!!!
  - e.g., one IOM estimate in 2006: the average patient will experience one medication error PER DAY!

Two key opportunity areas were defined by the NAE/IOM report:

1. *Apply proven engineering techniques to solve healthcare's problems, including biomedical engineering, systems engineering* and software engineering, and
2. *Leverage information & communication technologies already transforming industries like manufacturing and aviation*

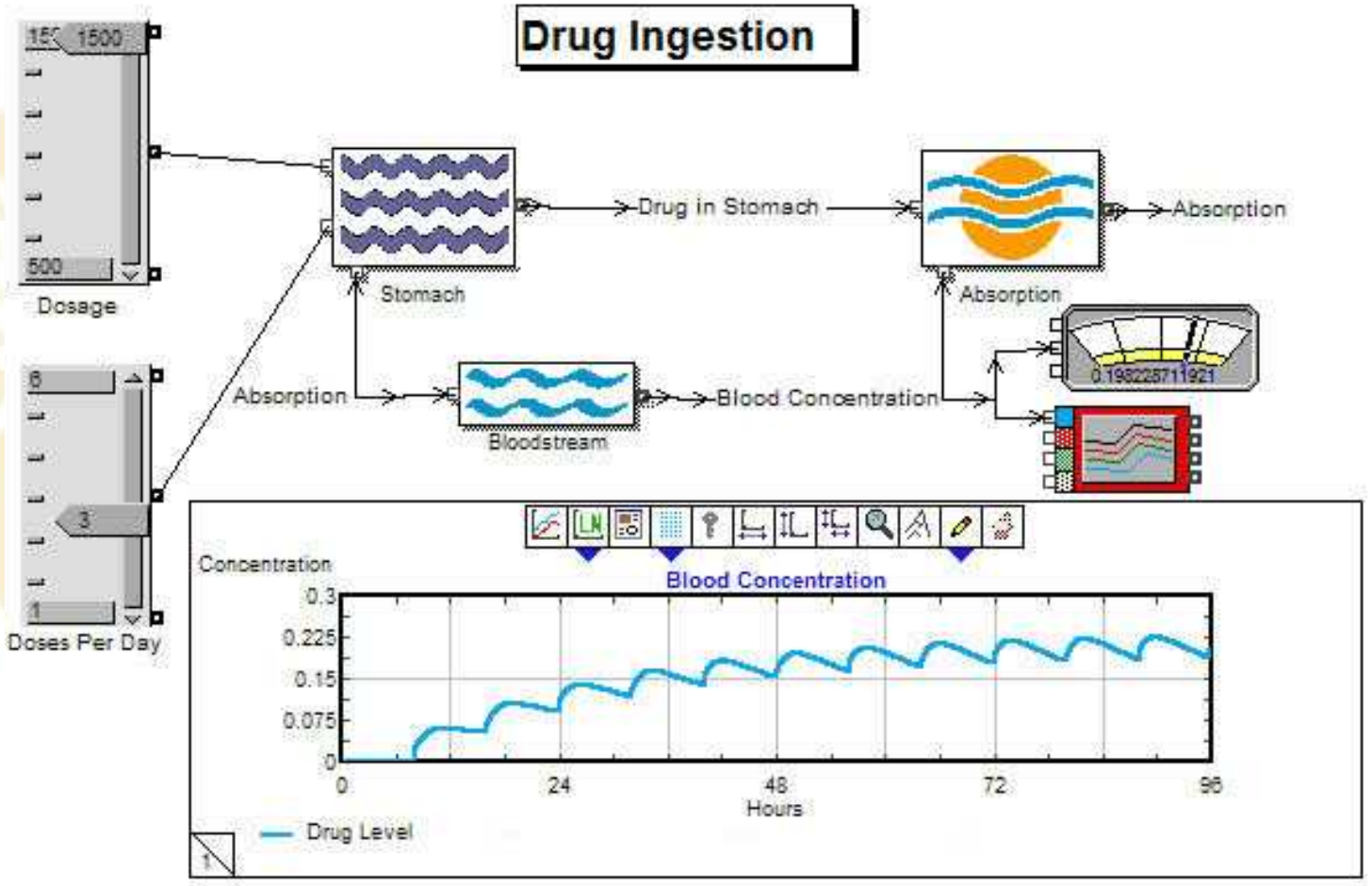
The NAE/IOM recommended strategy?

- *New, high-yield research and innovation partnerships and cross-training between engineering and clinical professionals – HSE!!*

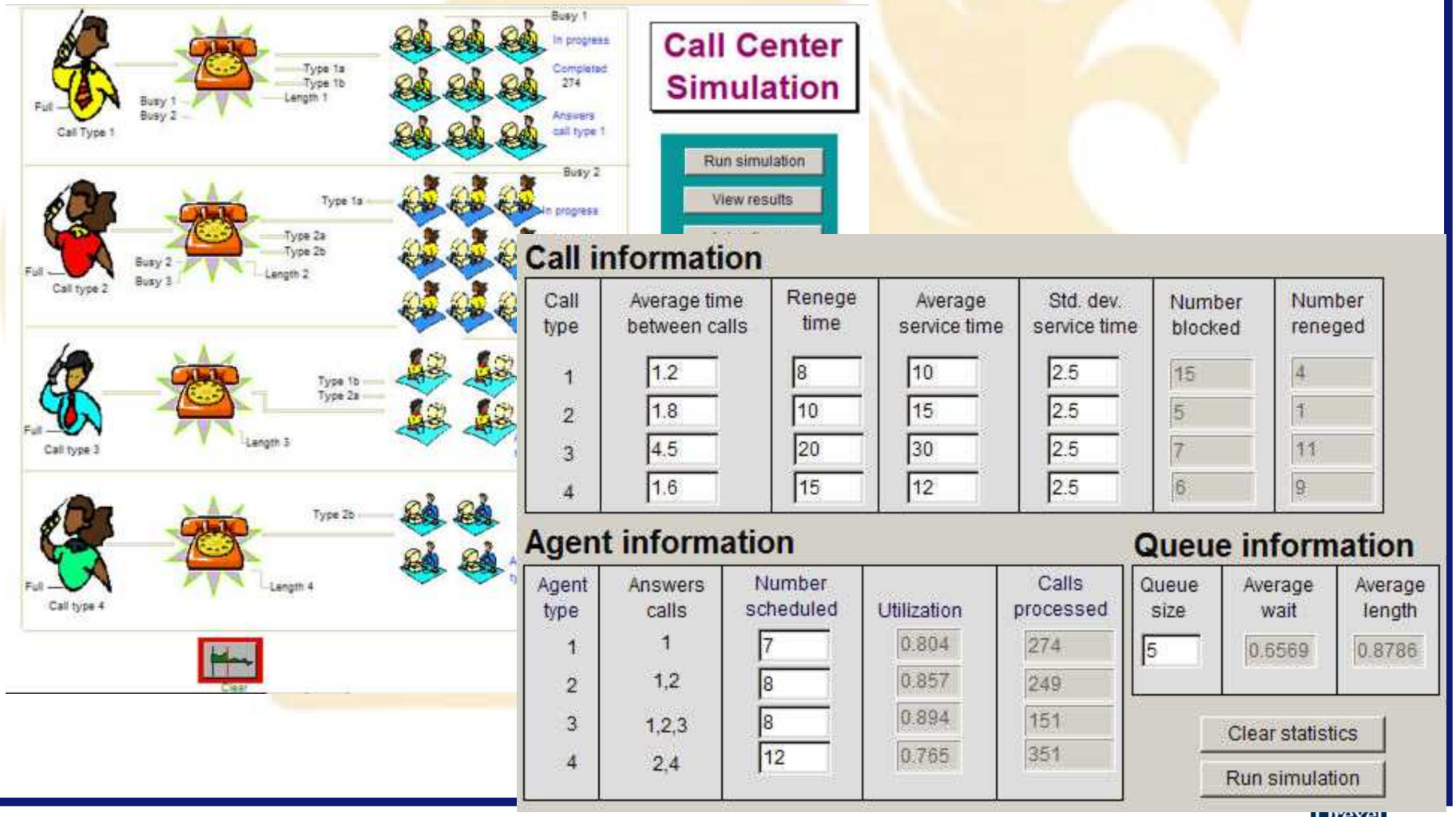
*Re: THE TOOLS OF **SYSTEMS ENGINEERING** (NAE/IOM)*

- ***"Engineers use system analysis to help themselves and others understand how complex systems operate, how well systems meet overall goals and objectives, and how they can be improved…"***

A System Engineering Queuing Method (QM) Medication Example



A second Queuing Modeling example: design and maintain a high-availability, high acuity, high safety home infusion telemedicine program.



One “fly in the ointment!”

- **You cannot make a model for something that you cannot (or have not) measured!!!!**
- **THAT is why *Interoperable* Medical Informatics, Telemedicine, and Telehealth, have become the “keys to the kingdom!!”**
  - ***To do a true systems analysis, you have to be able to know, or at least reasonably estimate, the inputs, outputs, and transformations that occur for ALL healthcare activities!***

Interoperability

- A quality of data, devices, and systems that ensures consistent, accurate, and timely information is acquired, transmitted, analyzed, and incorporated into each part of a process

- e.g., in aviation, until *ALL* aircraft, pilots, and air traffic control began to use the same transponders, the same radar systems, the same airport abbreviations, the same units of measurements, the same language, and the same procedures in the early 1980's aviation accidents were quite common.
  - TODAY, they're almost non-existent!

Drexel Health Systems Engineering efforts focus on achieving Goal 2 below by advancing our research, education, and leadership in Goal 1:

1. ***Leverage the kinds of information & communication technologies that already transform industries like manufacturing and aviation****, and*
2. *Apply proven engineering techniques to solve healthcare's problems, including biomedical engineering, systems engineering* and software engineering, and

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There are really “3 Acts” of health reform in play (so far):

Act 1 – ARRA/HITECH 2009 – “The Stimulus Act”

Act 2 – Affordable Care Act of 2010 – “The Health Reform Act”

Act 3 – The 2010 FCC Broadband Healthcare Strategy

In **Act 1**, medical technologies, specifically Electronic Medical Records, received over $35 Billion in funding in the **Feb 2009 Stimulus Bill (ARRA/HITECH)**

- Provides funding for National Electronic Health Record (EHRs) for all citizens by 2015, with advanced Clinical Decision Support Systems (CDSS) for primary and chronic care.
  - ***By 2015, HITECH will also be providing funding for "Remote Monitoring" of chronic care and other patients at home and other sites***

$35 Billion is a hefty investment over 5 years, but is it really enough to trim the US $2 Trillion ANNUAL healthcare bill?

