Annual Review of IM/IT in Healthcare

Breakfast with the Chiefs
March 25, 2008

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US National Academy of Engineering lists "advancing health informatics" as one of the fourteen grand challenges of engineering in the 21st century

1. Make solar energy economical
2. Provide energy from fusion
3. Developing carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advancing health informatics
8. Engineering better medicines
9. Reverse-engineering the brain
10. Prevent nuclear terror
11. Securing cyberspace
12. Enhancing virtual reality
13. Advancing personalized learning
14. Engineer the tools of scientific discovery

"there is now a consensus that a systematic approach to health informatics — the acquisition, management, and use of information in health — can greatly enhance the quality and efficiency of medical care and the response to widespread public health emergencies."

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Source: National Academy of Engineering, http://www.engineeringchallenges.org/

Capital Health Netcare and Alberta Netcare Merge

- Capital Health netCARE and Alberta Netcare combined into a single portal in January of this year
- There were approximately 10,000 unique active users on the two systems that have now been brought together on a single platform
- Approximately 30% of active users are physicians

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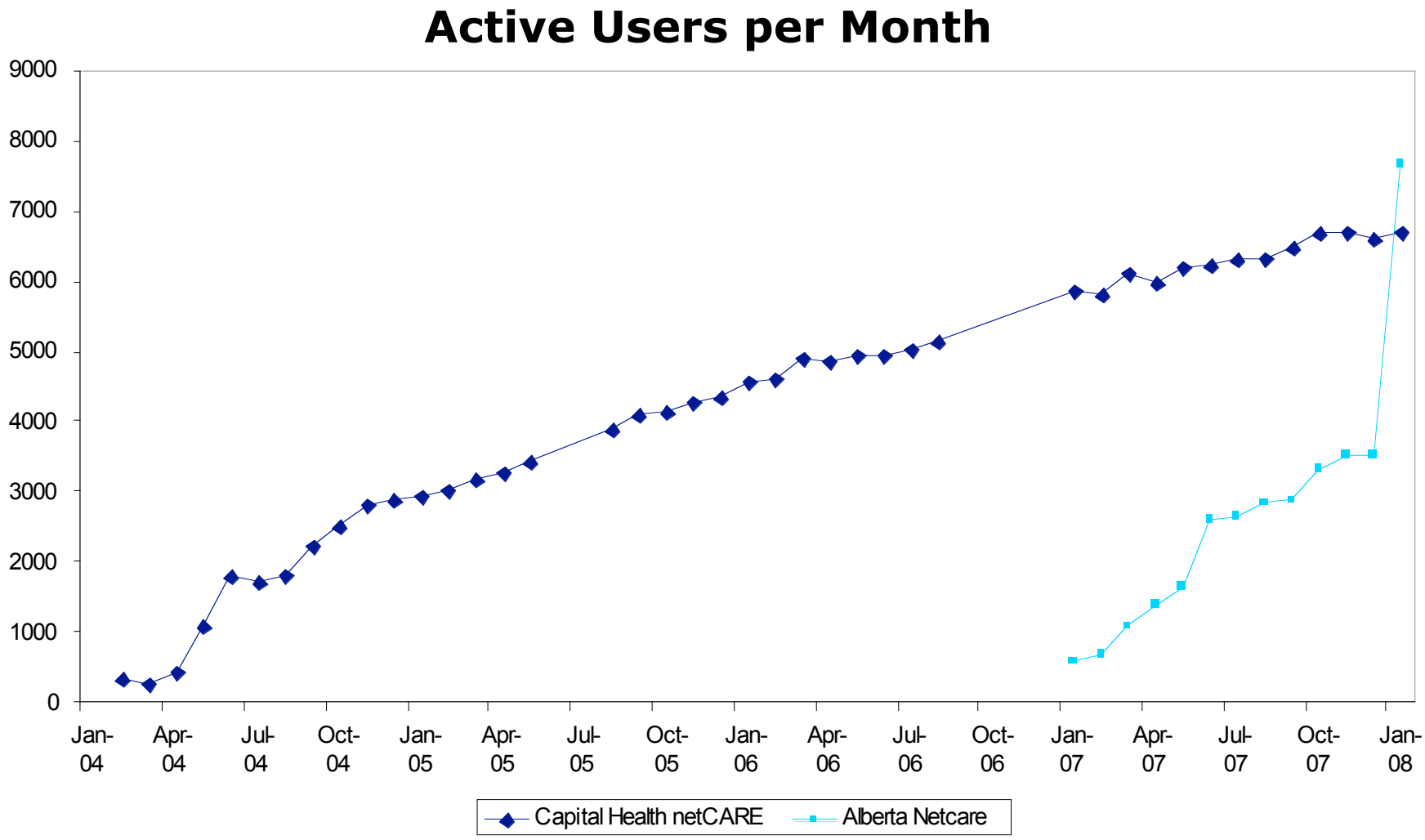
Source: "Utilization Update" *Alberta Netcare* February 24, 2008

Netcare utilization continues to increase



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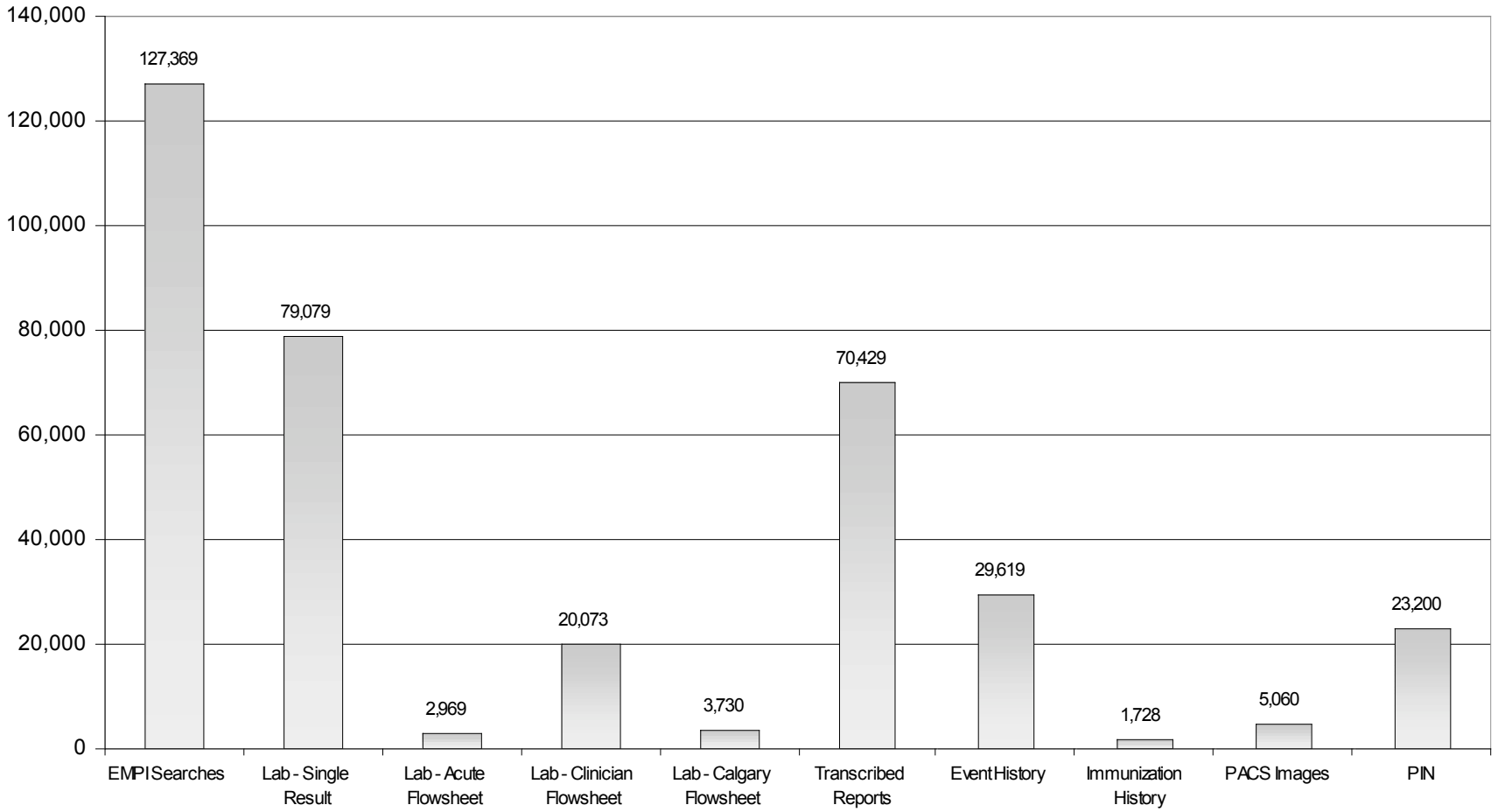
Source: "Utilization Update" *Alberta Netcare* February 24, 2008

User activity is tracked to focus improvements on priority areas

Netcare Screens Accessed by Functionality, January 2008



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Source: "Utilization Update" *Alberta Netcare* February 24, 2008

PRO is the Toronto equivalent (Patient Results Online)

Data Sources

- Mount Sinai Hospital
- UHN
- Life Labs (Former MDS Labs)
- Woman's College Hospital

Sites Accessing Reports

- Bridgepoint Health
- CHC
- Mount Sinai Hospital
- Royal Victoria Hospital
- St. John's Rehab
- St. Joseph's Health Centre
- St. Michael's Hospital
- Toronto Rehab Institute
- UHN
- West Park
- Women's College Hospital

