



OECD Broadband Workshop 2002

Medical Use of Broadband

Joseph Dal Molin
e-cology corporation



Agenda

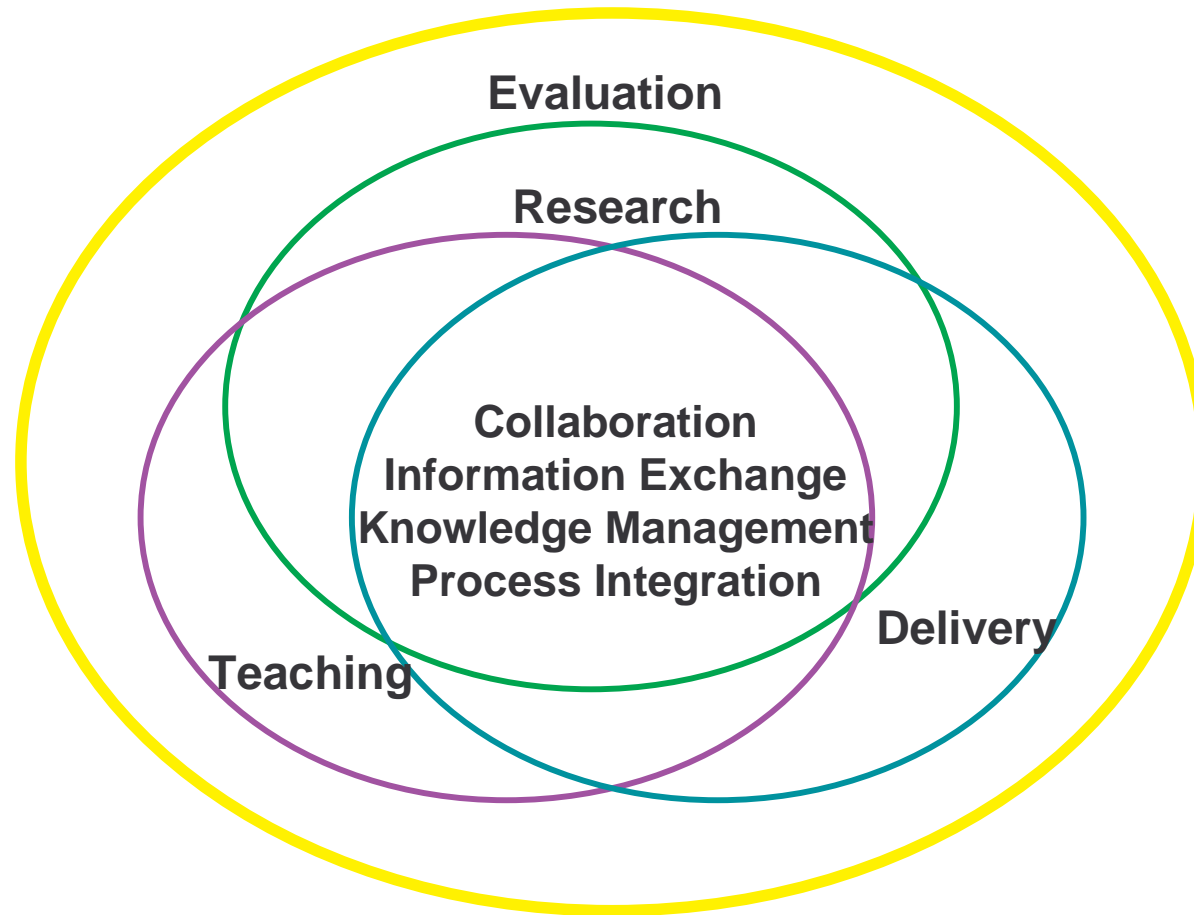
- Background: Health Care is an **e-cosystem**
- Why Health Care is the Ultimate Living Lab for Broadband
- Strategic Issues/Opportunities



The Health Care E-cosystem



The Health Care Ecosystem



Why Healthcare is an Ecosystem

- Looks chaotic on the surface
- It is a complex adaptive system
- It is unpredictable, non-linear behaviour
- Work processes and relationships are complex and fluid
- No two stakeholders are identical
- Does not respond well to command and control models
- New management thinking needed



Networks Are Health Care's Life Critical Nervous System

- Traditional, linear business supply chains, mixed with
- Dynamic non-linear value webs and workflow
- “Just-in-time” takes on a new sense of urgency
- Reduces processing errors
- Help overcome distance and time barriers to effective and consistent levels of care
- Connect the global research community and create the context for strategic transformation and innovation



