Effectiveness of Barcode Tracking

In Documenting Errors
&
Preventing Patient Specimen Identification Incidents
in
Anatomical Pathology Laboratory

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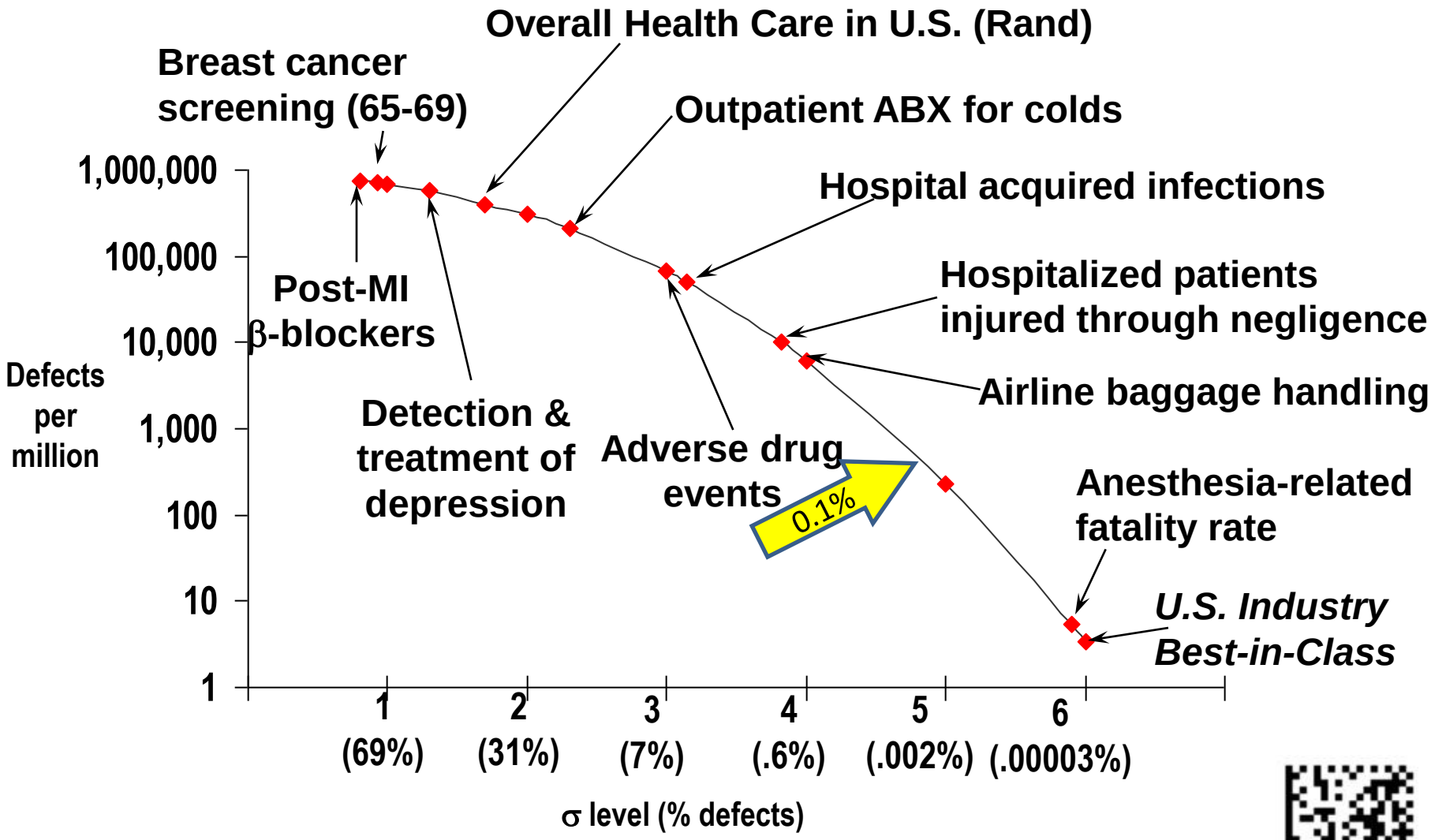
"Identification error is the single most important cause of patient safety incidents in pathology. "

Lord Carter's review of NHS Pathology Services
submission of the Royal College of Pathologists, 2006