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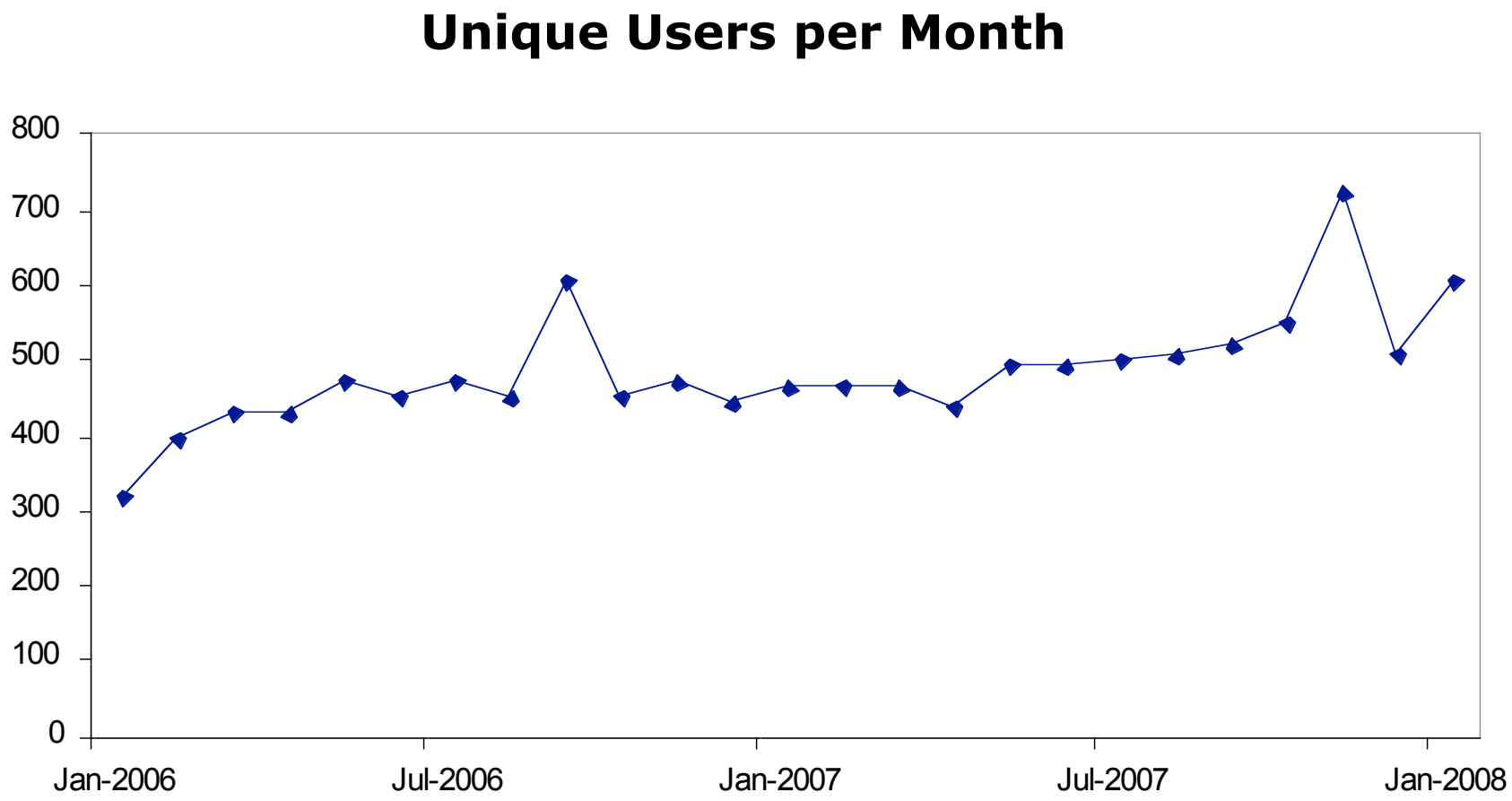
Number of unique users on PRO continues to increase



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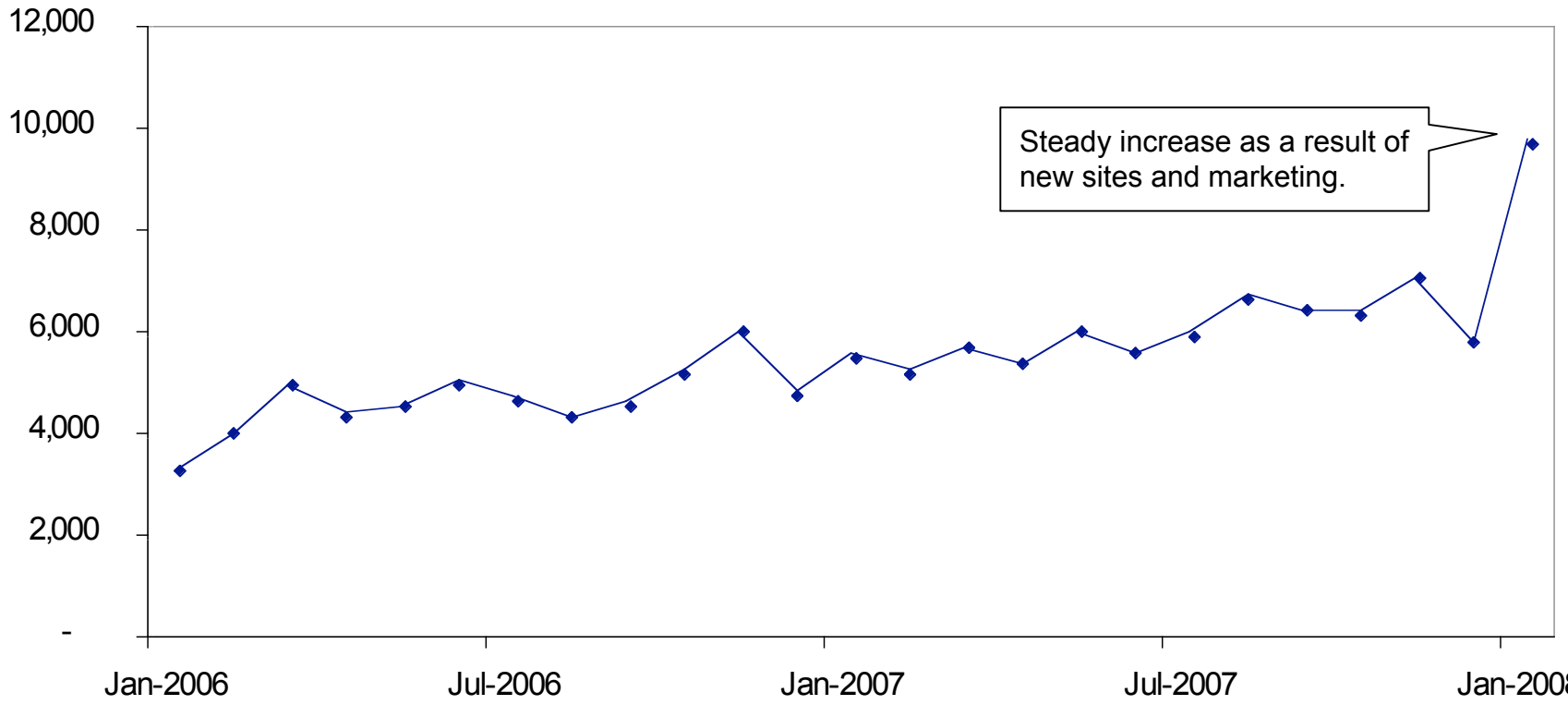
Source: PRO Statistics, 2006-2008

Report access volumes are also increasing

Number of Reports Accessed per Month



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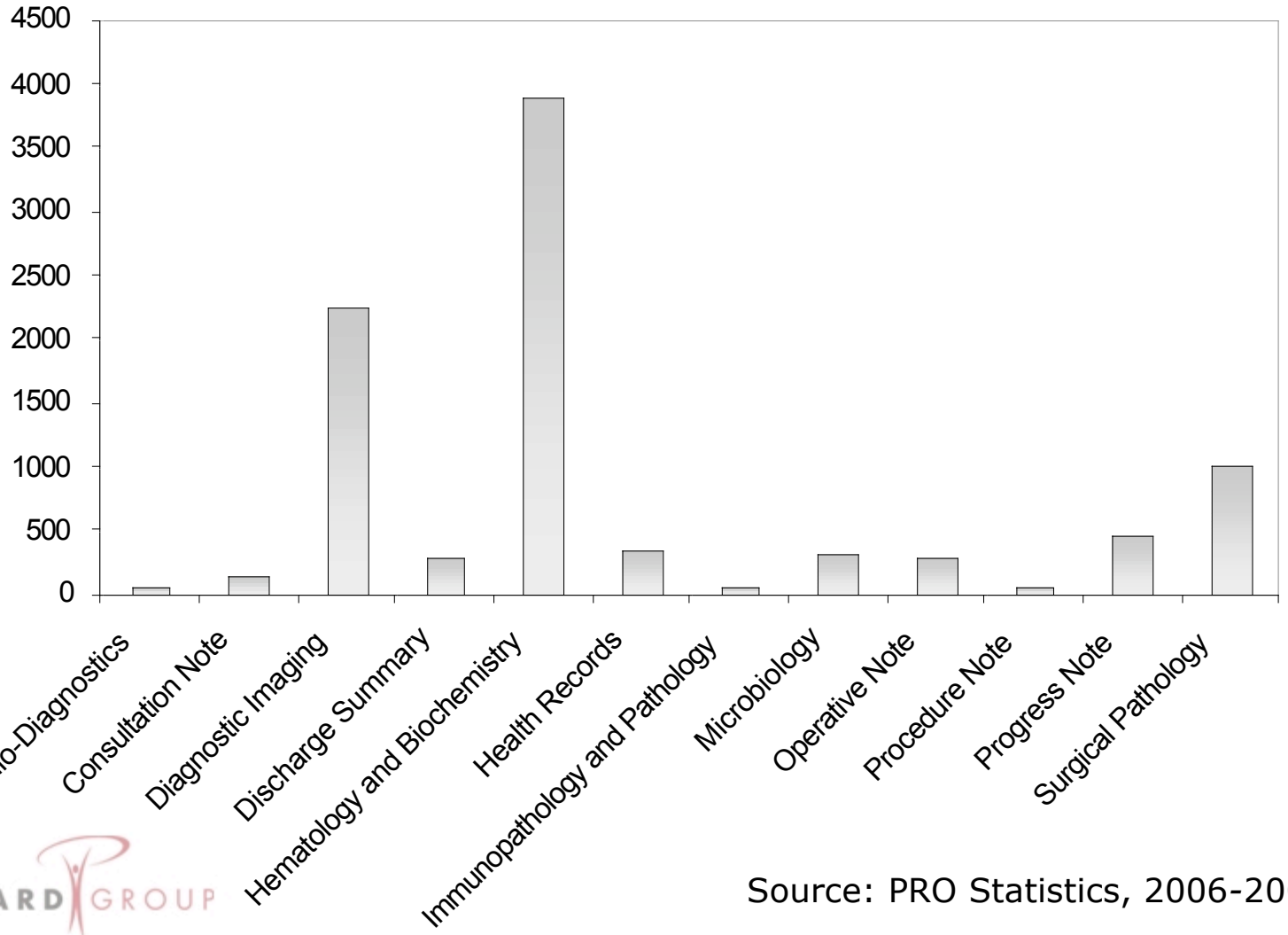
Source: PRO Statistics, 2006-2008