THE "US Healthcare Reform" Act (PPACA) is really "Act 2"

- The PPACA brings ***$940 Billion*** into healthcare in the first decade, *($923 B of which kicks starting in 2015!)*
  - 32 Million new insured Americans into healthcare by 2019, adding >10% to our patient pool
    - A good portion of the 32 Million patients will be coming from relatively poor health status, having had no safety net except for the ED for most of their lives
    - Still leaves about 19 million uninsured citizens, plus all illegal aliens, in the "ED First" crowd
  - Most "underinsurance" gaps, e.g., pre-existing conditions and Medicare medication costs, will be eliminated for the 280 Million "fully-insured" Americans by 2019

It is UNDERSTOOD that we cannot afford the care we're providing today for 248 million.

There is REAL urgency to find innovative solutions and re-engineer healthcare ASAP!

How is Act 2 going to be accomplished?

- Significant new revenues and savings
  - e.g., the controversial 2.9% federal tax on the sale of medical devices (aside from common necessities like eyeglasses)
  - Personal and corporate payments of new health insurance taxes
  - DIFUSSION of healthcare to other points of service and to other service providers

Nurses (and other allied health professionals) are being mobilized – and paid!

- New education and roles for nurses to be directly responsible for health care
  - Nursing-run Community Health Centers are given special privileges and roles
  - e.g., Drexel's "11th Street Health Center"
    - http://www.drexel.edu/11thstreet/pdf/Drexel-11thSt.Tribune.pdf
    - Run by nurses, and delivering primary care in urban communities
  - Many more roles, authorities, and funding are defined for nurses
    - Provides nurses with direct clinical privileges to provide primary care in communities, outside of the hospital setting,
      - Creates a nursing-run public health system
    - New education for nurses to provide geriatric and other care

SEE: http://www.aacn.nche.edu/Government/pdf/HCRsupport.pdf

Huge new funding coming online for Telehealth – "Act 3"

- FCC *MUST* spend up to $400 Million PER YEAR to improve rural "deployment of broadband for healthcare"
  - These funds are from the Clinton/Gore days, from the $1/month/cell phone taxes we have all paid for over a decade!
  - Some of those funds are implicated in the PPACA
    - e.g., CMS ("Medicare and Medicaid") is charged with implementing an "Independence At Home" program
    - Independence at Home uses home telehealth monitoring to allow elders and patients with chronic diseases to live at home instead of Long Term Care facilities

In fact, telemedicine and telehealth play a major role in PPACA!

- Formally, “telemedicine” is the only kind of service reimbursed by CMS today
  - A long list of CMS-reimbursed remotely-monitored physician visits is in place, but all require “audio and video telepresence” of a practitioner
    - e.g., initial intake or discharge to SNFs or LTCs can be done with telemedicine and reimbursed as if in person.
    - Telemedicine must be provided at a non-home site of service, *including nurse-managed Community Health Centers!*

"TELEHEALTH" services are much broader, and part of PPACA

- e.g, for the PPACA ***Independence at Home*** program, home based telehealth will have to be quickly defined – and funded – by CMS!
  - You can bet that will mobilize technology AND nurses!
  - e.g., nurses (and other less costly health professionals) already play a significant role in billable "Telemedicine" services. That list includes:
    - Physician;
    - Nurse practitioner;
    - Physician assistant;
    - Nurse midwife;
    - Clinical nurse specialist;
    - Clinical psychologist,*
    - Clinical social worker;* and
    - Registered dietitian or nutrition professional.

    For details, see http://www.americantelemed.org/files/public/policy/Medicare_Payment_Of_Services.pdf & https://www.cms.gov/Telemedicine/

Interesting to note that CMS characterizes "telehealth" as "store and forward" technologies rather than real-time medical care.

In short, in the 10 years from 2010-2019, FCC's "health technology" funding is huge

- $4 Billion in rural telemedicine "pilot projects" that will greatly expand broadband's "last mile" reach to rural clinics, provider practices, and, of course, homes
  - FCC recognize this moves their (formerly) communications-only funding into medical care, and in July, '10 they signed an MOU with FDA to ensure the safety of the products and services that FCC brings to the market
    - Both "broadband and wireless" technologies
    - See: http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db0726/DOC-300200A2.pdf

Many of these funding sources – and regulations – "interlock"

- e.g., the current CMS telehealth reimbursement is currently restricted to underserved populations in non-urban settings
  - The FCC's funding reinforces that emphasis
- Newly issued CMS regulations will cut through the "staff privileges" bottleneck that has locked up inter-state telehealth privileging.
  - Hospitals were required to individually "privilege" each telehealth practitioner,
    - Put the hospital and practitioners at odds with state credentialing boards
  - Under the proposed CMS regulation, hospitals will be allowed to accept the recommendations of other credible sources for each practitioner they "privilege" for CMS-reimbursable telehealth
- Reimbursement wording is shifting from "physician" to "practitioner" in many federal bills to empower – and compensate – nurses and other allied health professionals

FCC's $400 M/year focuses on "the last mile" to Rural America

(From the MOU)

"The goals of the FCC-FDA collaboration are to explore ways to:

Further enhance information sharing efforts in order to further ensure the safety and efficacy of ***medical devices***.

Improve the efficiency of the agencies' regulatory processes in areas where their jurisdiction overlaps, such as with respect to various ***medical devices*** that utilize broadband and wireless technology.

Promote efficient utilization of tools and expertise for ***product analysis, validation, and risk identification.***

Build infrastructure and processes that meet the common needs for evaluating broadband and wireless enabled ***medical devices***."

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Evolution of Medical Devices to Medical Device Systems of Systems (SoS)

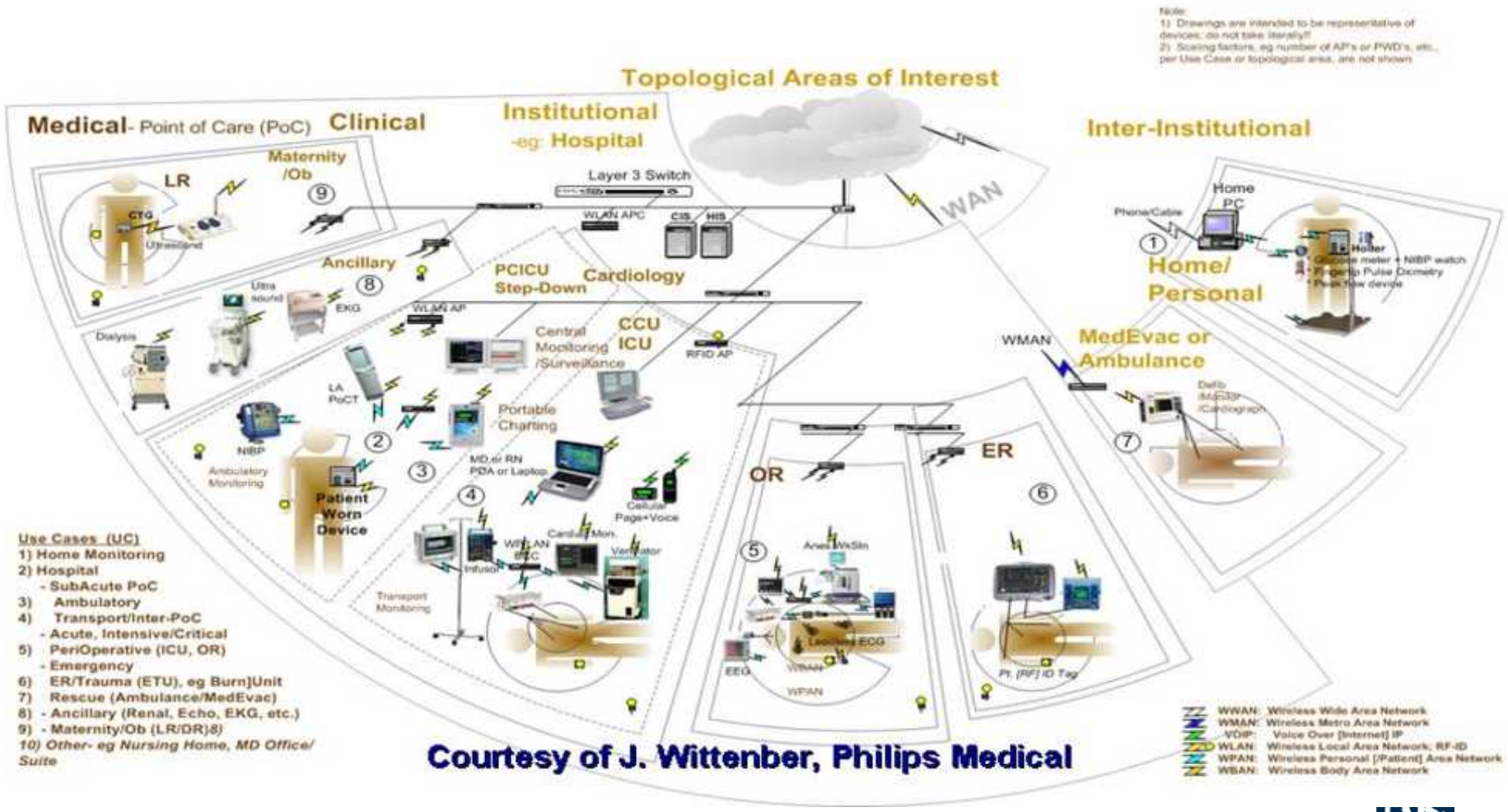
- 1950's – 1970's
  - Almost all individual devices, analog I/O, no standards
- 1970's
  - Mid-1990's some single-brand SoS, like an HP or Philips Central Nursing Station or a GE PACS (RS-232 serial data interface)
- Mid-1990's on
  - Emergence of PC networks, and shift of medical device data to LANs
- 2004 onward
  - Global standards drive towards multi-vendor, multi-product interoperable device standards for flexible and complex SoS configuration/reconfiguration
- 2010 onward (eHealth, mHealth, uHealth, pHealth)
  - Global medical device and electronic health record (EHR) interoperability at the Point of Care (bedside, home, mobile)