Laboratory Processing Quality is Among the Best



Source: modified from C. Buck, GE

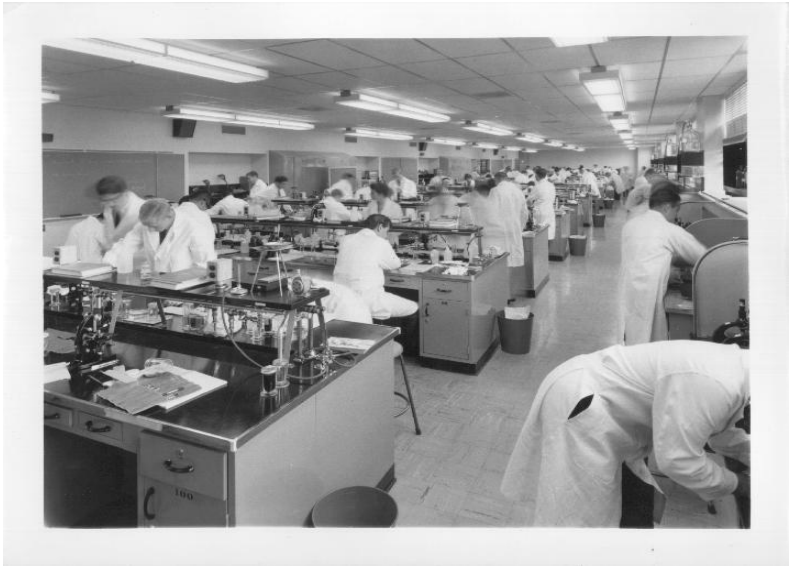
Laboratory Errors – When and Where

- One study of 129 incidents*
  - 71% pre-analytical, 18% analytical, 11% post-analytical
  - 30% involved cognitive error (incorrect choices caused by insufficient knowledge)
  - 73% involved non-cognitive error (lapses in expected automatic behavior)
- 95% potential adverse events
- 73% preventable – including patient specimen identification errors

**** Classifying laboratory incident reports to identify problems that jeopardize patient safety.***
Astion ML, Shojania KG, Hamill TR, Kim S, Ng VL. Am J Clin Pathol. 2003;120:18-26.

Anatomical Pathology Lab Processing

Histology laboratory workflow has not changed in decades



Yet

- Increasing volume
- Expanding scope and complexity
- Processing remain largely manual

Anatomical pathology laboratory results often have a **high impact** in patient management

A21 港聞三 on.cc 東方日報 2008年3月1日 星期六

東華離譜 病人捱電療恐不舉

調亂報告 前列腺病當癌醫

東華醫院「醫錯人」時序表

化驗樣本沒標籤 致割錯病人乳房

【明報專訊】北區醫院公布割錯女病人乳房的醫療事故報告，調查指外科病房2名醫生和3名護士涉及此宗事故。一組醫護在7月17日，先爲一名乳癌女病人抽取乳房活組織化驗，並將5個樣本分別盛載在兩個樣本樽內，但其中一個樣本樽卻沒有標籤。事隔14日，醫護再爲另一36歲女病人抽取乳房活組織化驗，並將她的的樣本盛載在早已存放了首名女病人的樣本樽內，結果導致36歲女病人被誤診患上惡性腫瘤，並接受左邊乳房割除手術。報告指錯誤在於醫護沒有即時將樣本標籤。

錯用已盛載癌病人活組織樣本樽

報告指醫院經多次的DNA測試後，調查小組確認癌組織是屬於同一病房內一名患癌的女病人，她較36歲女事主早14日抽取乳房活組織檢查，該女病人已接受適當治療。

報告指錯誤在於醫護用了兩個樣本樽，盛載該名患乳癌病人的樣本，但沒有即時將樣本標籤，其中一個樣本樽更被誤爲未被使用；並於14日用來盛載另一病人的樣本。小組認爲事件在外科病房發生，醫生和護士均涉及抽取組織的程序。有乳腺專家指凡從病人身上抽取樣本化驗，便應「即時將樣本標籤」，今次錯誤「難以置信」。