User activity is carefully tracked to focus improvements on priority areas

Total Reports Accessed by Type, January 2008

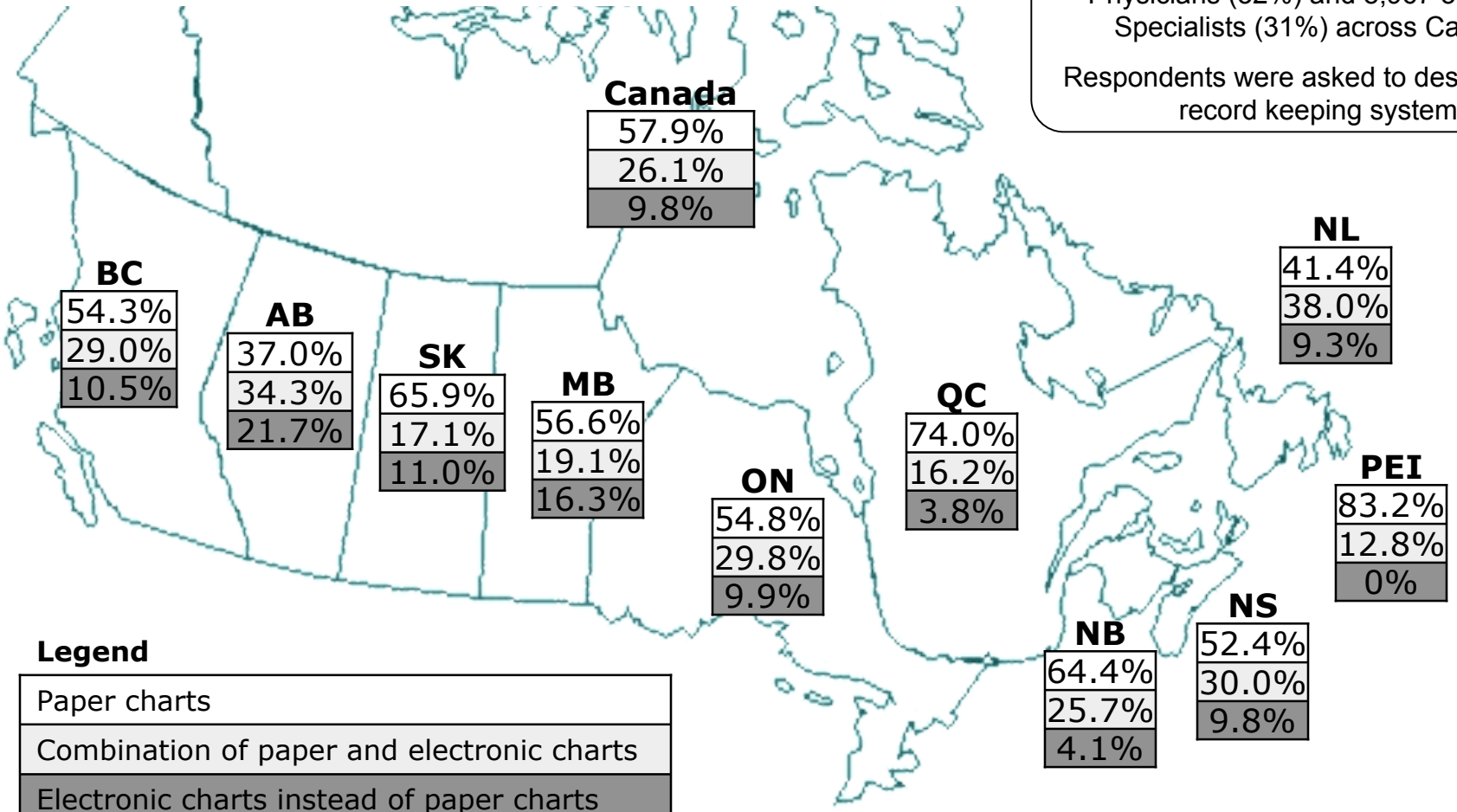


Source: PRO Statistics, 2006-2008

Adoption of electronic record systems by physicians continues to be slow

Surveyed 10,272 of 28,785 Family Physicians (32%) and 8,967 of 28,785 Specialists (31%) across Canada.

Respondents were asked to describe their record keeping system.



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Source: National Physician Survey, 2007.

The Innovator's Dilemma

- In Clayton M. Christensen's book, *The Innovator's Dilemma*, he explains why well-managed firms, with market leadership and technological dominance, lose their positions of leadership to other firms.
- He argues that these well-managed firms fail *because* they are well-managed. They focus their energy on "Sustaining Technologies" and neglect the rise of "Disruptive Technologies" in smaller markets simply because the commonly held principles of good management guide them to do so.

Sustaining Technologies	Refers to technologies that improve performance on products that customer have typically valued.
Disruptive Technologies	Refers to technologies that begin with weak product performance and have fringe features (usually new) that customers in smaller markets value.

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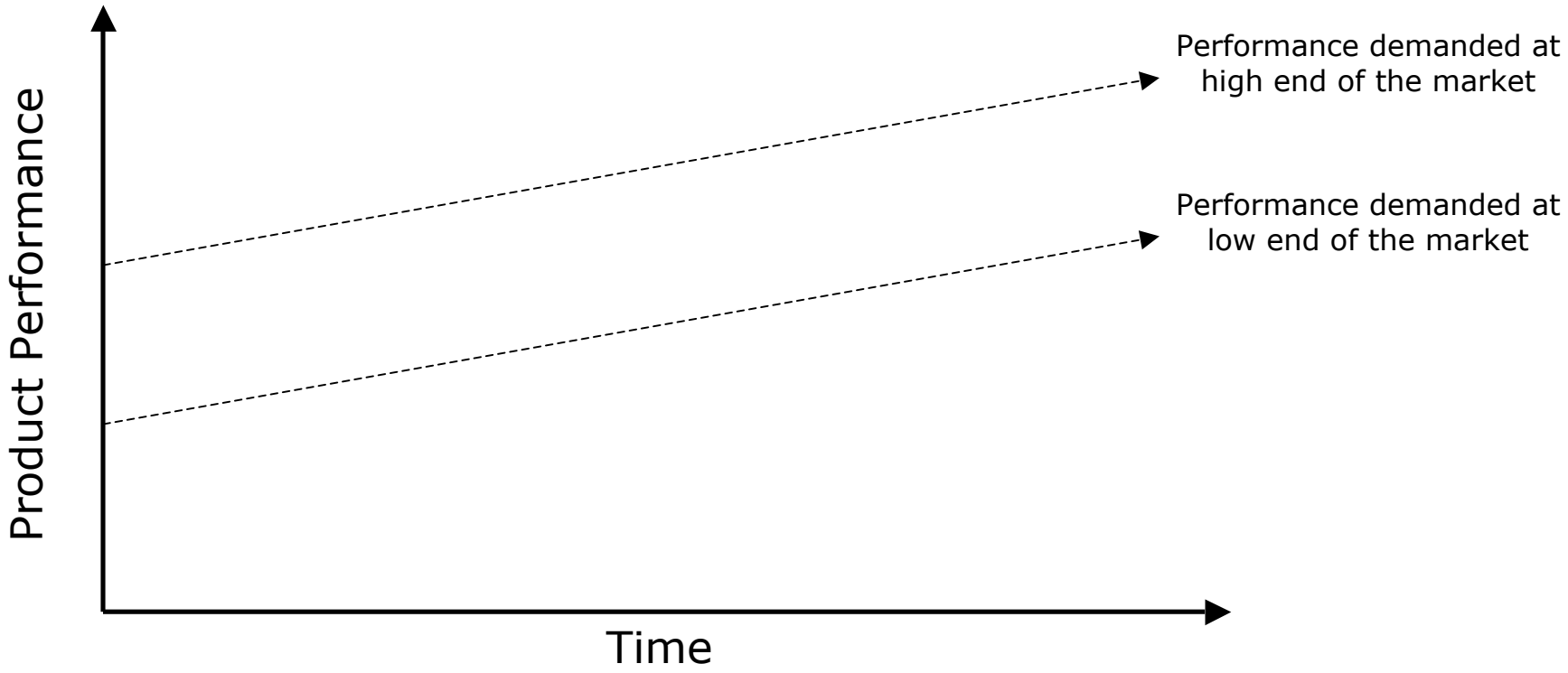
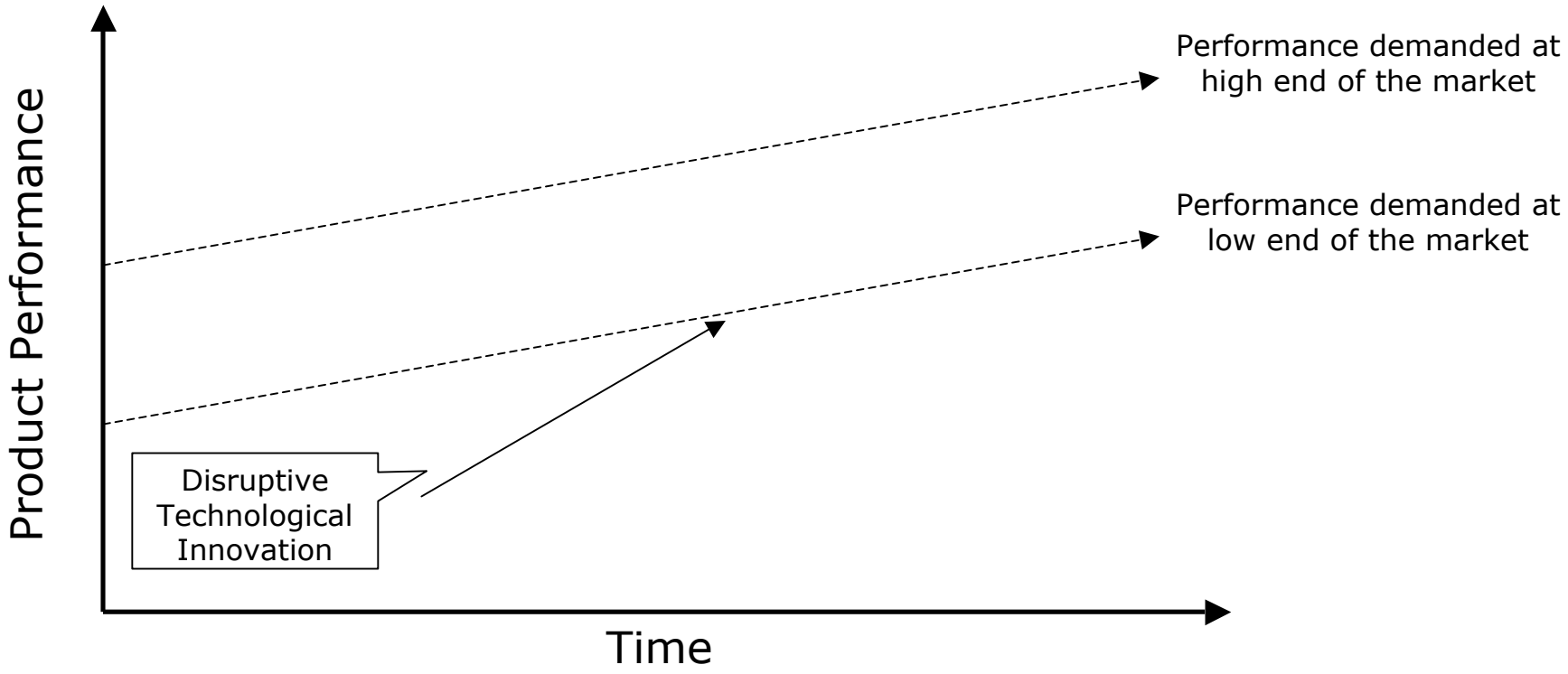
Source: Christensen, CM. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" *Harvard Business School Press* 1997.