A Wireless Medical Systems Map

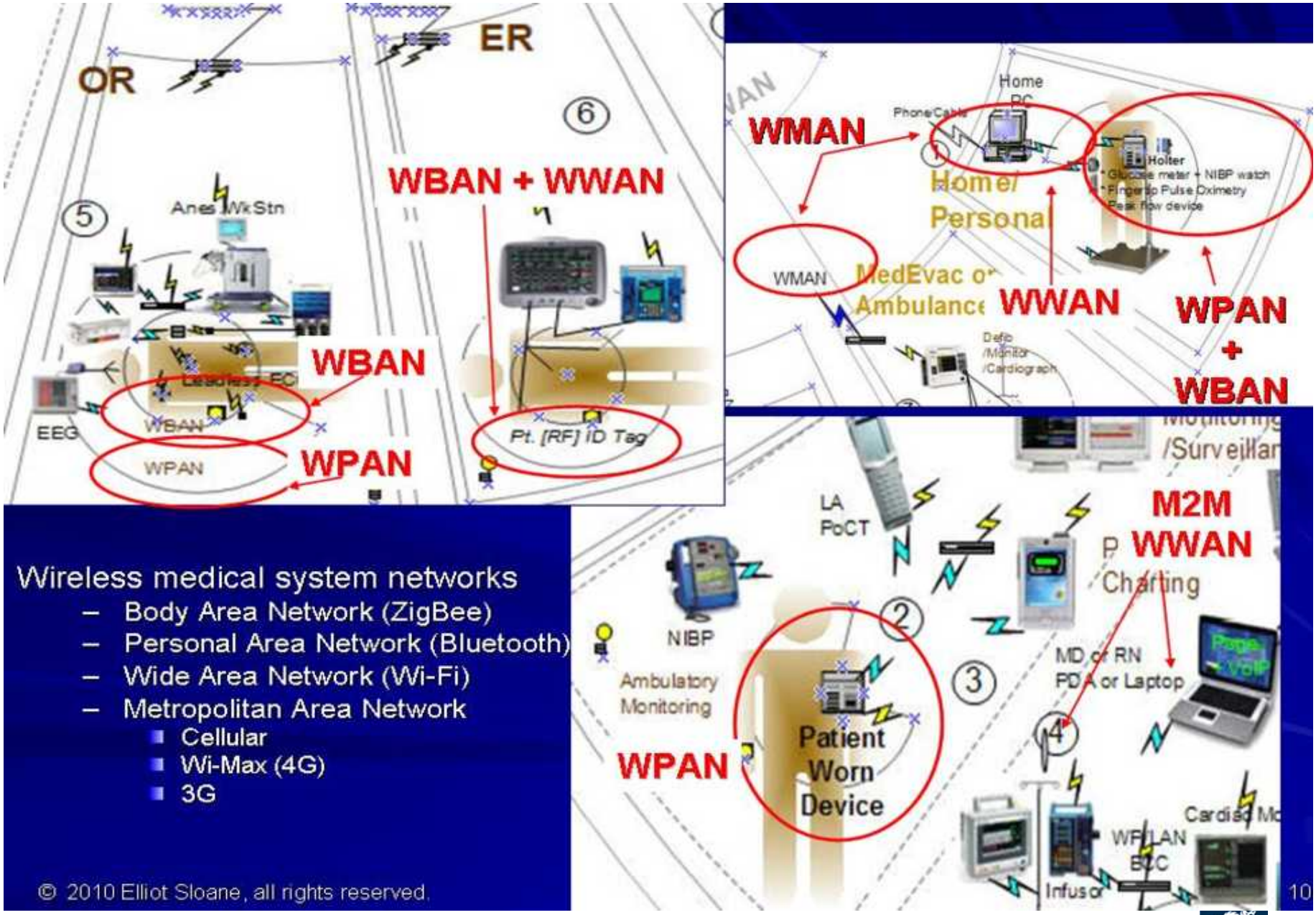
Medical Device Semantics and Communication Modalities Use Cases

IEEE 11073.x and IEEE 802.x Standards At Work

22July10 Rev 4a



Courtesy of J. Wittenber, Philips Medical



Wireless medical system networks

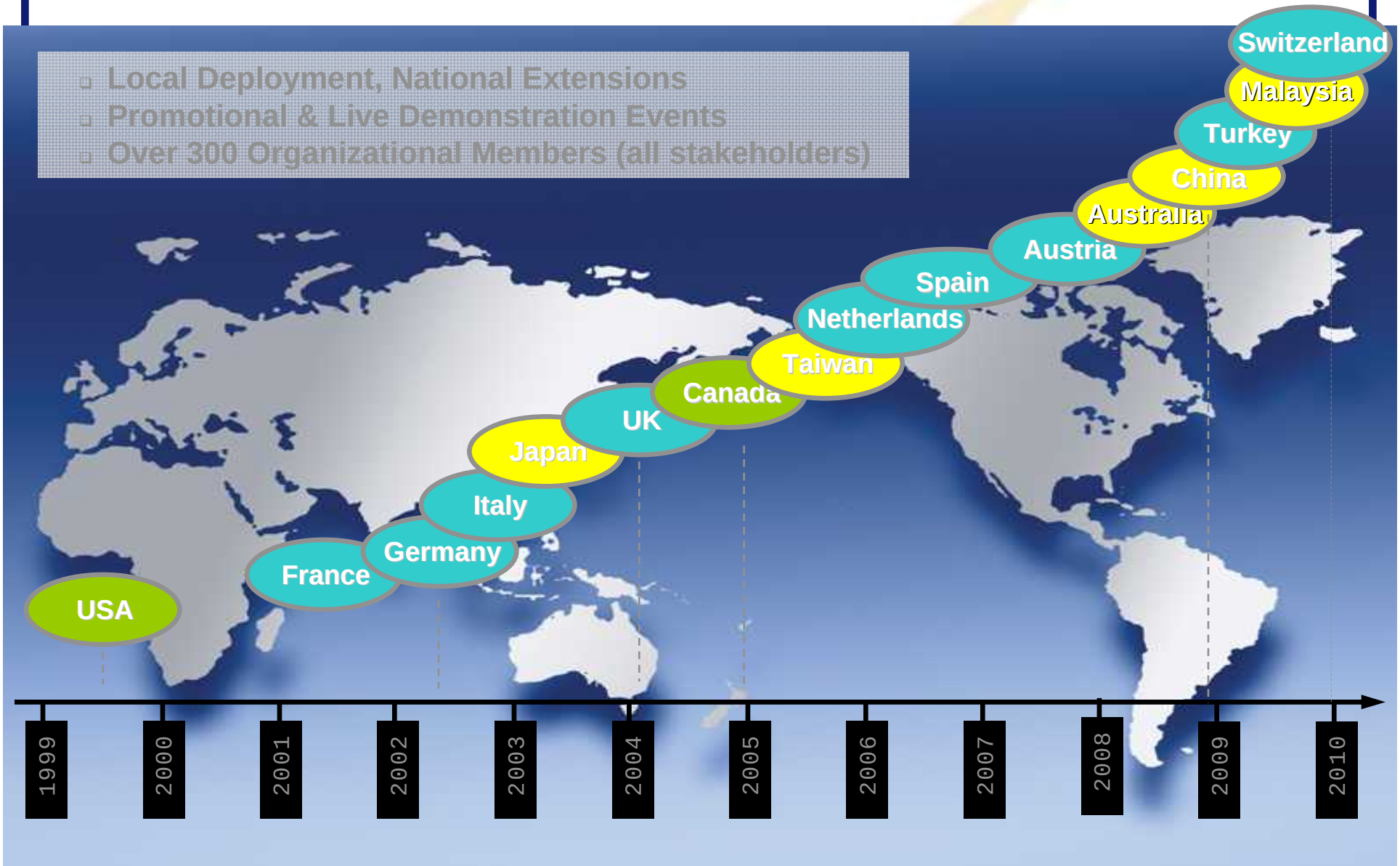
- Body Area Network (ZigBee)
- Personal Area Network (Bluetooth)
- Wide Area Network (Wi-Fi)
- Metropolitan Area Network
  - Cellular
  - Wi-Max (4G)
  - 3G

Common elements of the Medical Device SoS environment

- Today, almost 100% Ethernet (IEEE 802.3) and/or WiFi (IEEE 802.11 a/b/g/n) based
  - Rapidly evolving to wide- and metropolitan-area networks (WAN and MAN) for mobile health (mHealth) using IEEE 802.11n/m, 3G and 4G cellular
- Rapid global uptake of ISO/IEEE 11073.x medical device semantic interoperability standards for data structure and content
- Rapid global uptake of open-source Integrating the Healthcare Enterprise (IHE) Electronic Health Record *AND* IHE Patient Care Device (IHE-PCD) data interchange standards

