

Designing a Portable Clinical Gateway (or PCG)

Peter Miller, Director
Vanderbilt HealthTech Laboratory
peter.miller@vanderbilt.edu
615 - 936-8415



“....Computers as we know them today will be (a) boring and (b) disappear into things that first and foremost are something else: smart nails, self-cleaning shirts, driverless cars, therapeutic Barbie dolls, intelligent doorknobs that let the Federal Express man in and Fido out.....”

- Nicholas Negroponte, MIT Media Lab 1998



Captain Picard, I'm reading 1000 lenats on the bogometer!
(For those under 30, that equals 20 kurzweils.)

The Landscape

- **Information is the principal driver of the clinical process.**
 - *Electronic medical records, CPOE, evidence-based clinical guidelines,...*
- **Providing (recording) clinically relevant information to (from) the point of care in real-time is the core problem for clinical information systems.**
 - *Integrated workstations in ICU's, tablet computers for nurses,...*
- **An integrated systems (informatics) approach to building clinical systems has resulted in powerful, quantifiable gains in quality and productivity.**
 - *EI as a foundation for building EMRs from legacy systems,...*
- **....but, healthcare is becoming increasingly fragmented and distributed. Highly evolved hospital-based systems have not been designed for this new, rapidly evolving environment.**
 - *Work-based clinics, home-based disease management, specialty practices,....*



The Evolving Environment

- In place now: Hospitals, HMOs, 3rd party clinics & group and specialty practices
- Over the horizon: (more) work-based clinics, home-based (connected) care
- Future: support community (church, school, community clinics...) connected to community of care (multi-skill provider networks)
- Many more assisted-living and skilled nursing facilities
- Mobile medicine to reach rural and underserved communities

Bottom line: Healthcare providers will increasingly be forced to operate in a distributed environment.



Scenario: Assisted Living / Skilled Nursing Facility (LTC)

- Disabled older population will grow by more than 50 percent between 2010 and 2040
- Anticipated shortage in trained clinical staff (especially gerontologists, high-skill nurses)
- New facilities will include broadband connections to other care facilities (local/regional tertiary care centers)
- Clinical providers who provide on-call services will need to access medical records and monitoring information and issue orders *in situ*
- A gateway to the resources required to manage individuals in these facilities is needed



Scenario: Mobile Medicine

- Healthcare providers are increasingly on the move to work with rural and underserved populations
- Middle Tennessee – 330 community clinics
- Work-based clinics are growing
- VMC specialists regularly visit regional hospitals
- Cannot rely on capabilities of location-based systems
- Providers want to ‘take it with them’ (but don’t want to lug around a PC)
- Wireless broadband infrastructure is an enabler for mobile medicine



What is a Portable Clinical Gateway?

- Anywhere, anytime access point to clinical data, information and transactions (“Pervasive E-Health” – Jakob Bardram)
- Small, powerful device with broadband connectivity (an ‘hPod’).
- Designed to fit clinician’s work style and the culture of care
- Securely connected to a HRB, RHIO and the NHIN
- Seamless user experience
- Individually customizable and tailored to the clinical culture





What? No EPSILON. What kind of PCG is this?

What Capabilities Are Needed?

- Interactive access to medical and health records
- Connect to and display data from *in situ* monitors and sensors
- Receive alerts and reminders
- Send/receive (filtered) messages
- Issue orders (including eRx)
- View and navigate both static and dynamic images
- Dictate & transcribe
- Access to clinical management and payment systems
- Access to medical literature (evidence-based medicine)



Usage Model: The Clinical Connection

- The culture of care must be reflected in the usage model
- The patient-provider interface must not be fundamentally changed
- Minimal directed interaction to achieve maximal access to relevant data and information
- Physical context (location) is critical to providing patient-specific data
- Data/information ‘flooding’ must be avoided
- Contexts should be preserved from one session with a patient to another (or between orthogonal activities)
- Context-switching must be rapid and reliable (“Spaces”)



Design Challenges: Information Navigation and Focus

- Patient information (especially hospitalization-related) is deep and dense.
- Example: VMC's StarChart/StarPanel
- Small (PDA) screens are not acceptable. Large 'virtual' screens are required.
- Even with large screens, focusing on the relevant information must be made easy.
- Display cueing "Vital signs last 24 hours".
- Focusing mechanisms are needed but can be overused.