Market requirements tend to increase incrementally



Source: Christensen, CM. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" Harvard Business School Press, 1997.

Disruptive Technologies enter the market with less than adequate performance



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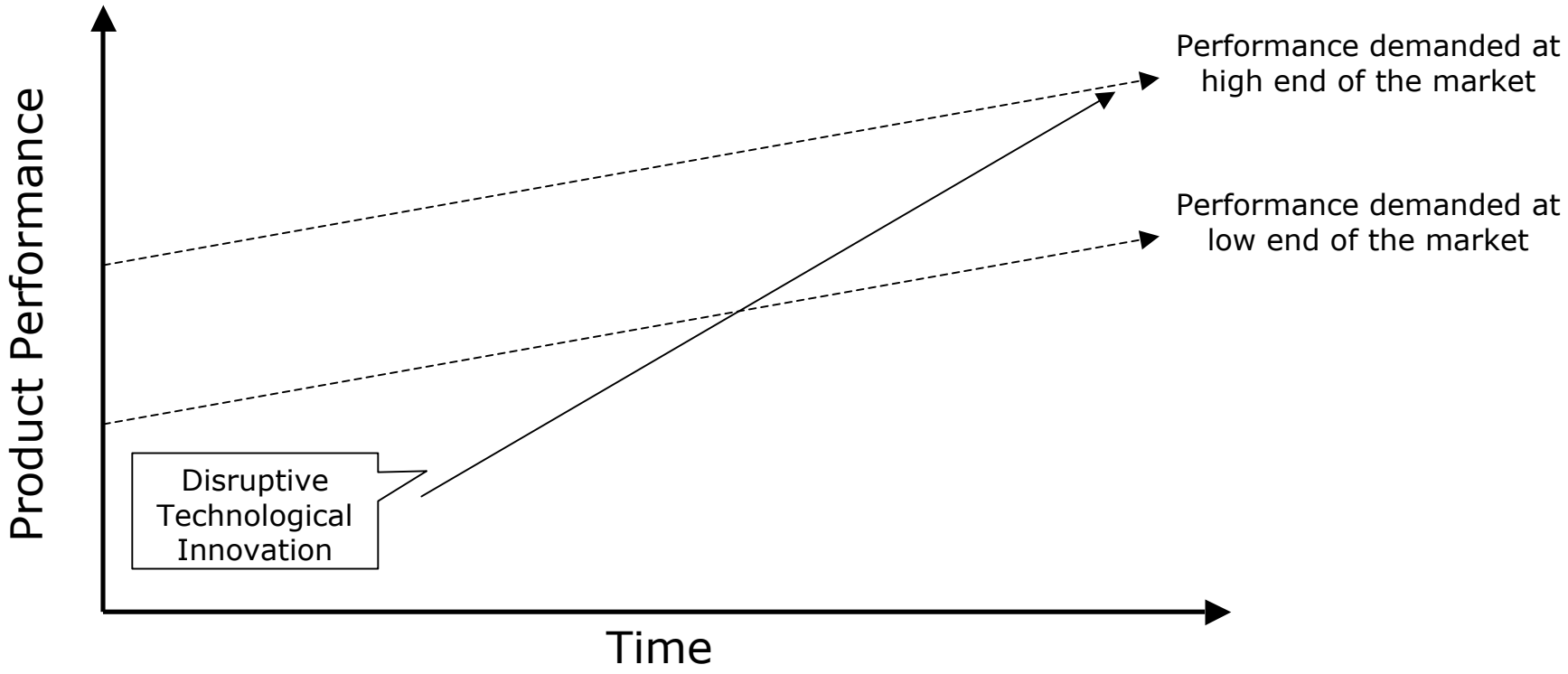
Source: Christensen, CM. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" Harvard Business School Press, 1997.

Over time the Disruptive Technology meets the performance needs of the high end of the market



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Source: Christensen, CM. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" Harvard Business School Press, 1997.

Leading firms neglect the rise of Disruptive Technologies because of rational management decisions

The choice of investing in disruptive technologies is not a rational decision to make by a leading firm.

- Disruptive technologies promise lower margins.
- Disruptive technologies are typically first commercialized in insignificant markets.
- A leading firm's best customer will typically not benefit or be able to use disruptive technologies.

By the time a disruptive technology meets the performance of the low end of the market, the leading firm will never be able to catch up and will ultimately lose its position of leadership.

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Source: Christensen, CM. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" *Harvard Business School Press* 1997.

Microsoft launched its Amalga Hospital Information System at HIMSS in February

Description	• Complete electronic medical record for hospitals • Will be marketed in developing and emerging markets only
Functions	• Complete patient and bed management, laboratory, medication management, RIS/PACS, pathology, financial accounting, materials management, and human resource systems
Platform	• Built from the ground up on scalable Microsoft technology • Consists of 50 clinical and back office modules that are designed to run on Microsoft Windows Server 2003 and Microsoft SQL Server 2005
Example Customers	ASIAN HOSPITAL AND MEDICAL CENTER (Philippines); Assunta Heart & Art of Care (Malaysia); Bumrungrad International (Thailand)

Source: Microsoft, http://www.microsoft.com/amalga/default.mspx

A multitude of PHRs have burst onto the scene

As defined by the Markle Foundation:

"PHRs encompass a wide variety of applications that enable people to collect, view, manage, or share copies of their health information or transactions electronically. Although there are many variants, PHRs are based on the fundamental concept of facilitating an individual's access to and creation of personal health information in a useable application that the individual (or a designee) controls."

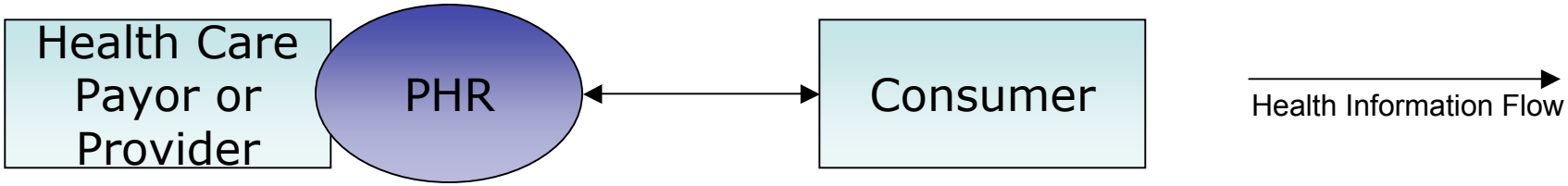
The PHR market is immature with no recognized market leader

A market analysis was performed by the Altarum Institute on behalf of the US National Coordinator for Health Information Technology (2006) and it concluded that:

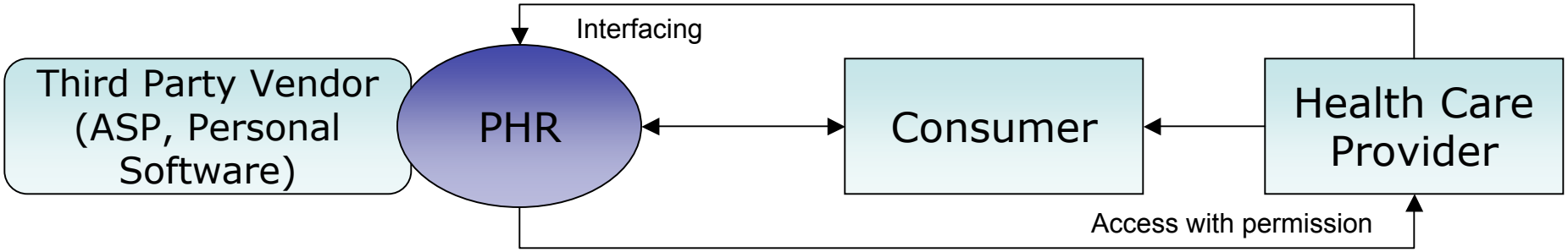
"the PHR market is relatively immature and lacks an obvious technological or market leader. PHR products show an enormous variation in functionality; vendors are pursuing a multitude of business models and approaches to privacy and confidentiality. Security issues are diverse and changing. They can be standalone, tethered to other sources of healthcare data like provider and insurer systems, or robustly integrated with several sources of healthcare data."