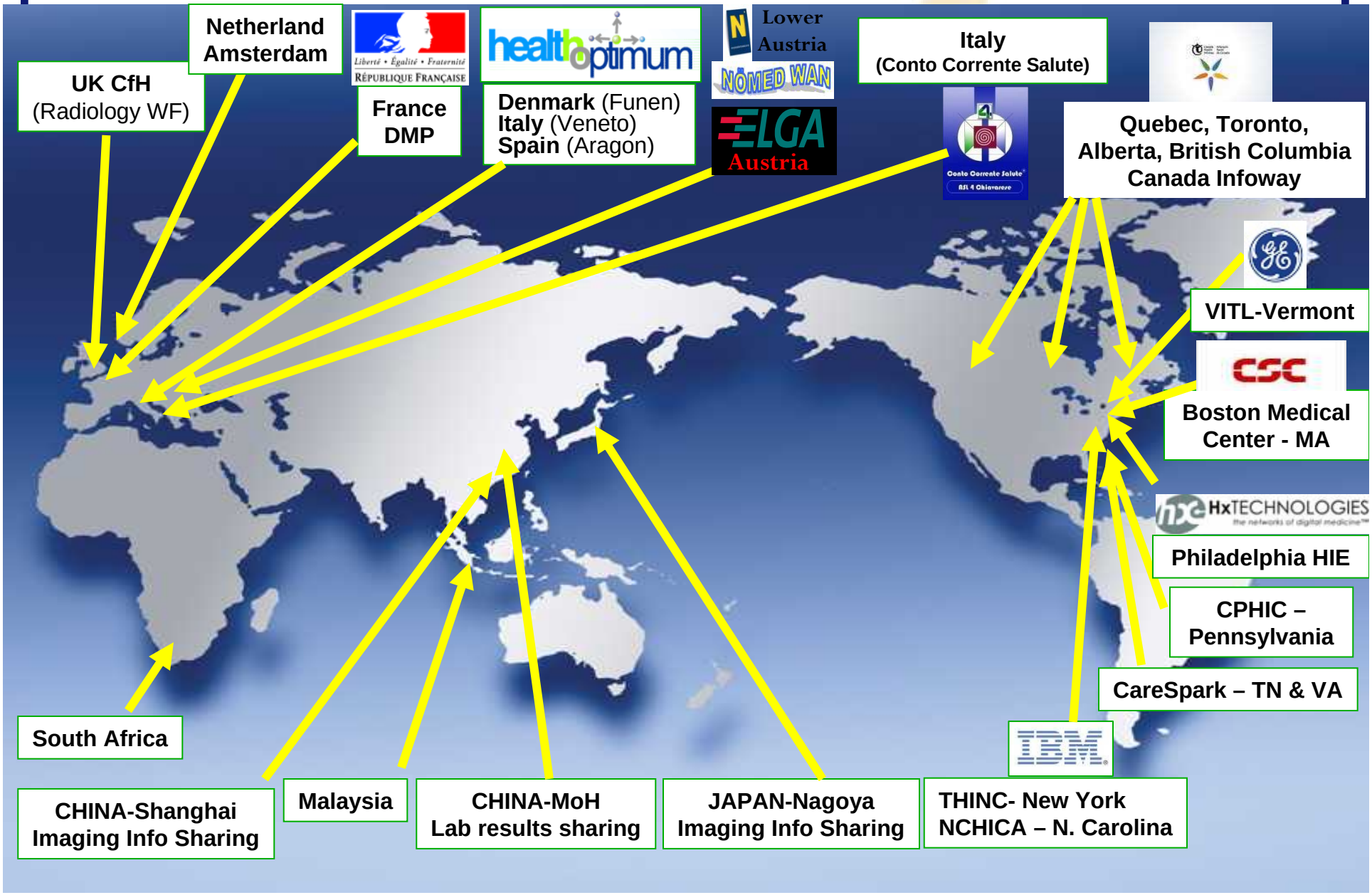
International Adoption of IHE

- Local Deployment, National Extensions
- Promotional & Live Demonstration Events
- Over 300 Organizational Members (all stakeholders)



Pragmatic global standards harmonization + best practices sharing

National and Regional Projects Use IHE Profiles



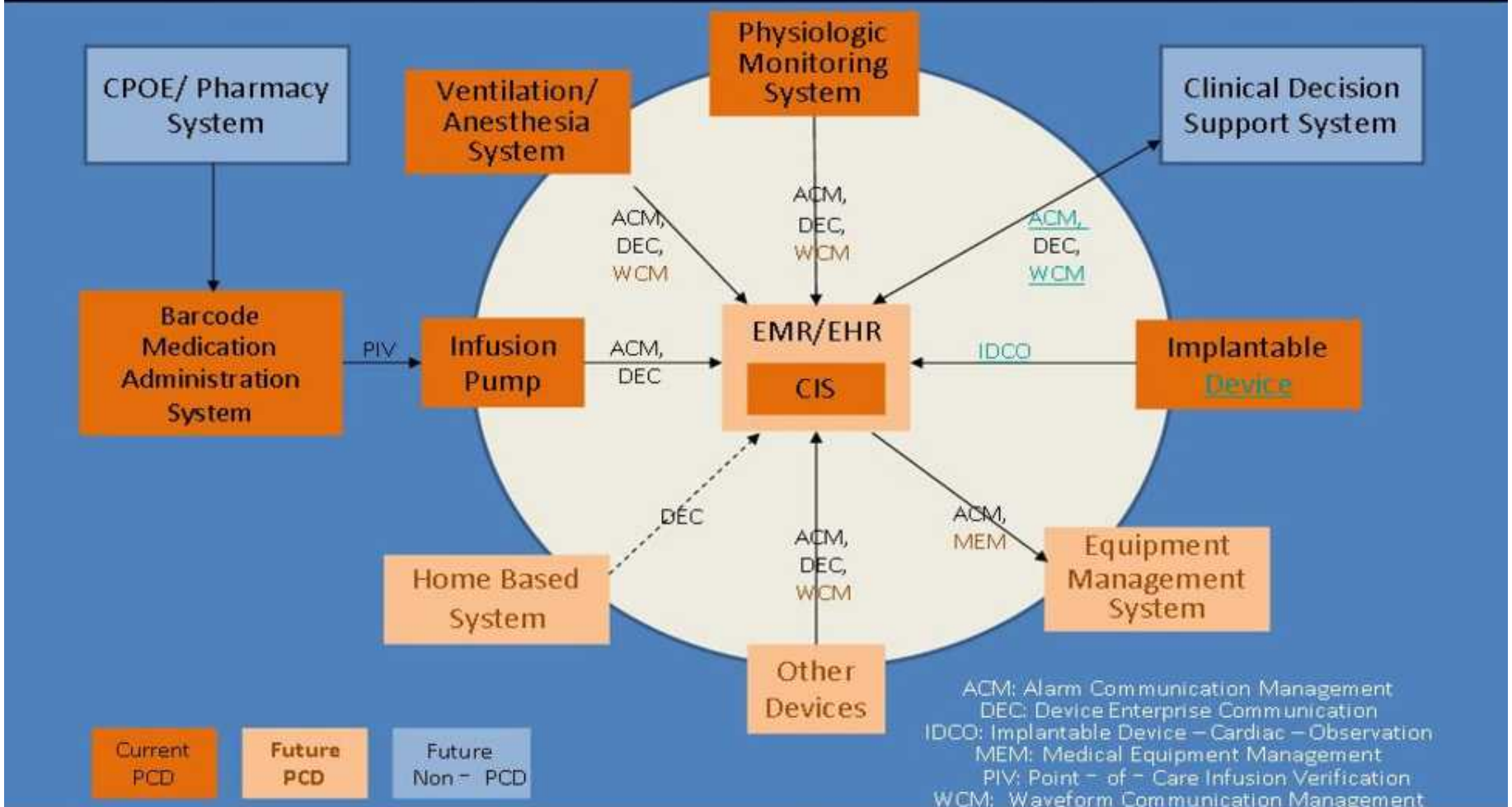
Interoperability: From a Problem to a Solution

Disclosure

- **I am the co-chair of IHE International, the founder of the IHE-PCD standards program, and the Sponsor of the IEEE Medical Device 11073 standards, so *I AM BIASED!***

- I will give you more details about the IHE-PCD SoS framework, but because I do not directly participate in and am not a member of the Continua Alliance program, nor the ASTM Integrated Clinical Environment program (ASTM F2671-2009)
  - I cannot and do not formally speak for or represent their views
- I consider them partners in our IHE and IEEE efforts to improve patient care, and recommend that you read Bridget Moorman's AAMI article as one source of more complete details
  - http://www.continuaalliance.org/static/cms_workspace/132-138_IT_WorldMA2010.pdf

IHE PCD – Profile Overview

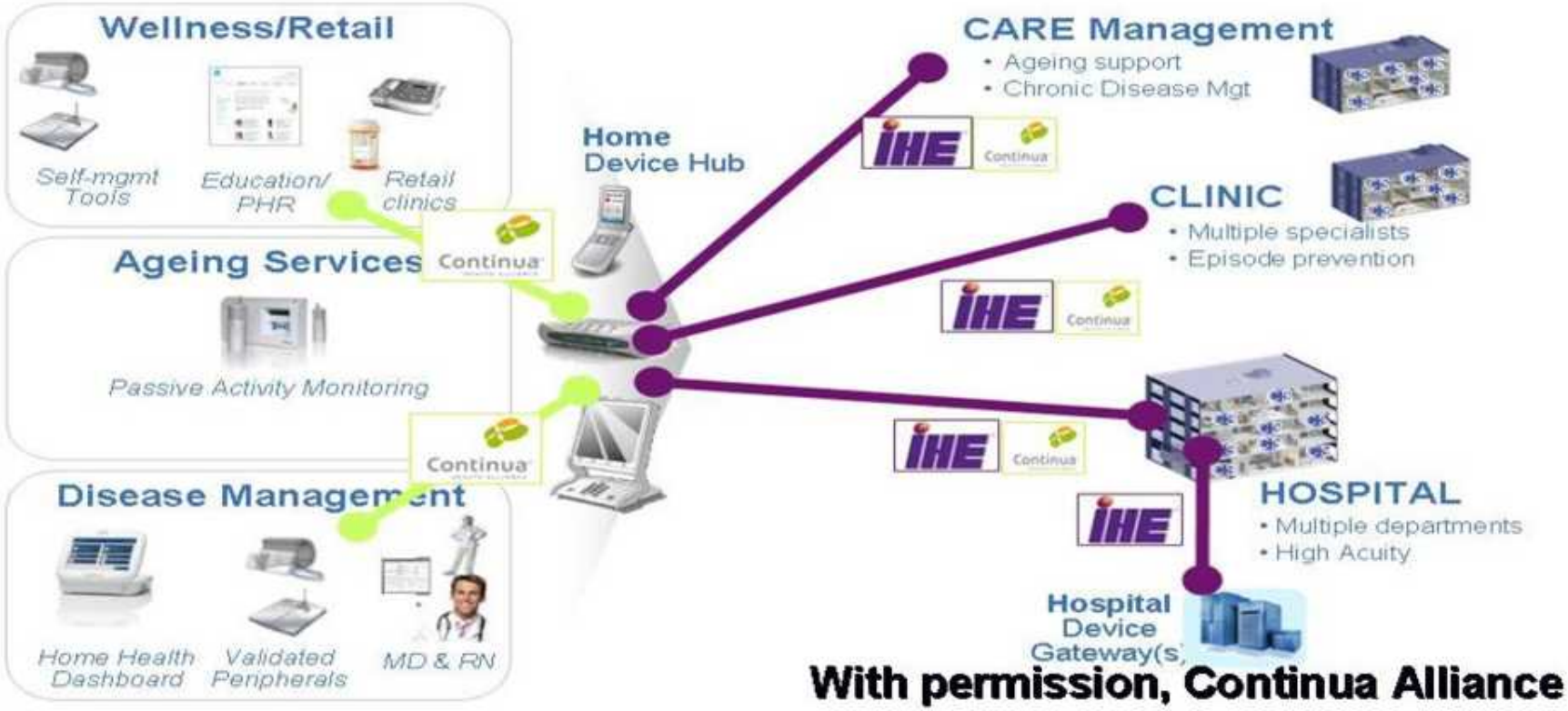


HIMSS ACCE IHE

Beginning this Fall, a single data interface architecture can be used by all Continua Personal Health Devices, all IHE-PCD Medical Devices, and all IHE EHRs!