- Administration
- Jirjis
- Outpatients
- CDC_travel
- Clear all
- CME
- Consults
- Denny_
- Documents/VI
- e-mail
- Folders
- Google
- ICD-9
- Inpt. census
- MDCONSUL
- MsgBaskets
- MyHealth
- New results
- new
- no-MR msg.
- OPOC_Prod
- Outpt. visits
- panel_Jirjis
- Outpatients
- Panels
- PatientsView
- Preferences
- Recent pts.
- Reminders
- Satellink
- pager
- Scratch cens.
- SignDrafts
- SN Editor
- StarNotes
- Teams
- UpToDate
- Patient Lists
- Work Lists
- Inf. Resources
- Customize

User **jirjffj (Jim N. Jirjis)** SignDrafts Reminders Messages: 1 (Jims/Jm-MD)
 Go to: [Pt.Chart](#) [StarVisit](#) [StarNotes](#) [Forms](#) [OPOC](#) [Oulll Rx](#) [Panels](#) [PatientLists](#) [MsgBaskets](#) [NewResults](#) [SignDrafts](#) [Miscellaneous](#)

Alert **PCP: Jirjs, Jim N. Start Kiosk**
 ALL AllDocs Appntm. Calendar Clin Comm Corresp EnterData Faxed Labs Meds Merge Orders PL-Probl List Radiology Refresh Reports Search ToPanel VitalSigns
 CancerStage Disclosure ExternalLabs Forms Immuniz. IntakeAssess. NewMsg Pt.Letter ReferralMsg Reminder StarVisit TypeNewDocument UploadImage

(05/23/1955 - 49YO F)

Date	Categ.	Document Type	Comment
<input type="checkbox"/> 2005/04/06	Form	Patient Letter	Fowler, Michael James
<input type="checkbox"/> 2005/04/06	Admin	Hipaa Privacy Notification	Fowler, Michael J.
<input type="checkbox"/> 2005/04/06	Admin	Release Of Information	Fowler, Michael J.
<input type="checkbox"/> 2005/04/06	Admin	Insurance Cards	Fowler, Michael J.
<input type="checkbox"/> 2005/04/06	Comm	Clinical Communication	Jim N. Jirjis
<input type="checkbox"/> 2005/04/06	Comm	Patient Teaching	Cook, Jacqueline Marie
<input type="checkbox"/> 2005/04/06		Patient message	
<input type="checkbox"/> 2005/04/06	Intake	Intake Assessment	Isom, Joan M.
<input type="checkbox"/> 2005/04/06	Pt. List	Problem List	Fowler

(05/23/1955 - 49YO F) Alert

StarTracker Diagnoses: [Diabetes Mellitus](#)
 HgbA1C 8.1 (03/01/2005) LDL-C 139 (03/11/2005)

Problem list doctor: fowler Updated 2005/04/06 09:37 by isom:st [Patient-specific guidelines](#) [Medications Log](#) [Update Problem List](#)

<p>Significant Medical Diagnoses and Conditions: Chest pain stress sestamibi 6/01 neg (suboptimal) DM type II 250.02 HTN 401.9 Family history of CAD mother Asthma ?? 493.90 Depression 311 Family history of breast cancer (mother) HEP B-(FAST) Allergic rhinitis 477.9 EGD normal 2/03, reflux on 9/03 with possible Barrett's Hemangiomas of the liver ASCUS Paps Smoker</p> <p>Significant Procedures: Cath neg 2/02 SVD's x 2 Cesarean Section (Tri 13), 8/1997</p>	<p>Adverse and Allergic Drug Reactions: CODEINE nausea SULFA rash</p> <p>Medications: humabid 600 mg po 1 twice a day for fourteen days Advantage curved Test Strips 1 strip finger stick twice a day Depo Provera IM q 3 months, last inj. 12/22/2003 Elavil Oral Tablet 25 mg 1 (one) tablet by mouth every evening at bedtime Norvasc Oral Tablet 5 mg 1 tablet by mouth every day Avandia Oral Tablet 4 mg 1 tab(s) by mouth twice a day for 1 month(s) Lexapro Oral Tablet 10 mg 1 tablet by mouth every day Glucophage Oral Tablet 500 mg 1 tablet by mouth every day Humulin 70/30 Subcutaneous Suspension 70-30 unit/mL 33 unit subcutaneously twice a day Nexium Oral Capsule, Delayed Release(E.C.) 40 mg 1 capsule by mouth every day for eight weeks Lortab 5's one orally every 4 to 6 hours prn #42 (03/02/05)</p> <p>Health Maintenance: Immunizations PPT: 4/2001 see</p>
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Design Challenges: Privacy and Security