There are three different types of PHRs

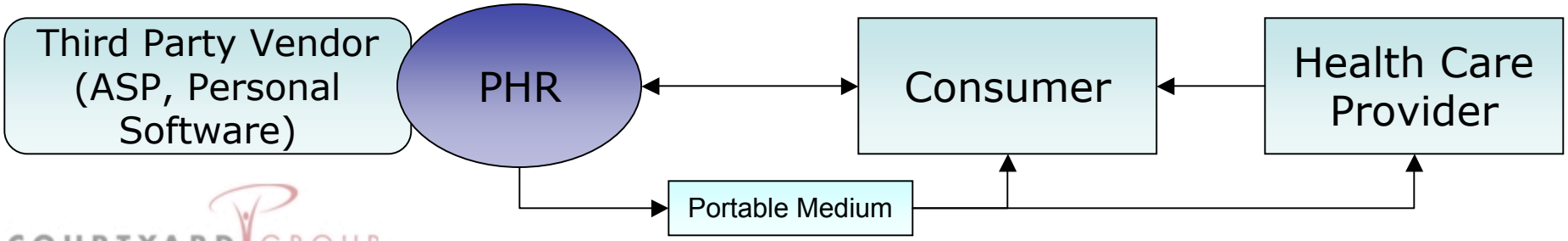
Type 1: Tethered PHR, organization based



Type 2: Un-Tethered PHR, platform based



Type 3: Un-Tethered PHR, portable technology based



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Type 1: Tethered PHR, organization based

PHR Name	Organizations	Description
MyHealtheVet	Department of Veteran Affairs	• Provides benefits admin, a health journal, prescription refill, Chronic Disease Management tools. • Intended expansion to viewing appointments, financial information, and EMR online.
MyChart	Cleveland Clinic	• Available through a web portal for Cleveland Clinic patients. • Provides appointment administration, prescription renewal, laboratory viewer.
MyMedicare	Centers for Medicare and Medicaid Services	• View claims and status, eligibility, entitlement and preventive services, enrollment information and prescription drug plans. • View or modify drug list and pharmacy information. • Order Medicare summary notes.

Type 2: Un-tethered PHR, platform based

PHR Name	Organizations	Description
Dossia	AT&T, Applied Materials, BP America, Inc., Cardinal Health, Intel, Pitney Bowes, sanofi-aventis and Wal-Mart.	• Web-based system that compiles an electronic summary of medical history. • Stores medications, procedures, tests, allergies and family history. • Practitioners will have to update PHR fields electronically in order to maintain their preferred provider status.
HealthVault	Microsoft	• A free online service that allows consumers to store, organize and retrieve health information. • Consists of a health information search engine, an EMR and a connection centre. • Consumers can directly input information and can have information faxed into their PHR.
Google Health	Google	• Stores information on conditions and symptoms, medications, allergies, procedures, test results and immunizations. • Provides decision support for medication use.

Type 3: Un-tethered PHR for the purposes of populating portable information media

PHR Name	Description
Medbase/ MedKey	• Online service that facilitates the transfer of personal health information to a MedKey device or USB compatible portable device. • Captures demographics, immunizations, allergies, emergency contact information, physician information, medical contacts, local hospital, insurance information, medical reports, prescription drugs, medical visits, lab tests, surgeries.
Angel	• The consumer populates their medical profile online. • Information is transferred to a medical Blotter (information card, EMS sticker, key ring tags) or a USB device. • Information is retrieved through a Angle Voice # called by practitioners.
FollowMe	• Stores allergies, immunizations, medical conditions, tracks medications, provides emergency medical cards and prints comprehensive medical reports.

The future of PHRs

"In the next three to five years, PHRs are likely to progress along two paths.

1. One will involve developing better links between health records containing a patient's observations and the records her or his clinician keeps.
2. The other will entail a greater proliferation of more clinically useful home-monitoring and alert systems as home electronics mature."

-- Patricia Flatley Brennan, R.N., Ph.D. National Program Director, ProjectHealthDesign. Professor and Chair, Department of Industrial and Systems Engineering, University of Wisconsin-Madison.

Medtronic offers the CareLink® Network uses wireless technology to collect data from implantable devices.

The CareLink Network

- Service that allows data from implanted cardiac devices to be sent wirelessly to a CareLink Monitor then transferred over the phone line to centralized servers, then accessed by clinicians via the Internet.

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Source: Medtronic

Medical Devices that use the CareLink® Network

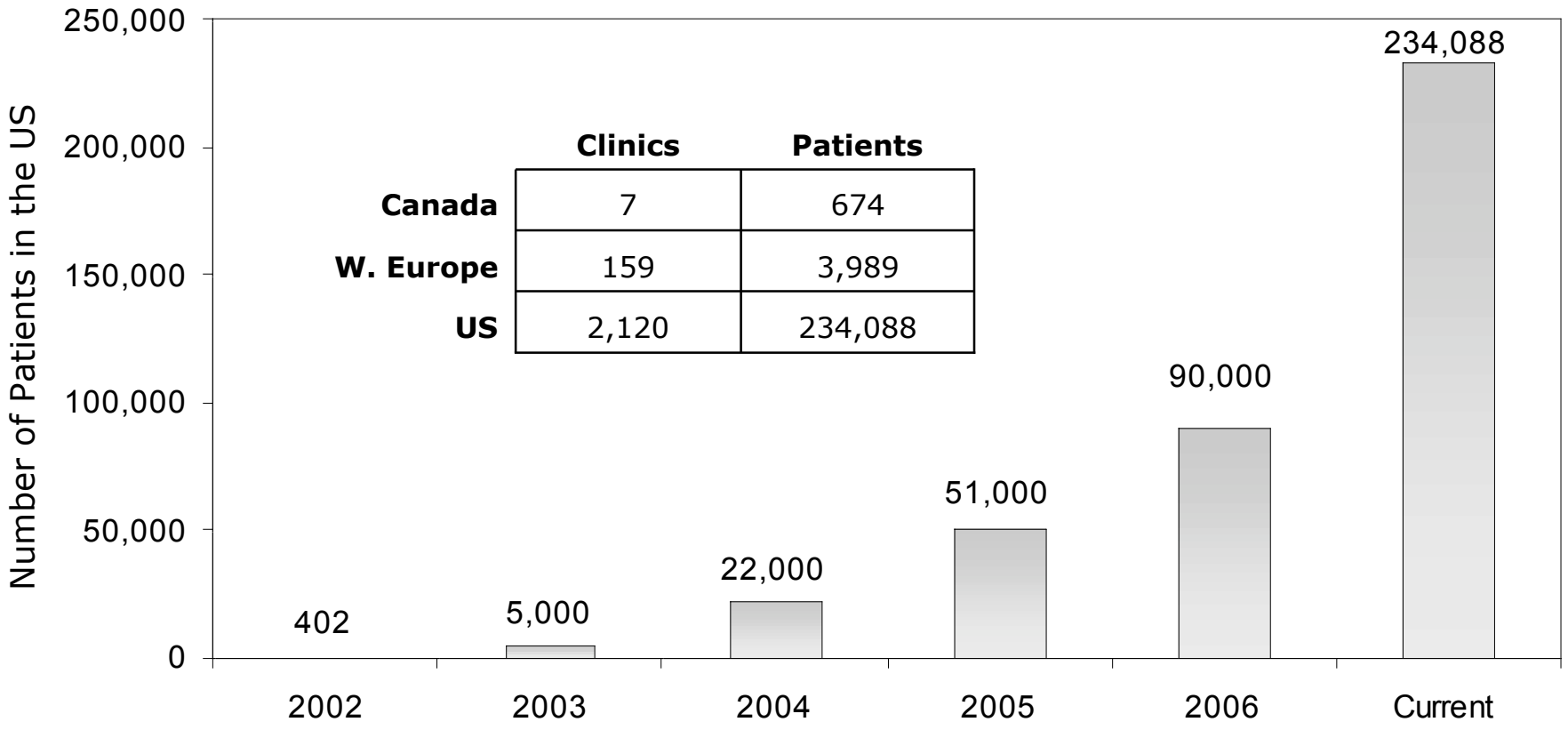
Implantable Cardioverter-Defibrillator (ICD)	A battery powered electrical impulse generator implanted in patients who are at risk of sudden cardiac death due to ventricular fibrillation.
Cardiac Resynchronization Therapy Device and Defibrillator (CRT-D)	A single implantable device that uses a combination of resynchronization and ICD therapies, diagnostics, and intrathoracic fluid status monitoring (OptiVol).
Pacemaker*	An implantable device that uses electrical impulses (connected to the heart) to regulate the beating of the heart.

ICD

Pacemaker

Source: Medtronic

As of February 2008, 234,088 patients in the US were enrolled in the CareLink® Network and the numbers continue to rise.