Home health – Key connection Standardized

IHE and CONTINUA have agreed to support the ***a single common IHE DEC profile*** *for feeding* ***home device*** *data and clinical device data into health records*

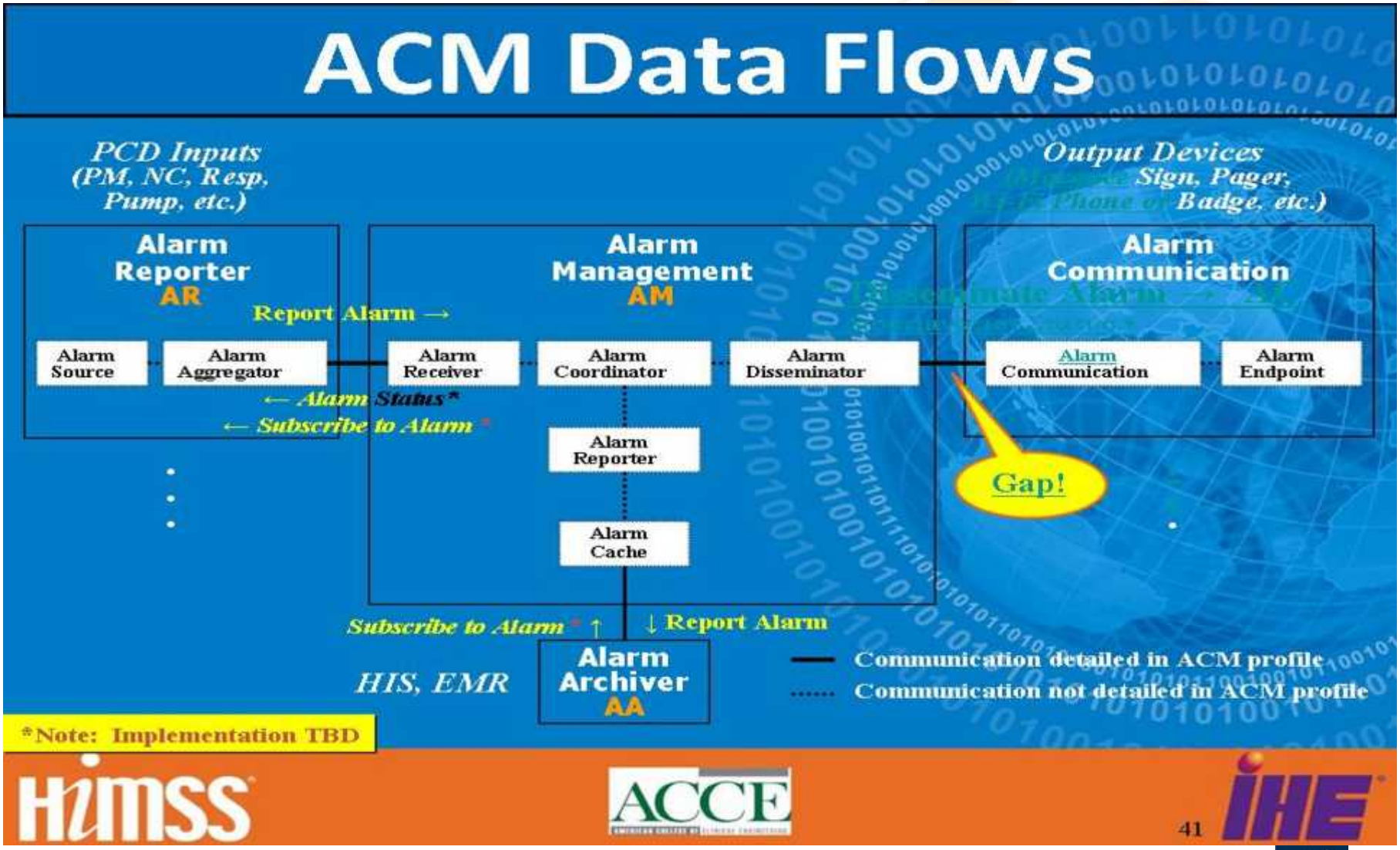


With permission, Continua Alliance

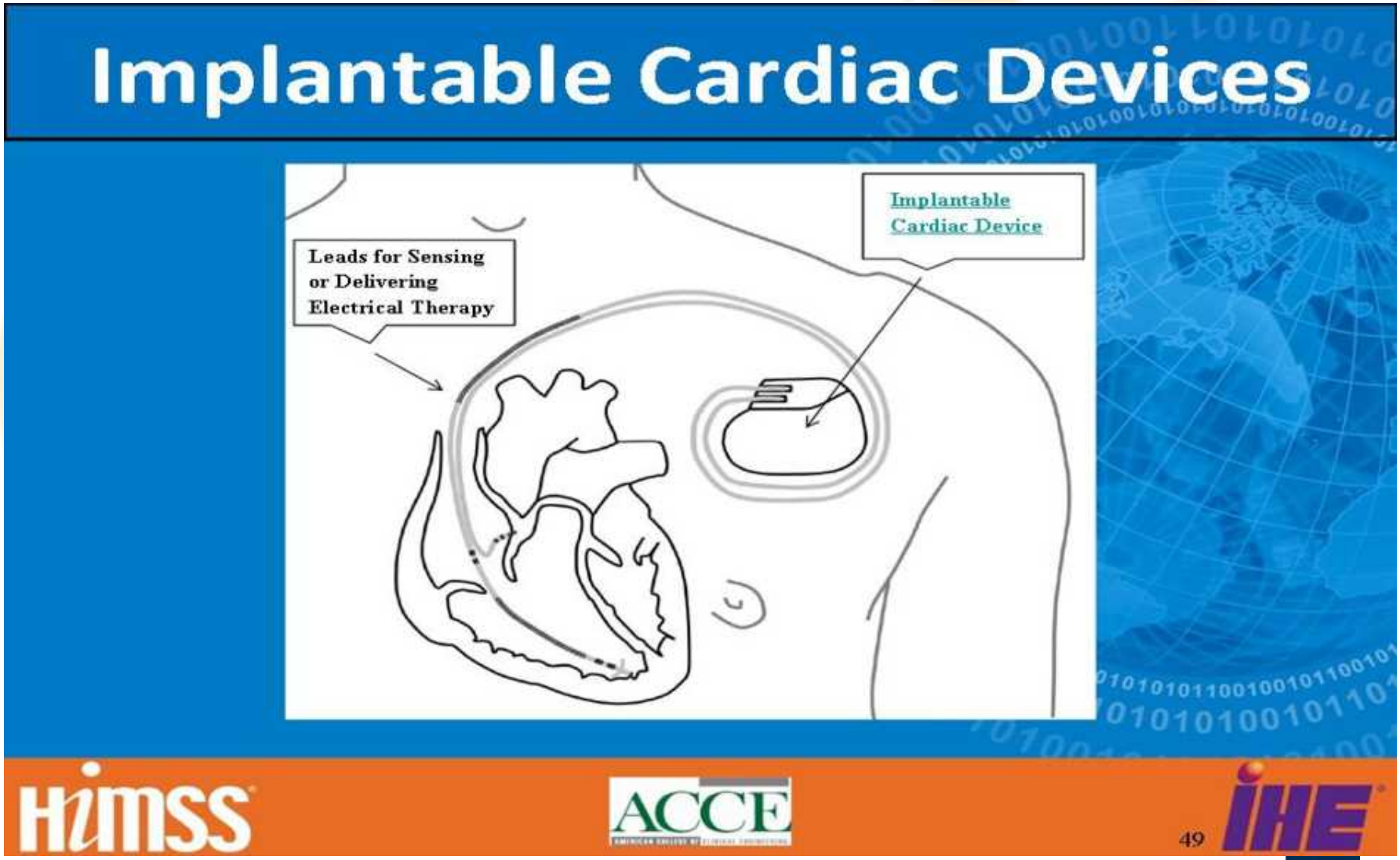
IHE-PCD and Continua "live" in two different but overlapping worlds

- *Continua* – **Personal Health Devices** non-regulated personal appliances, non-life-critical settings like home, car, gym, simple data sets
  - Personal wellness status, chronic illness home care
- *IHE-PCD* – Full-on clinical devices and applications, from home chemotherapy through intensive care, implanted devices, and surgery
  - Becoming MUCH more mobile, including relative acute care management at the home
- *Both products must co-exist in the home, with overlapping missions, different price-points*

e.g., IHE (and ASTM-ICE) have to tackle life-critical, real time Alarm Communication Management