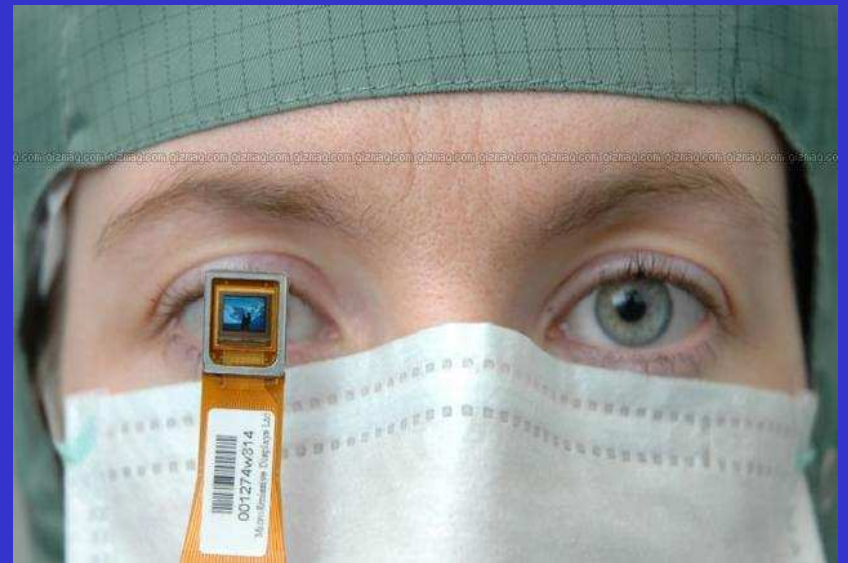
- Guaranteeing the privacy of health information is paramount.
- HIPAA regulations + state and local regulations
- Principle: a lost or stolen PCG is useless (i.e. will reveal nothing)
- Problem: What can be permanently stored on the PCG?
- Problem: What can't the PCG do with protected information?
- Two-factor ID
- Proximity unlock
- Encryption
- Auditing
- Remote erase option?



Design Challenges: User Interface and Interaction Modalities

- Voice is essential (for both input and navigation)
- Dictation/transcription (turnaround time?)
- Cueing (a voice track/thumb wheel?)
- Retinal tracking promising but still needs work
- Access using coherent information clusters
- 'Next', 'More', 'Back', 'Last', ... 'Labs', ...
- CDSS/advisor overlays or reminders
- Orders are a challenge without good voice recognition





Speech recognition technology allows voice control of aircraft systems

June 22, 2007 - New technology that allows pilots to control aircraft systems by voice command has been successfully tested on a UK Army Air Corps Gazelle helicopter. Designed to alleviate the problem of pilots spending too much time looking inside the cockpit – a problem exacerbated by the advent of complex multi-function displays – QinetiQ's Direct Voice Input (DVI) system incorporates speech recognition technology to facilitate the direct voice control of avionics equipment using standard aircrew helmet microphones and intercom.



Design Challenges: Managing Complexity

- The clinical (diagnosis, treatment, management,...) domain is inherently complex (e.g. huge, overlapping lexicons: CPT, ICD, LOINC, SNOMED-CT,...)
- All clinical information systems make compromises to deal with this complexity - menus, popups, links, overlays,.....
- Workflow has been the primary driver (CPOE)
- Task semantics and domain semantics are starting to be widely used as an essential method of complexity reduction (e.g. order sets)
- The 'dream' CIS – two-way dialog combined with automatic instant access to required information
- Challenge: can a PCG-based CIS reduce complexity in new and novel ways?