	Clinics	Patients
Canada	7	674
W. Europe	159	3,989
US	2,120	234,088

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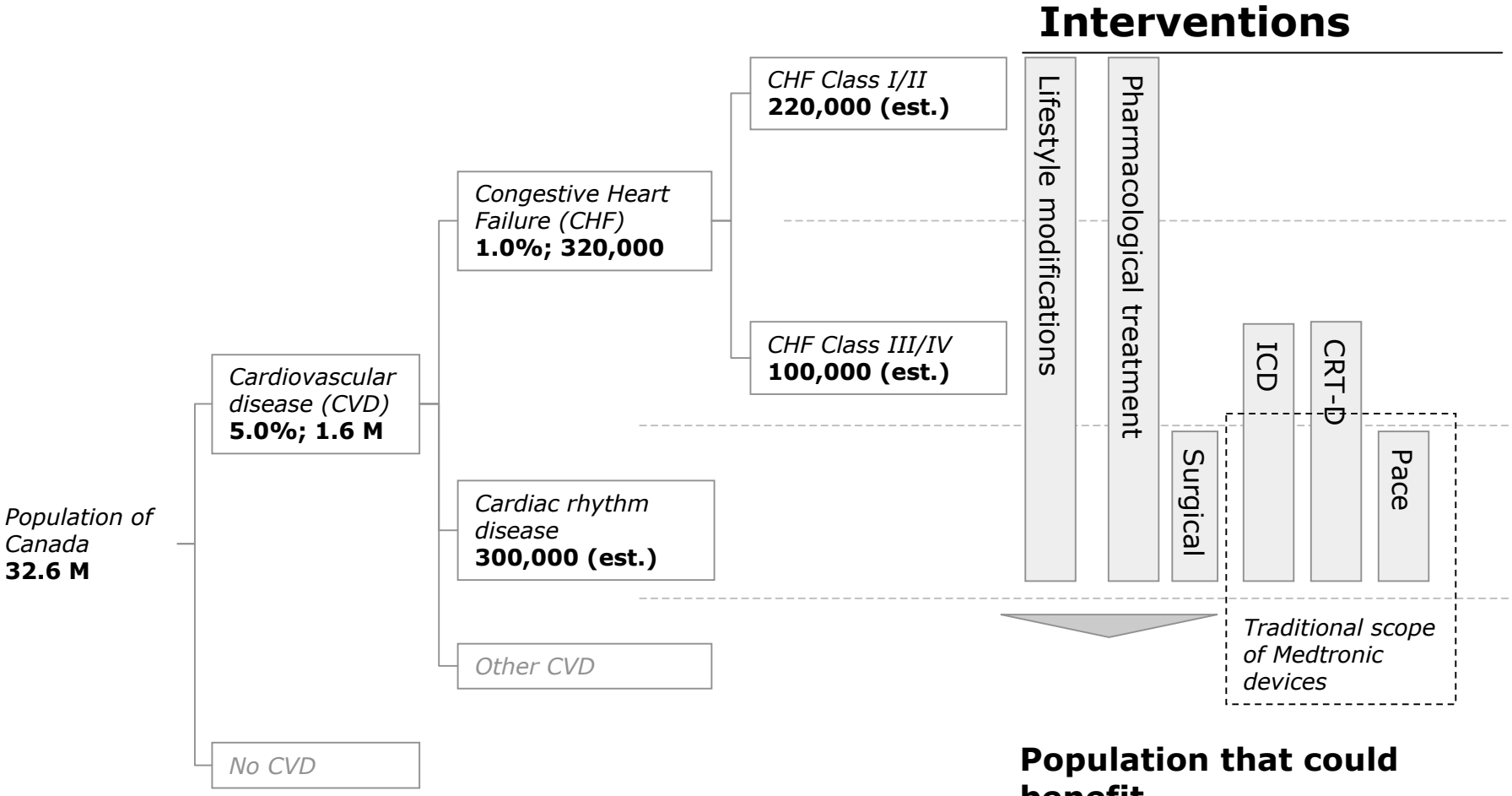
Source: Medtronic; Courtyard Analysis

Many Canadians with heart disease could benefit from implantable devices

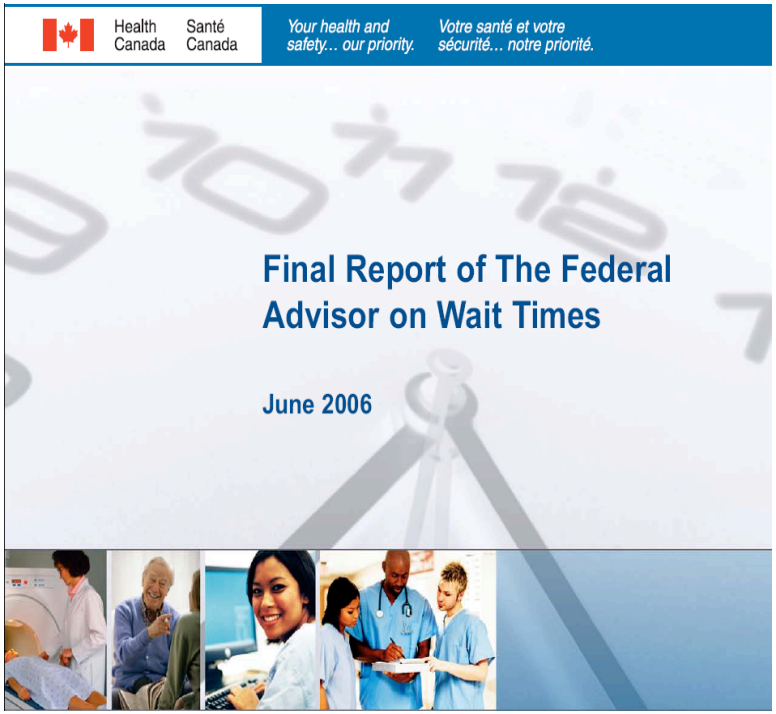


Population that could benefit

• ICD	100,000
• CRT-D	100,000
• Pacemaker	300,000

Source: Canadian Cardiovascular Outcomes Research Team 2006; BC CHF Collaborative 2002; Medtronic; Gillis 2005; Courtyard analysis

Brian Postl's "Final Report of the Federal Advisor on Wait Times" calls for the use of industrial engineering and further investigation into surge capacity



Source: Postl, B. (2006) "The Final Report of the Federal Advisor on Wait Times."

"Despite the fact that many industries and businesses use queuing theory and industrial practices routinely to streamline their processes, the application of this thinking to health care systems is relatively rare. We have not sufficiently exploited the academic resources available to us from business management schools or industrial engineering."

"I urge federal, provincial and territorial governments to consider the potential of arrangements planned to address issues of surge capacity."

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In a recent *Healthcare Policy* journal article Patrick and Puterman examine complex scheduling decisions in healthcare

"In most healthcare settings, patient scheduling is carried out by schedulers who must make complex trade-offs in the absence of intelligent software and precise decision rules to support their decisions. This activity becomes especially challenging and complex when

- patients are categorized into priority classes with different service time targets,
- there are multiple types of equipment with different capabilities on which a patient can be scheduled,
- patients must be booked for a course of treatment requiring several days or weeks or
- resources are spread across a wide geographic region."

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Source: Patrick, M. and Puterman, M. (2008) "Reducing Wait Times through Operations Research: Optimizing the Use of Surge Capacity" *Healthcare Policy* 3(3): 75-88.

Patrick and Puterman have developed an optimal scheduling policy to be used to guarantee wait times

1. Assign patients to any unused time slots in the next day in priority order.
2. Schedule any remaining high-priority demand to the earliest available time slots (before their maximum recommended wait time).
   - If there are no slots available, serve these patients through overtime.
3. Schedule all other priority classes (in priority class order) starting from the last available day that does not exceed the maximum recommended waiting time for that priority class.
   - If there is insufficient capacity, serve these patients through overtime.

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Source: Patrick, M. and Puterman, M. (2008) "Reducing Wait Times through Operations Research: Optimizing the Use of Surge Capacity" *Healthcare Policy* 3(3): 75-88.

Patrick and Puterman's concluding thoughts raise fundamental questions about our scheduling practices in healthcare

"Our research shows that it is never advisable to book patients beyond their wait time targets. Doing so does not avoid the need for overtime; instead, it just delays when it is needed."

"Our research shows that optimal scheduling policy remains optimal regardless of the number of priority classes, the specific wait time targets for each priority class and the length of the booking horizon. Also, it remains optimal for all reasonable overtime costs and as long as capacity is not significantly greater than average demand."

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Source: Patrick, M. and Puterman, M. (2008) "Reducing Wait Times through Operations Research: Optimizing the Use of Surge Capacity" *Healthcare Policy* 3(3): 75-88.

The airline industry solves its forecasting and scheduling challenges with dynamic scheduling

"Even with an *optimized* schedule, many flights upon departure have empty seats, while others suffer a lack of seats to accommodate passengers who desire to travel."

"We approach this challenge, recognizing that demand forecast quality for a particular date improves as the date approaches, by developing a dynamic scheduling approach that re-optimizes elements of the flight schedule during the passenger booking process."

"Our re-optimization approach, re-designing the flight schedule at regular intervals, utilizes information from both revealed booking data and improved forecasts available at later re-optimizations."