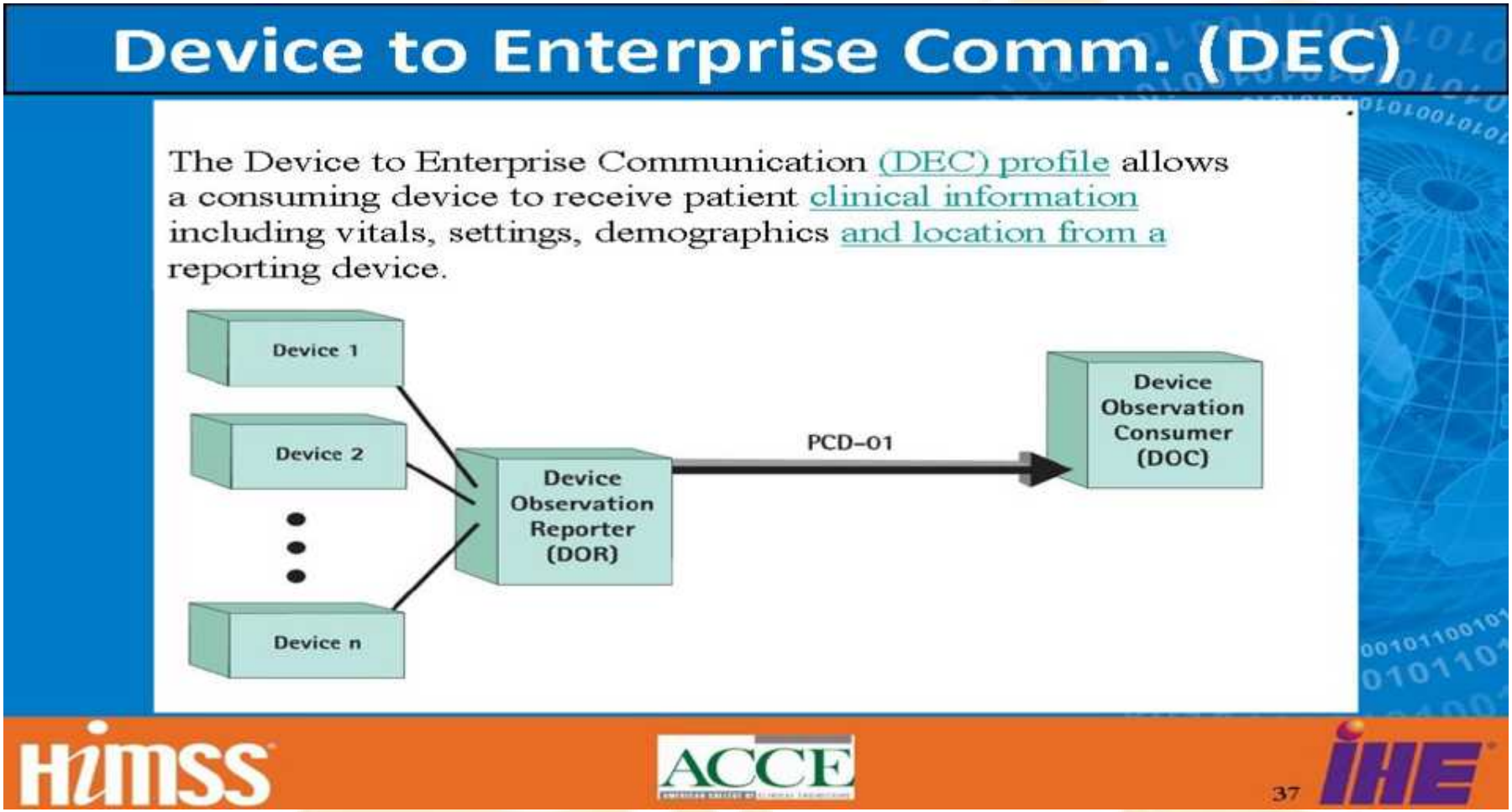
e.g., IHE-PCD has to tackle implants



Profiling has emerged as a POWERFUL enabler

- IHE's and Continua's "Integration Profiles" take myriad "base standards" such as DICOM, ICD9/10, HL7, or IEEE and "*CONSTRAINS THE OPTIONALITIES*"
  - e.g., Each base standard has a different (or many different) coding choices and data structure locations for Date and Time
  - An Integration Profile ***specifies the SOLE option*** to be used for each standard AND ***specifies a SOLE Global Standard*** for "Universal Timekeeping" (typically "internet time")

e.g., IHE-PCD and the **Continua-WAN** profile have adopted the same "DEC" profile to enable interoperability



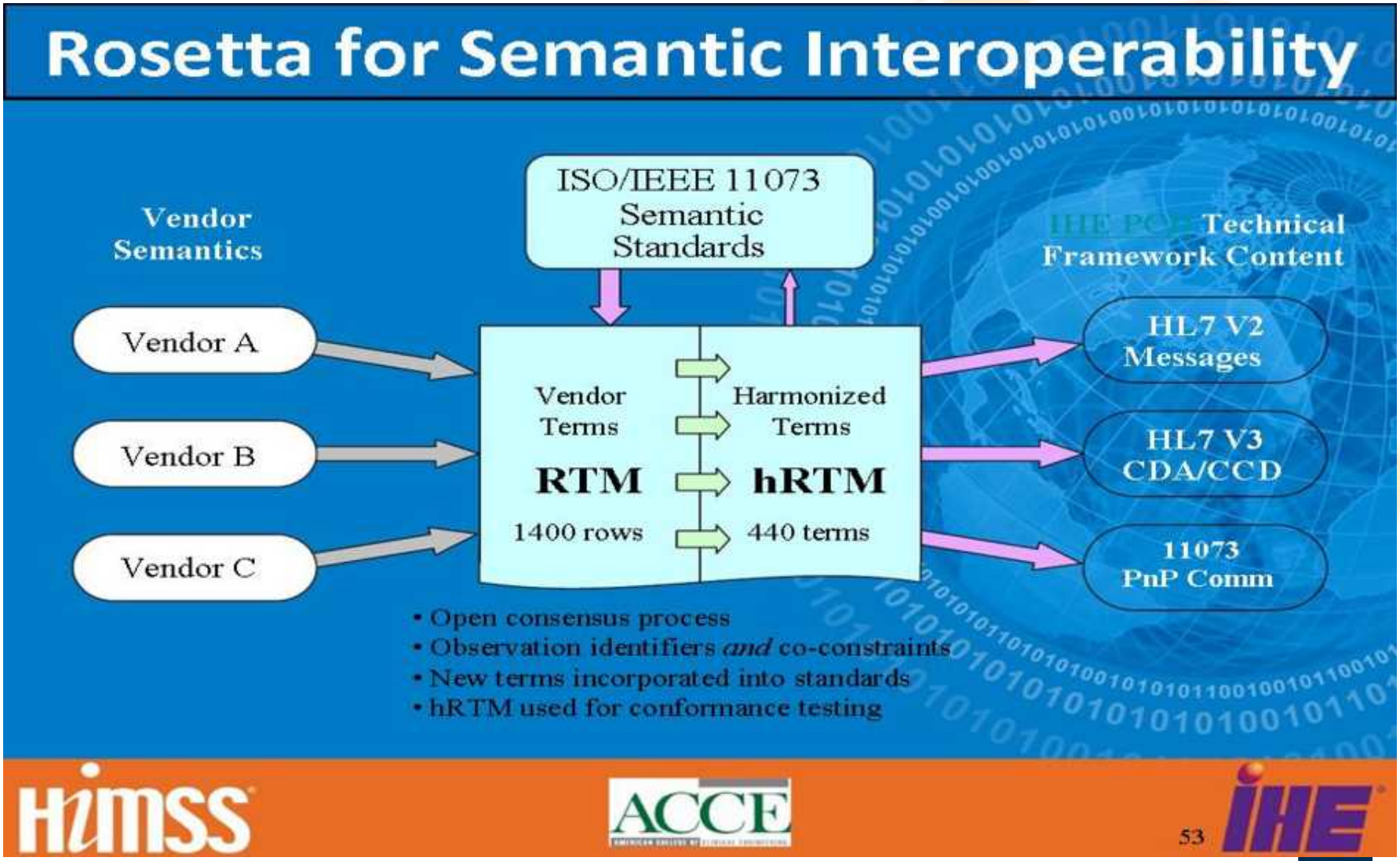
Look for new Continua-WAN products this Fall/Winter

The **GREAT** news?

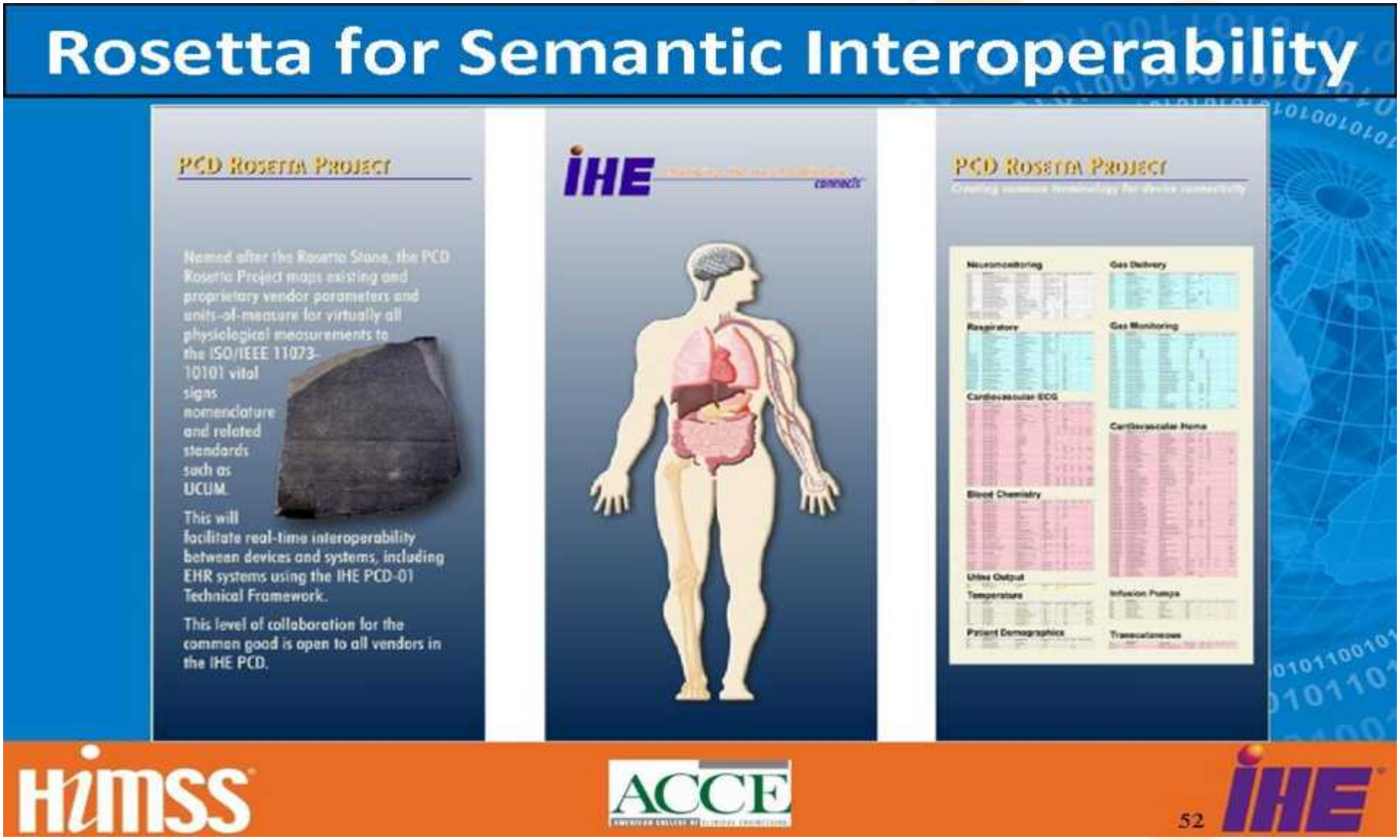
- With Continua, ASTM-ICE, and IHE-PCD working together, all of our work can converge in ways that intersect the global trend for interoperable Electronic Medical Records!