Designing for Success

- User involvement is the key element of a successful design
- VMC experience with CPOE & EHR – active engagement throughout the entire design and testing process
- Ability to customize an interface (and not just cosmetically) to fit the work style of an individual
- Inductive learning of tasks and (desired) presentation/organization
- Does the ‘right’ thing with little or no prepping: context cueing
- Playback for review & prep
- Avionics / flight-control model



Design Principles: Cultural Integration

- PCG should disappear in patient encounters
- A clinical tool, not a master or driver
- Integrate well with a set of diverse clinical environments
- Not only for the physician - nursing culture is critical
- Interchangeable and exchangeable.
- Loss / disabling of device should cause a minimum of inconvenience



Design Principles: Task / Process Integration

- Critical issue for a portable system that it is ‘on the firing line’.
- CIS frustration – workflow support (CPOE), information access (EHR) and decision support are not well integrated.
- ESB is the correct model for interrelated but quasi-orthogonal functions (HSOA – Healthcare Services Oriented Architecture)
- Service orchestration and usage model needs to be driven by task/domain rules not normal “alert box” design model
- Investigate the use of T2S alerting as a parallel interaction path



'Elegant' Smartphones

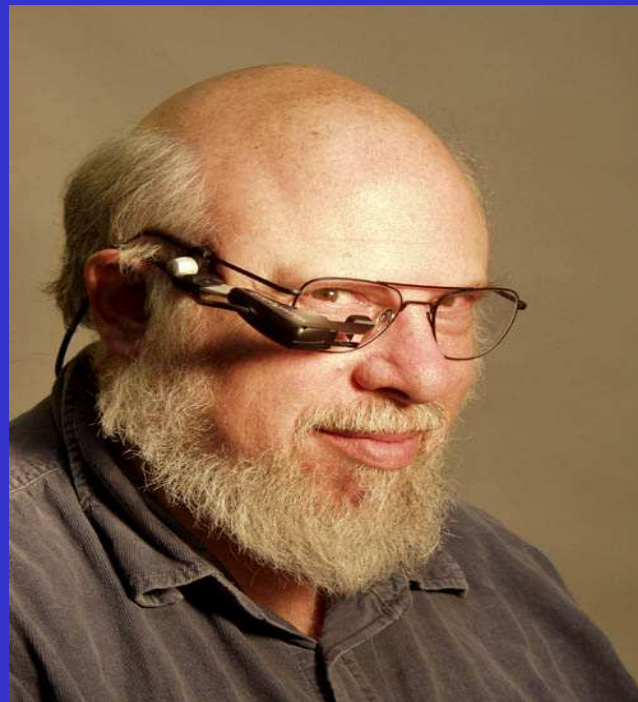


Is this the right model for a PCG?

- + Major industry investment
- + Rapid evolution
- + One device does everything

- Broadest common denominator
- Semi-closed platform
- Not focused on problem domain

Wearable Computers



?

Promising Technologies

- OLED microdisplays (Microvision, eMagin, IBM?)
- Domain-specific voice recognition (Dragon, Voicera?)
- Gesture mapping & recognition
- GIG (Global Information Grid) & related endpoint devices
- OS-supported context / activity switching (OS X Leopard)
- Portable / federated identity management (Credentica, IBM,...)
- 4G / WiMax,...



Vanderbilt's Approach: The HealthTech Laboratory

- Mission: Through novel technologies, foster the revolutionary transformation of healthcare process with an emphasis on many-fold increases in patient centeredness, quality, and productivity.
- Focus: Connection
 - Individuals, families and their support communities are connected to their community of care.
- Focus: Cognition
 - Evidence and patient information - including genomic and proteomic data - are synthesized in advance into personalized knowledge bases.
- Focus: Prediction
 - Embedded sensors and decision support tools combine to predict problems, reduce care required and eliminate most transactions.