Why Health Care is the Ultimate “Living Lab” for Broadband



Health Care Service Examples

Service Domain	Example
Consumer Health	<ul style="list-style-type: none">– Health Web Sites– E-mail Between Patients and Providers– Online Health Records– Patient Monitoring and Home Care
Clinical Care	<ul style="list-style-type: none">– Remote Consultation– Medical Imaging– Clinical Transactions
Biomedical Research	<ul style="list-style-type: none">– Biomedical Databases– Linked Simulations– Remote Control of Apparatus– Internet– Collaboration Among Researchers
Professional Education	<ul style="list-style-type: none">– Graduate Education– Continuing Medical Education



Estimated Quality of Service for Selected Applications & Bandwidth Classes

Application Professional E-Health	Application Technology	Individual	Small Institution	Large Institution
		10 Mbps	100 Mbps	1 Gbps
High-quality non-real-time video-imaging for diagnosis	File transfer	High Quality	High quality	High Quality
Cardiology neurology and emergency room consultations	H.323 video	High quality	High quality	High Quality
Cineo-angiography and Echocardiograms	H.323 video	High quality	High Quality	High Quality
3d Interactive brain imaging	Sgi Vizserver	Unsupportable	Medium Quality	High Quality
Clinical decision-support Systems	Web browsing	High quality	High Quality	High Quality
Advanced clinical decision support systems	Image transfer	Low quality	Medium Quality	High Quality
Professional Tele-education	MPEG 1 video	High quality	High Quality	High Quality



Source: The Next Internet: Broadband Infrastructure And Transformative Applications, CANARIE Inc., 2001

© 2002, e-cology corporation

Estimated Quality of Service for Selected Applications & Bandwidth Classes

Application	Application Technology	Individual	Small Institution	Large Institution
E-Learning		Cable Modem/xDSL Class	10 Mbps	100 Mbps
Effective e-learning	Multimedia browsing	High Quality	High quality	High Quality
Comprehensive learning environment	H.323 Video conferencing plus T.120 applications sharing	Medium Quality	High Quality ⁵⁴	High Quality
E-Health in the Home				
Home Tele-monitoring	Telemetry	Medium Quality		
Home Tele-visits	H.323 video	Medium Quality		
Health Information/the Public	Web browsing	High Quality		



Source: The Next Internet: Broadband Infrastructure And Transformative Applications, CANARIE Inc., 2001

Detailed Bandwidth Required for Various Applications

APPLICATION	TECHNOLOGY	CAPACITY REQUIRED Per Instance (Mbps)
E-Learning		
Effective e-learning	Multimedia browsing	0.15
Comprehensive learning environment	H.323 Videoconferencing plus T.120 applications sharing	0.40 to 0.8
E-Health		
High-quality non realtime video-imaging for diagnosis	File transfer	0.05
Cardiology, neurology, and emergency room consultations	H.323 video	0.40
Cineo-angiography and echocardiograms	H.323 video	0.77
3d Interactive brain imaging	SGI Vizserver	70
Clinical decision-support systems	Web browsing	0.40
Advanced clinical decision support systems	Image transfer	16
Professional Tele-education	MPEG 1 video	2.00
Home Tele-monitoring	Telemetry	0.40
Home Tele-visits	H.323 video	0.40
Health Information/the Public	Web browsing	0.05



Nominal File Sizes of Common Medical Images

Image Type	Image Size (bits)	Images per Exam	Size of One Exam (MB)
Nuclear medicine	262,144	30-60	1-2
Magnetic resonance imaging	786,432	60	6
Ultrasound (color)	6,291,456	20-230	16-180
Digital angiography	2,097,152	15-40	4-10
Digitized electron microscopy	2,097,152	1	0.26
Digitized color microscopy	6,291,456	1	0.79
Computed tomography	3,145,728	40	20
Computed radiograph	50,331,648	2	16
Digitized X rays	50,331,648	2	16
Digitized mammography	368,640,000	4	184

SOURCE: Huang (1996, 1999).



Nominal Bandwidth Requirements for Different Telemedicine Applications

Type of Telemedicine	Needed Bandwidth ^{1a}	Examples
High resolution, no motion	Store-and-forward	Radiology, dermatology, pathology
Medium resolution, low motion	128 kbps	Stethoscope, visual exams, psychiatric consultations, gastroenterology
Medium resolution, high motion	384 kbps	Cardiology, neurology, and emergency room consultations
High resolution, high motion	768 kbps	Cineo-angiography and echocardiograms
Very high resolution, high motion	Up to 2.5 Mbps	Gait analysis

akbps, kilobits per second; Mbps, megabits per second.