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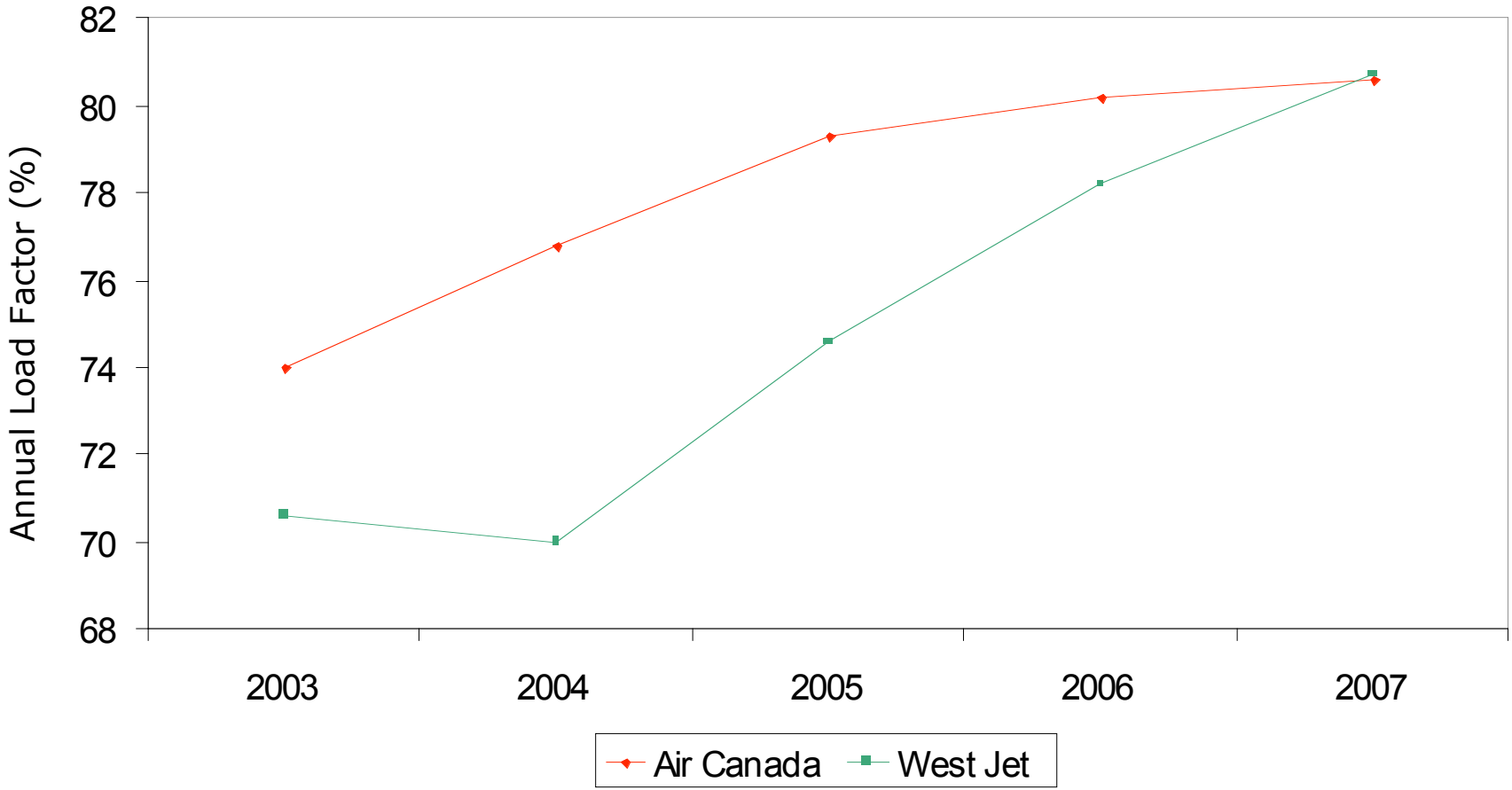
Source: Jiang, H. and Barnhart, C. (2006) "Dynamic Airline Scheduling" *Department of Civil and Environmental Engineering* Massachusetts Institute of Technology.

Air Canada and WestJet's load factors have increased steadily over the past five years.



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Source: Air Canada, *Management's Discussion and Analysis of Results of Operations and Financial Condition* 2005, 2006, 2007; WestJet, *Annual Report* 2007

Air Canada uses online booking, variable pricing and dynamic scheduling to optimize its load factors

1 Select departing flight

★ **New cabin interior** (Learn more)
Aircraft assigned may change without prior notice.

Day's lowest fare→	Mon 24-Mar $597	Tue 25-Mar $597	Wed 26-Mar $339	**Thu 27-Mar $339**	Fri 28-Mar $339	Sat 29-Mar $339	Sun 30-Mar $339	Mon 31-Mar $339	Tue 01-Apr $412	Wed 02-Apr $323	Thu 03-Apr N/A

From: **New York, La Guardia, NY (LGA)**
To: Toronto, Pearson Int'l, ON (YYZ)

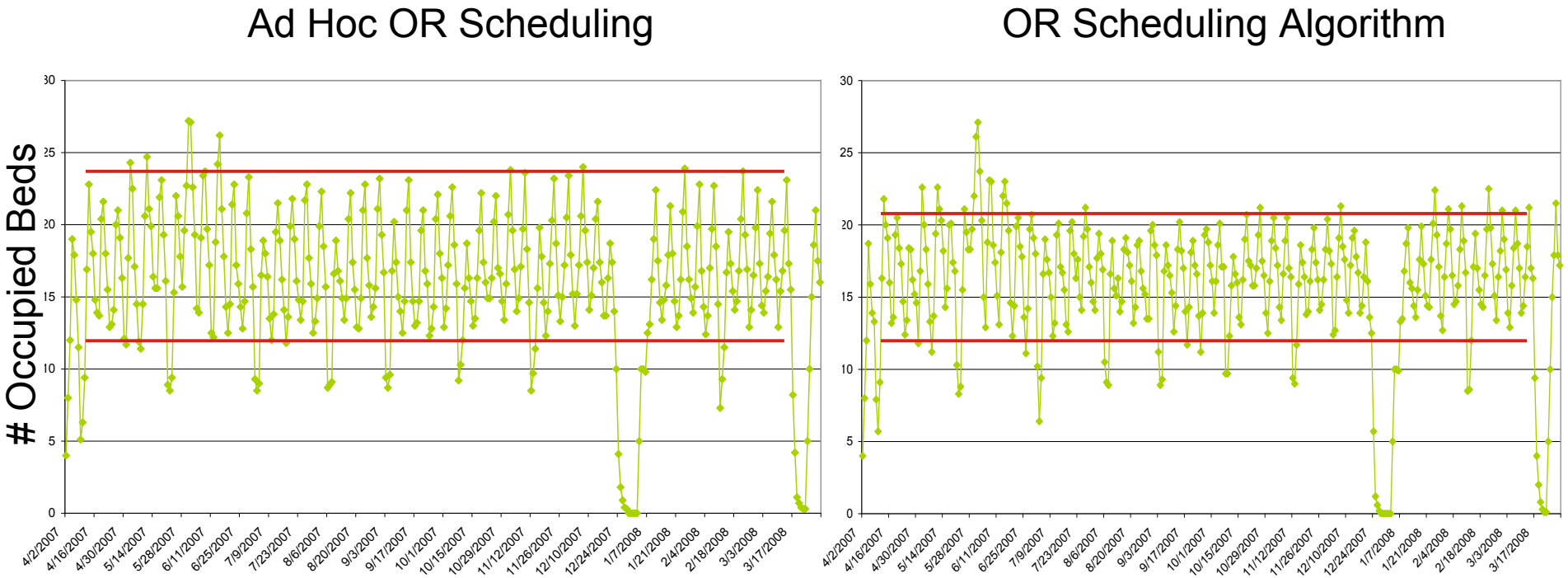
Compare our fare options

Op.	Flights	Depart	Arrive	Aircraft		Stops	Connections	Tango	Tango Plus	Latitude	Executive Class
Direct Flights											
	AC701	**06:30**	**08:08**	E90	★	0		-	$597	$679	$827
	AC705	**08:40**	**10:25**	E90	★	0		-	$597	$679	$827
	AC707	**10:30**	**12:14**	E90	★	0		-	$339	$539	$1062
	AC709	**11:30**	**13:09**	E75	★	0		-	$339	$539	$827
	AC711	**12:30**	**14:04**	E75	★	0		-	$339	$539	$827
	AC713	**13:30**	**15:08**	E75	★	0		-	$339	$539	$827
	AC715	**14:30**	**16:03**	E75	★	0		-	$597	$679	$827
	AC719	**16:30**	**18:12**	E75	★	0		-	$648	$679	$1062
	AC721	**17:30**	**19:19**	E90	★	0		-	$648	$679	$1062
	AC723	**18:30**	**20:10**	319		0		-	$648	$679	$1062
	AC725	**19:30**	**21:14**	320		0		-	$597	$679	$827
	AC727	**20:40**	**22:18**	320		0		-	$597	$679	$827

'-' indicates flight is sold out or not applicable

Source: Air Canada Consumer Website, www.aircanada.com

Quality data is essential for quality management



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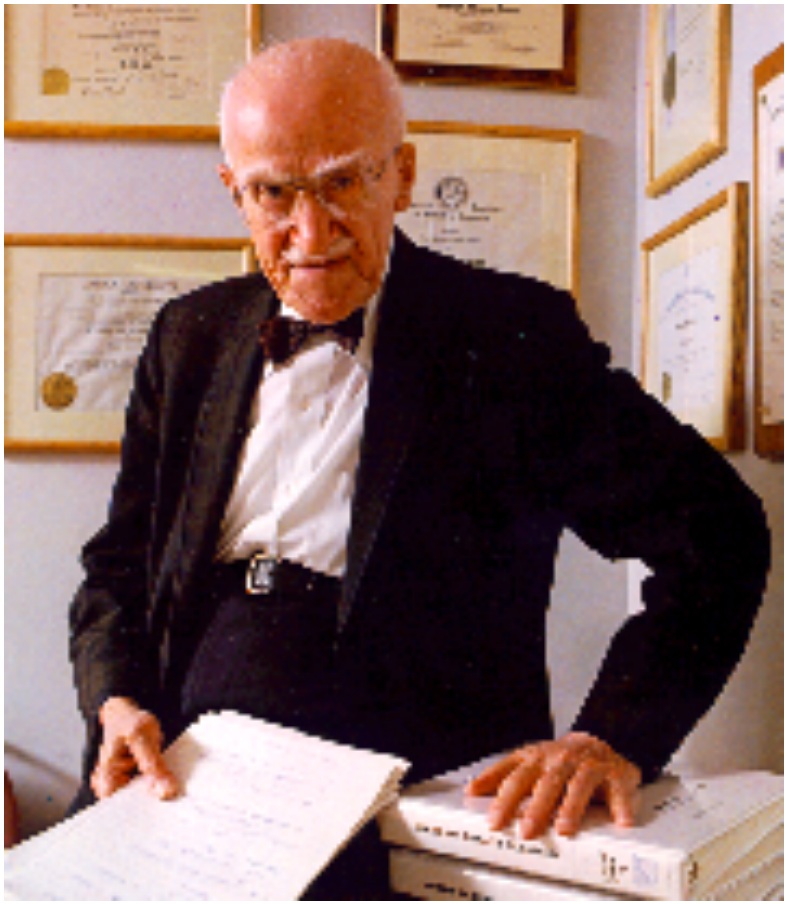
Joseph Juran, 103, Pioneer in Quality Control, Dies February 28th 2008