- The GLOBAL leadership to ensure the inclusion of all of our good works in the international ISO and HL7 frameworks goes to the near single-handed expert leadership of Todd Cooper, by the way.
  - You have NO idea how much work that guy does for YOU!

What's "inside the box?" The EMBS IEEE 11073.x standards are foundational to both Continua and IHE



IHE's *Rosetta Project* maps ALL vendor clinical coding to each other via IEEE 11073



IHE Rosetta Project

- Now over 400 columns of vendor-specific mappings of clinical variables and globally-harmonized UCUM units of measurements
  - e.g., Every brand of ECG monitor, EHR, or IV pump can “know” the kinds of data that other branded products might send, and can therefore translate that information correctly
  - This is ESSENTIAL for life-critical data preservation, interpretation, and, ultimately, closed-loop multi-vendor systems

The ISO/IEEE 11073 Standards began a long, long time ago

- They've come of age today, now formulated as semantic interoperability standards instead of an "electrical medical information bus"

All IHE and IHE-PCD profiles are FREE to download and use

- www.IHE.net and www.IHE.net/PCD
  - The IHE-PCD profiles are a joint product of ACCE, HIMSS, and IHE
    - IHE International and IHE USA are now independent non-profit agencies, incorporated in IL, and filing for 501(c)(3) status with the IRS
- Continua Alliance is also a non-profit agency, and its profiles are proprietary and require membership in the Community or direct purchase
- ASTM, HL7, and IEEE 11073.x standards must be purchased for use
- Happily, the complex IEEE 802.x Communications Standards ARE available for free, 6 months after they are published!
    - http://standards.ieee.org/getieee802/

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- US Healthcare Reform
- The Role of Medical Device and Medical Device Systems
- **Business as usual?**

Business as Usual? I don't think so!

Many new opportunities are emerging

- In order to meet the US Health Reform goals, flexible, multi-vendor interoperable medical device solutions must finally deployed
  - These are needed to facilitate telemedicine, eHealth, and mHealth as well as acute care, in-hospital uses
  - *Human data entry will be minimized, freeing up valuable physican, nurse, and caregiver time AND reducing errors!*
- Asset management (procurement, deployment, maintenance) should become easier as more interoperable products come to market

Electronic Medical Records REALLY get put to use!

- Over the next five years, Electronic Medical Record systems will begin to share timely and accurate data regionally and nationally
  - **Personalized Health and Wellness, Electronic Telehealth (eHealth) Mobile Healthcare (mHealth), Pervasive Healthcare (pHealth), and Ubiquitous Healthcare (uHealth) will emerge.**
  - **Personal, national, and global quality of care, clinical outcomes, and overall population health will become easier to see and manage in real time!**

So, in short, Health Systems Engineering opportunities will continue to grow

- More interoperable healthcare technologies, including EMRs/EHRs, than ever are going to be deployed
  - New regulations, standards, and services are going to emerge this decade!
  - Wireless, mobile, point-of-care healthcare solutions will dominate the market, and that will require dramatically different healthcare delivery (i.e., the doctor's office and hospital will NOT be the main point of care!)

Here is an OLD (circa 1994) example that will be reborn

- The Indian Health Service (IHS) is a part of the US government that provides medical care to the Native American population
  - Typically very widely and sparsely diffused in hard-to-reach areas like Alaska, Mountain States, and Desert/Plain States
- IHS has its own, separate funding, just like the VA and DoD
  - They began to build their own telemedicine systems with their bare hands in 1994!

"Telemedicine or Telehealth?"
A fine point in the US

- Telemedicine refers to using technology to provide a clinical consultation at a remote site with *audio-visual interaction* between the physician and a *patient-caregiver team* at a remote location *in real time*

- Telehealth refers to time-delayed, asynchronous collection of patient data from a remote site, a later subsequent interpretation and recommendation, and, finally, relay of the findings or recommendations back to the patient

NHIN Modeling Example: THE ALASKA TELEMEDICINE PROJECT

Participating Health Corporations

http://www.telemedicine.alaska.edu

ATTP Workstation

Telemedicine system in use…

Examples of diagnostic images, often limited to erratic 1200 baud telecommunication links!

- Alaska Telemedicine Project outcomes:
  - In this rural Alaska managed care case, the technological innovation increased the quality and reduced the cost of care
  - Quality: Decreased dispensing of incorrect antibiotics.
  - Reduced the average cost from $54 to $29 per visit (almost a 50% savings!)
    - No dangerous travel in the winter storms, either!

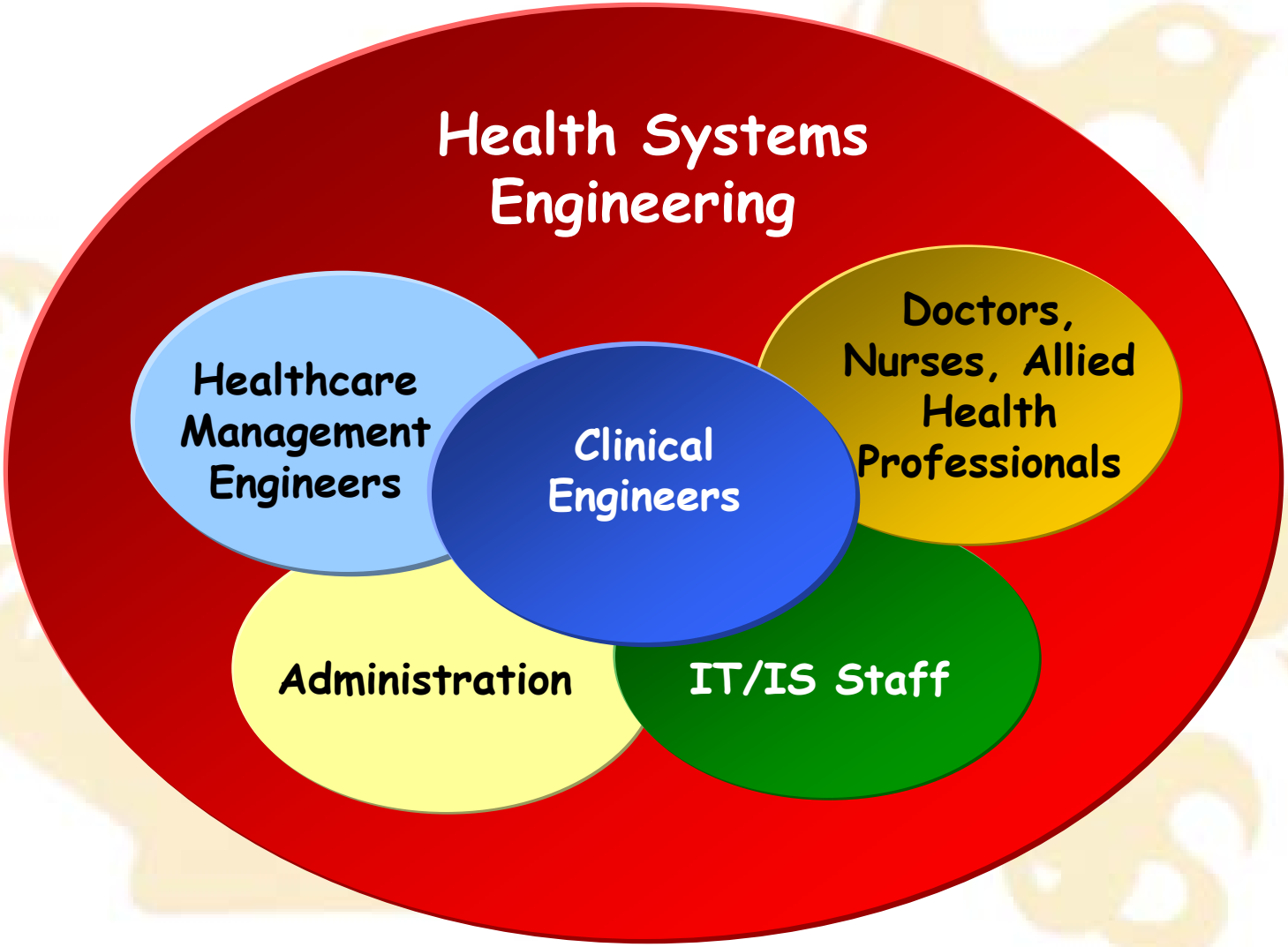
The Alaska IHS built over 100 telemedicine systems by hand in the 90's!