SOURCE: David Balch, East Carolina University, personal communication, February 2, 1999



Relative Importance of Network Characteristics for Health Applications

Application	Bandwidth	Latency	Availability	Security	Ubiquity
Consumer health	++	+	++	++++	++++
Clinical care	++++	+++	++++	++++	++
Administration	+	+	+++	++++	++
Public health	+	+	+++	+++	++
Professional education	+++	++	++	+	+++
Biomedical research	++++	+++	++	++	++

Source: Networking Health Prescriptions for the Internet, Computer Science and Telecommunications Board, National Research Council, USA, 2000



Strategic Issues/Opportunities

or

***Why It Is So Easy to Get a Flat Tire on the Way to
the Health Care Info-highway***



It Is Time for a New Paradigm

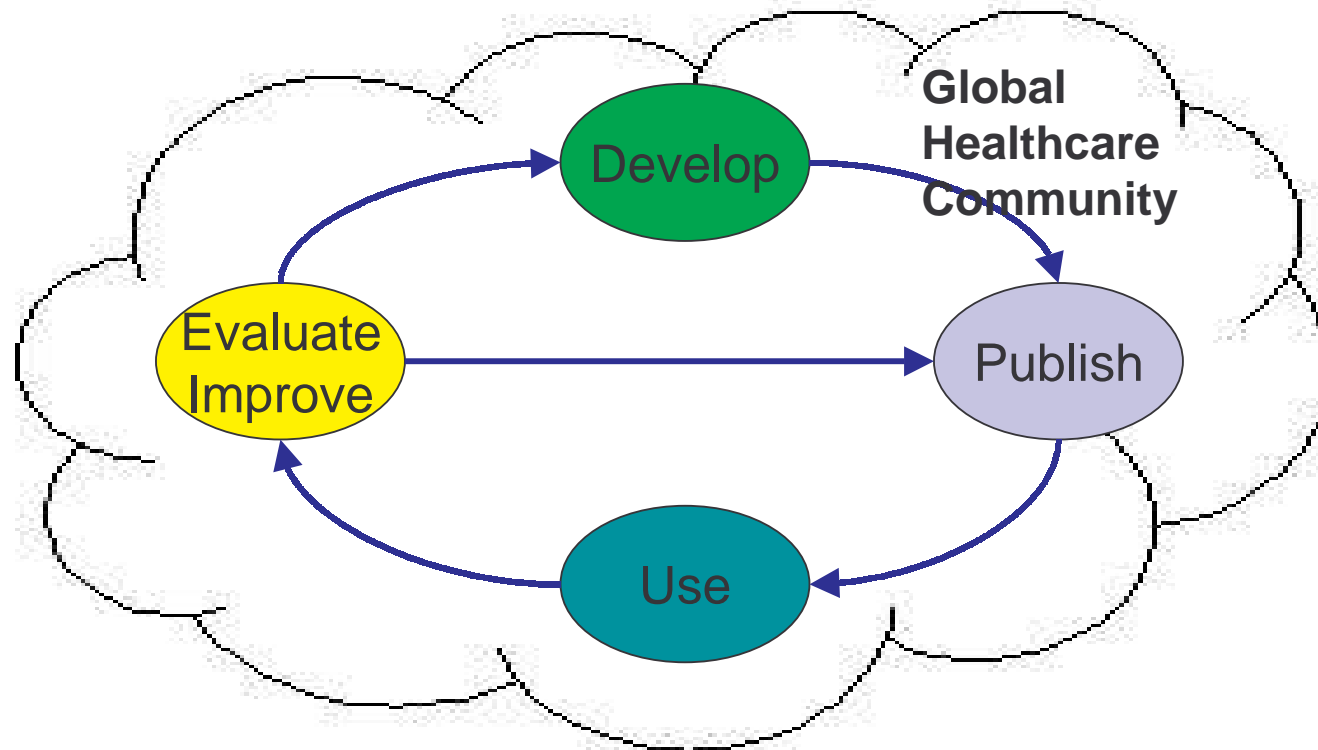
"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

Albert Einstein



Some Critical Success Factors

- Establishing a Discipline and Methodology for Health Outcomes / Evidence Based ICT



Some Critical Success Factors cont'd

- E-cosystem Organizational Interoperability
- E-cosystem Policy Alignment and Interoperability
- Make sure you are not trying to “Boil the Ocean”
- Find the “tipping point” or usability threshold at the grass roots level
- ICT Innovation Model Needs to be Transformed to Adapt to Health Care
- Embrace Creative Destruction



Promising Developments

- Open source paradigm in health care emerging
 - Fully integrated hospital system
 - Primary care EMR
- Health care ICT Collaboratories
 - UCLA + American Assoc. of Medical Colleges
 - UofT Program for Global eHealth Innovation
 - Open Source Health Care Alliance
- Evidence based evaluation of software in early stages of discussion



Opportunities

- Significant opportunity for “new entrant” SME’s who apply business models which:
 - are evidence based and focused on health outcomes
 - encourage the “virtuous spiral” e.g. open source
 - apply a “systems thinking” perspective
 - exploit current infrastructures
- The quality and effectiveness of Health Care e-cosystems will determine both health outcomes and who makes significant advances in health care



Conclusion

***The Health Care Ecosystem is the Ultimate Living
Lab for Broadband Evolution***





e-cology corporation

www.e-cology.ca