Amplifying Clinical Decision Making Consortium

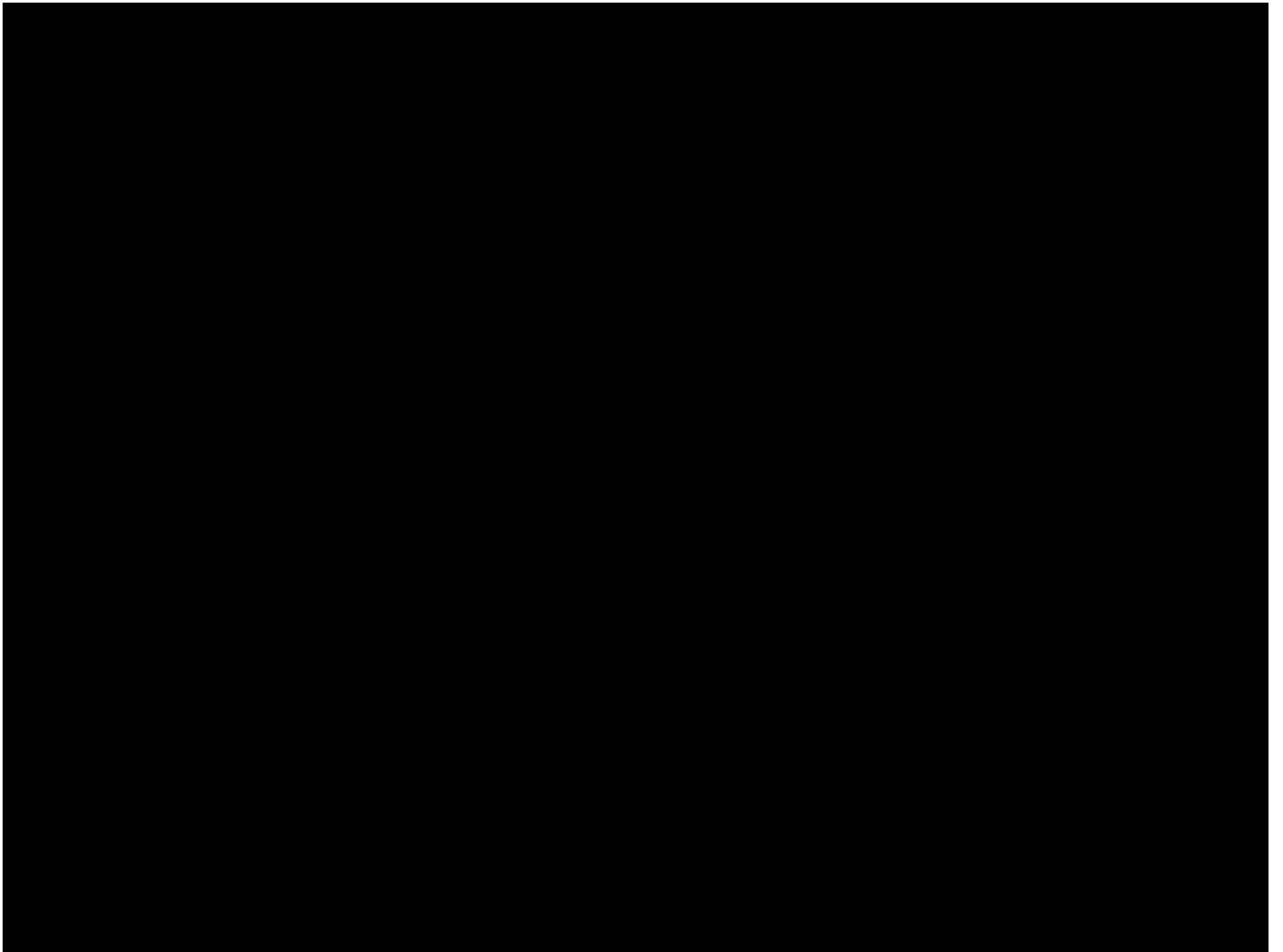
- **Focus:** building powerful tools for clinical practitioners to dramatically increase quality of care, effectiveness and efficiency by bringing clinically relevant information to the point of care in real time.
- **Goal:** managing the information ‘tsunami’ while dramatically increasing clinical efficiency and effectiveness and facilitating optimal care
- Areas of Interest:
 - *Designing and prototyping a Portable Clinical Gateway to provide healthcare workers and providers, whatever their location, with the knowledge, information and data that they require, in real time, at the point of care.*

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Jim, I think you're going to need this after this presentation.



Contact

Peter Miller

peter.miller@vanderbilt.edu

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