- **Just think what they do today and/or in the very near future?**
  - **Virtually free Skype/Microsoft/Google telemedicine videoconferences;**
  - **Low-cost IHE-PCD or Continua physiological monitoring devices sold by Amazon, Costco, and WalMart to collect data at home, not just at clinic;**
  - **Automatic inclusion of patient data from monitors, ePrescriptions, lab results, and radiology images directly into each patient's Electronic Health Record immediately and accurately?**
  - **Secure Emails and IMs with immediate follow-ups!**

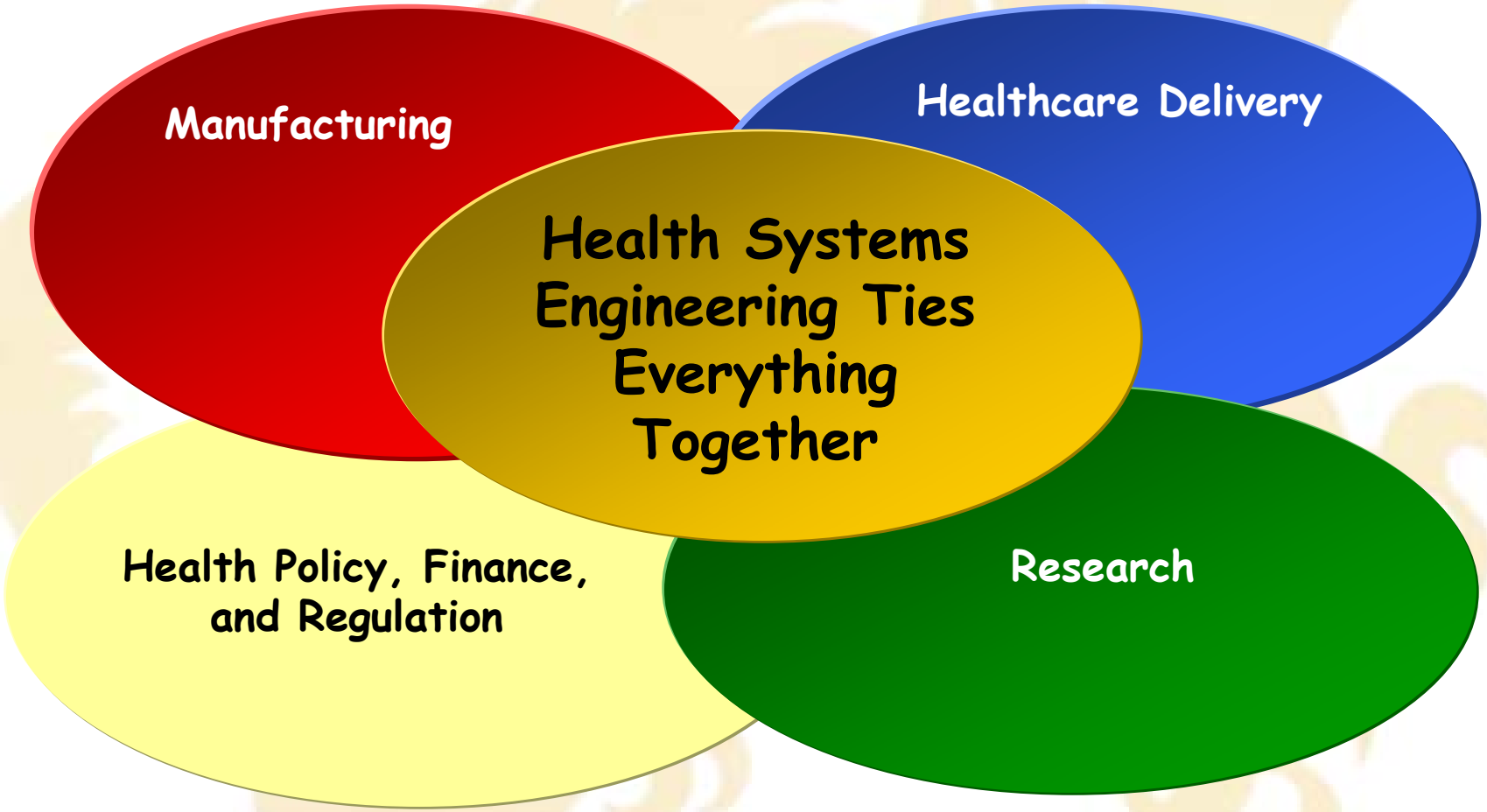
Health Systems Engineering

- Interoperability
- Secure and reliable information platforms
- Advanced decision support and data visualization
- Knowledge Management

Health Systems Engineering is a cross-disciplinary application of SoSE, Leveraging Clinical and Technology Resources



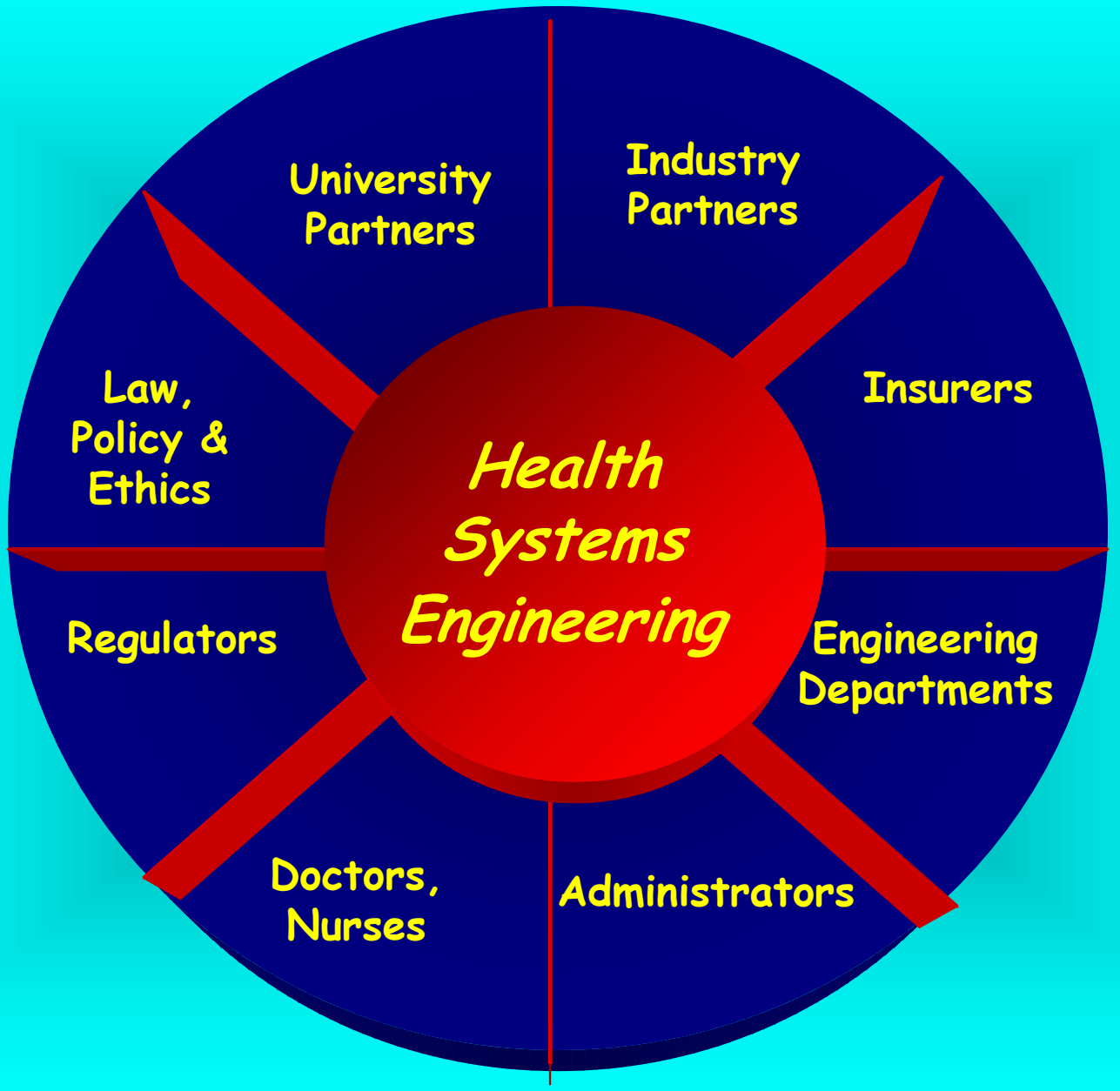
Where Health Systems Engineering Fits in the Overall Health Industry...



Somewhat analogous to "Enterprise Resource" systems, that tie customers to suppliers in a seamless, reliable, error-free, end-to-end, efficient process.

Health Systems Engineering

Data- and Knowledge-Driven Healthcare Re-Engineering


University Partners
Industry Partners
Law, Policy & Ethics
Insurers
Health Systems Engineering
Regulators
Engineering Departments
Doctors, Nurses
Administrators

There's No Free Lunch!

Consequences and Challenges

- Interoperable systems are relatively complex and have many hidden interdependencies
  - When one system or sub-system fails, many systems may fail too
  - Risk assessment and risk acceptance strategies need to emerge for planning and commissioning such systems
    - The ICT exposures, for example, are significant. Consider, e.g., if a single virus or worm enters such systems!
    - Wireless, though it provides essential mobility and point of care interventions, is vulnerable to interference and privacy breaches

There are many System of Systems Engineering (SoSE) Challenges

- e.g., Verification and Validation of SoS is relatively new field of research
- "Emergent Behaviors," i.e., unanticipated human-system interactions and effects are a new class of "unintended consequences" that DEFINE SoSE research
  - e.g., people with complex implants are now traveling on airplanes and are being asked to shut off their wireless interfaces!
- Clinical Engineering needs a whole new toolkit!
  - ICT- and SoS-aware actionable strategies, toolkits, and checklists need to be written, tested, published, and adopted by our profession ASAP!

Drexel BIOMED's Meeting the Challenge:

The new Wireless Medical Interoperability Lab Resources, sponsored by CHIRP

We are building a baseline Wireless Medical Device Interoperability Laboratory this winter at Drexel University's School of Biomedical Engineering, Science and Health Systems.

What will be in the lab?

- Multiple desktop, laptop, and netbook computers.
  - Copies of the Veterans Administration VISTA electronic medical record system
  - Copies of the federal CONNECT health information exchange that connects CDC, VA, DoD, IHS, and others
  - Continua-compatible data aggregation software
  - Security management software
- Multiple wireless medical and patient care devices.
  - Continua, IHE-PCD, and, potentially, student-built products
- IEEE 802.x wired and wireless networks and access points, including Ethernet, Wi-Fi, Bluetooth and Zigbee, plus USB and Wireless USB networks AND cellular phone network adapters
- RFID sensors and tags
  - For “presence” monitoring AND both asset and personnel tracking

Look for new courses and independent study opportunities this coming year….

Google the Open Health Tools ***Academic Challenge*** in Miami next March to see if YOU are interested!

Our goal?

Prepare our graduates to actively take part in **Engineering 21st Century Healthcare!**

Presentation Review

1. The Healthcare Landscape
2. Health Systems Engineering
3. US Healthcare Reform
4. The Role of Medical Device and Medical Device Systems
5. Business as usual? ***"I don't think so!"***

US Healthcare will cost $4 Trillion/year by 2019. Every 0.5% savings will be worth more than $20 BILLION per year!

Resources

- www.ebsloane.org/HealthSystemsEngineering/
- www.CEITCollaboration.org
- www.ContinuaAlliance.org
- www.HITSP.org
- www.IHE.net
- www.IHE.net/PCD
- http://standards.ieee.org/getieee802/
- http://academicchallenge.openhealthtools.org/

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or just Google™ me!!

I will be glad to send you a copy of this presentation.

Thank you!