Joseph Juran

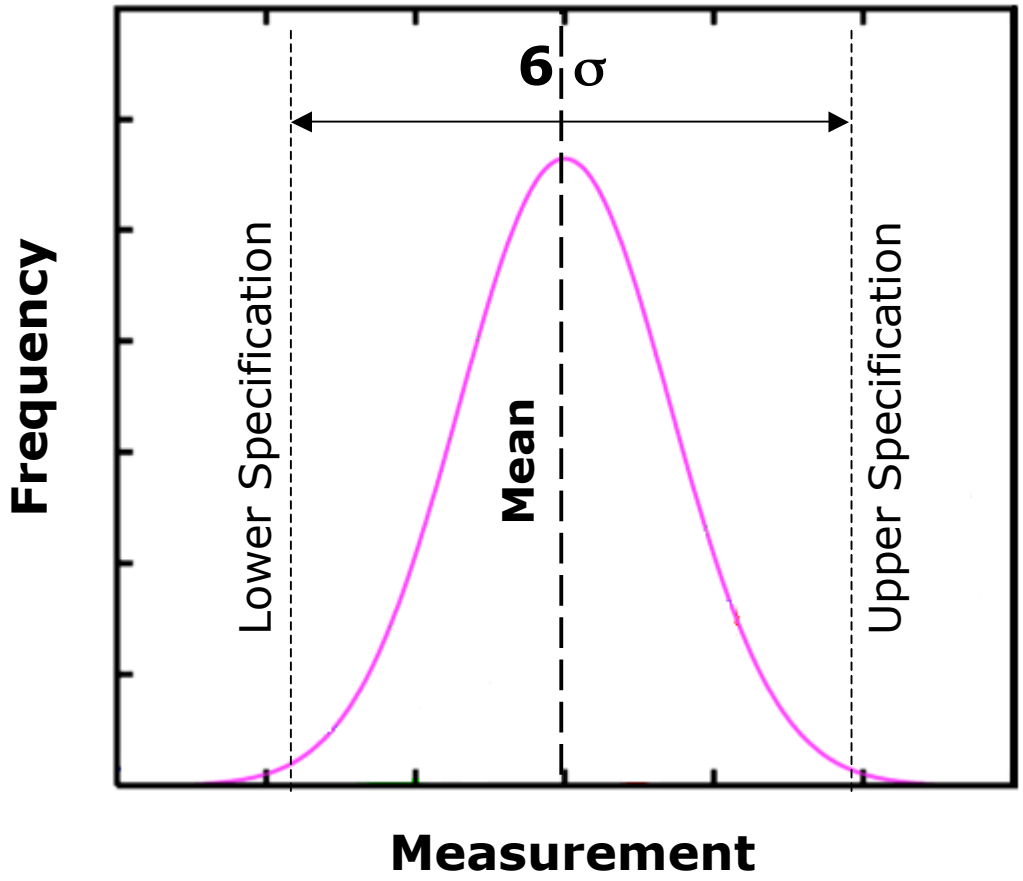
"Mr. Juran's work in quality management led to the development of the widely practiced business methodologies referred to as Six Sigma and lean manufacturing."

Source: *New York Times* March 3.

The Juran Institute estimates that "30 percent of all direct health care outlays today are the result of poor-quality care, consisting primarily of overuse, misuse, and waste."

Source: Midwest Business Group on Health. *Reducing the Costs of Poor-Quality Health Care* 2003.

6 σ is a level of quality where only 3 defects are found per million opportunities



Sigma (σ) refers to the standard deviation of a data set.

It describes **variation** (spread) from the **mean** (centre).

If a spread of 6 σ goes beyond the upper and lower specifications for achieving customer satisfaction, the goal is to reduce σ, or the variation.

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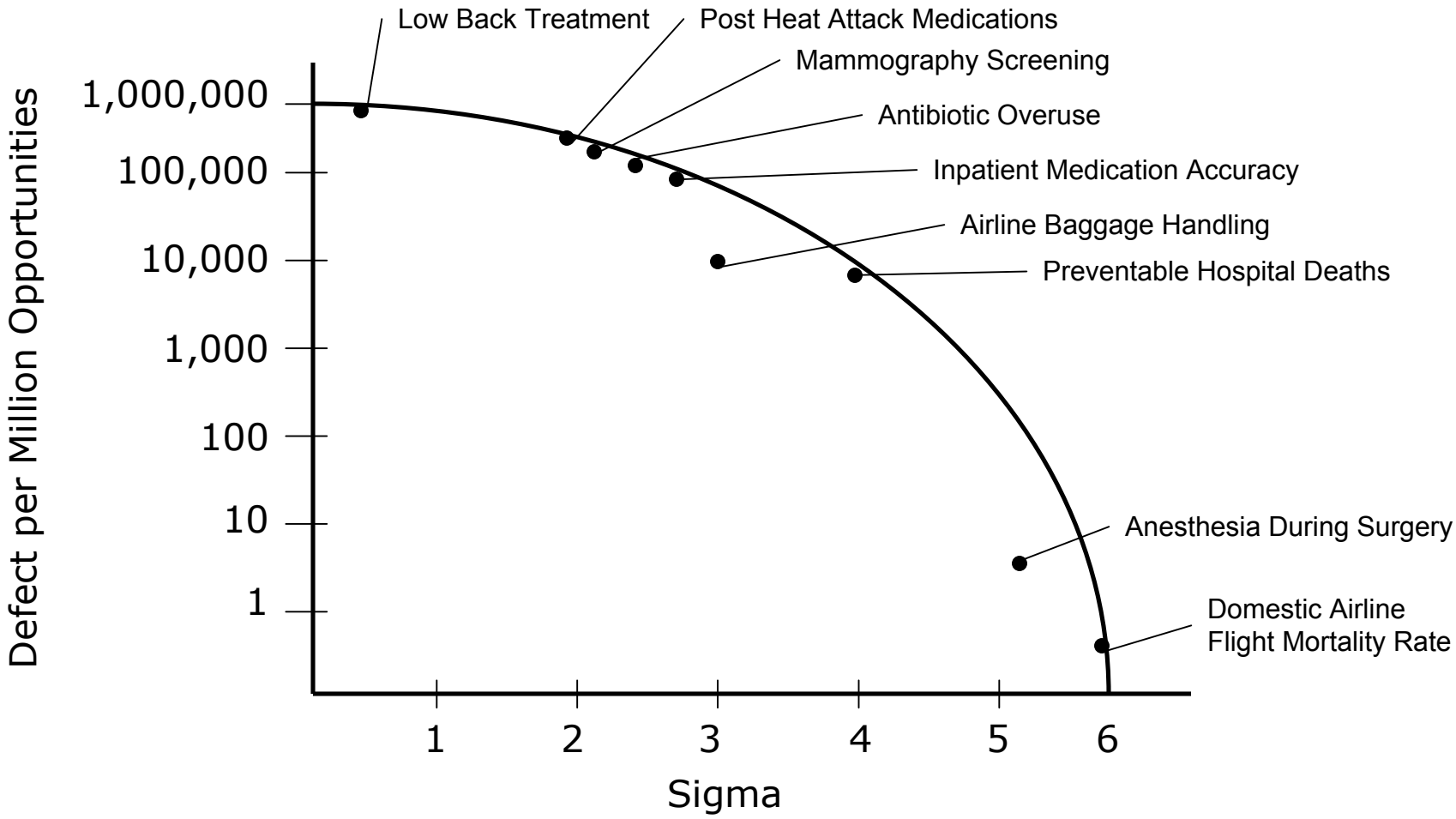
The healthcare industry does not meet the same quality standards as other industries



Source: Midwest Business Group on Health. "Reducing the Costs of Poor-Quality Health Care", 2003.

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What is a defect in the healthcare context?

The Rand Quality Assessment Tools

- Rand Corporation study, by Elizabeth A. McGlynn Ph.D. et al. New England Journal of Medicine 2003;348:2635-45
- Hundreds of quality indicators across 46 clinical areas
- The system can be added up across clinical areas – hence useful to purchasers and consumers in making a choice of providers
- Superior to current limited indicators as performance on publicly reported indicators tends to be superior to that in similar areas that are not reported

Information is a major barrier to quality improvement

- Elizabeth McGlynn editorial in Medical Care Vol 45, No.1, Jan 2007
- "We should be worried about the lack of an appropriate information infrastructure for delivering, evaluating, rewarding, or improving the delivery of healthcare services."
- "It is not possible within today's information environment to routinely monitor performance on clinically detailed measures of technical quality of patient-centered care at all levels in the health care system."
- "Until we solve the information infrastructure deficit, we can expect only limited progress on closing the quality gap.

Concluding remarks

- Rapid progress on the EHR is being made in some regions of Canada
- New developments will disrupt the EHR agenda before it is complete
  - New entrants (Microsoft Amalga)
  - New users (PHRs)
  - New players (Device manufacturers)
  - New needs (Dynamic scheduling)
  - New industry developments (Practical definition of quality)
- This is a battle for users
  - Content trumps functionality
  - Boarders don’t exist

People.
Passion.
Results.

Canada ▪ United Kingdom ▪ United States