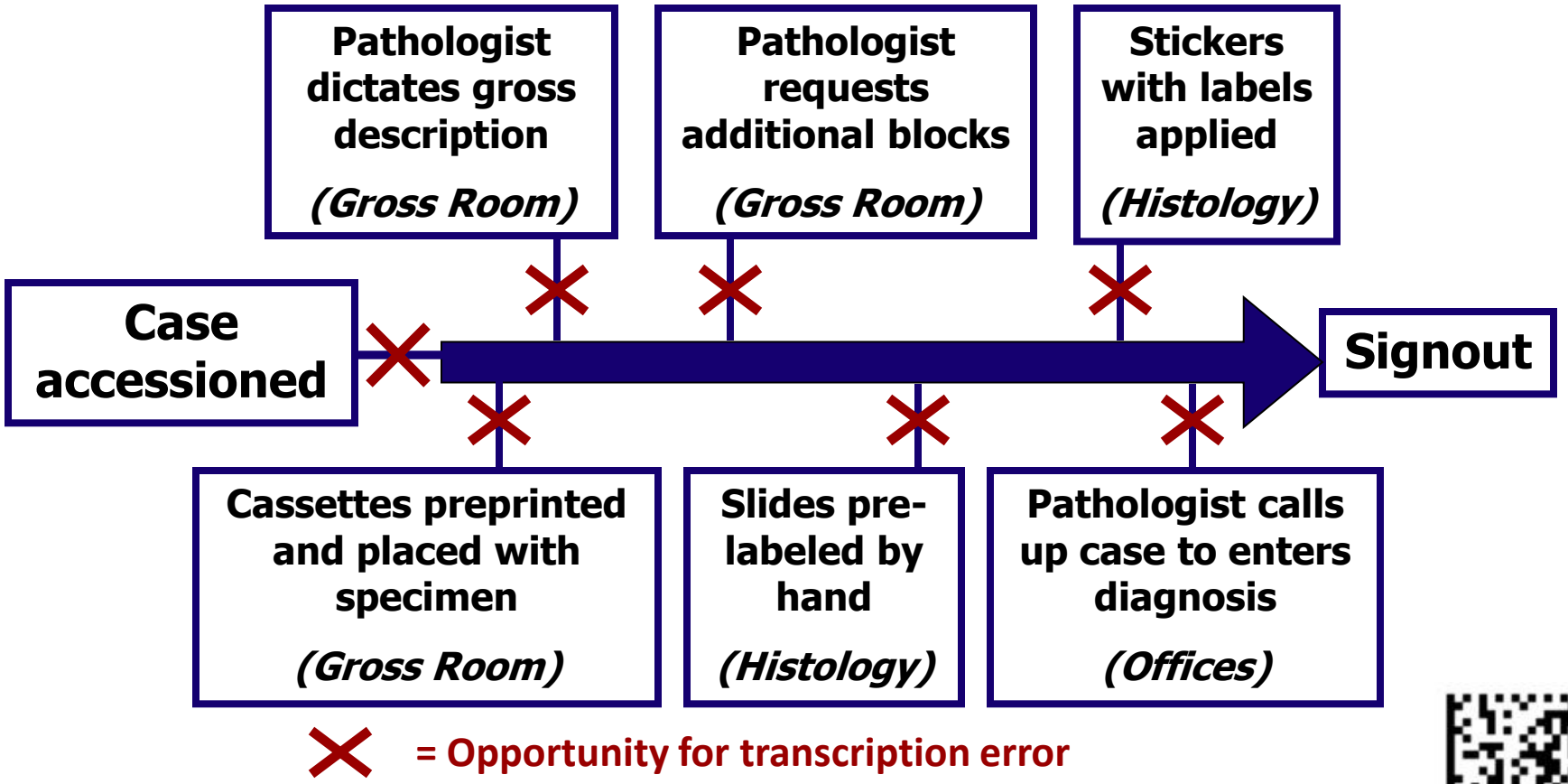
新界東醫院聯網總監馮康表示，將督促人力資源成立委員會，研究事故責任和處分等問題。他說出錯源於抽組織的程序分別由3名護士接手，但又交接不清，日後只會由一名護士負責整個抽組織程序。

院方已接納報告和建議，並檢討有關程序，以及執行及加強一系列的改善措施（見表），亦會加強風險管理及改善服務。該名受影響病人的康復進度理想，院方已向病人家屬表達歉意，並交代和解釋報告之內容和建議，以及醫院日後跟進工作。

調查小組對割錯乳房事故提出建議

- 抽取活組織須指定1人負責標籤樣本
- 完成程序後必須即時標籤樣本
- 將曾被開啓但沒有使用的樣本盛載樽棄置
- 考慮選用有密封標記的樣本盛載樽
- 每次只安排一名護士協助程序

Full of Mislabeling Opportunities



Tissue and Cytology Specimens Processing Is Prone to Errors

- Large study of 136 institutions, 427,255 cases*
- Errors occur in the procurement, accessioning, and processing of surgical pathology specimens
- Overall mislabeled rates of 1.1 per 1,000 cases:
  - 1.0 per 1,000 specimens
  - 1.7 per 1,000 blocks
  - 1.1 per 1,000 slides
- Wide range of reported error rates

**Mislabeling Rate of Specimens, Blocks, and Slides in Surgical Pathology*
College of American Pathologists QP094, 2009

Difficulties in Estimation of Identification Errors

- Lack of effective and timely information collection mechanism
- Variation in reporting practices
- Differences in defining errors
- Stigma of disclosing errors

Objectives

- To develop a tracking system capable of process-specific error capturing and documentation in every step of manual steps of specimen transfer
- To implement an automatic mismatch error reporting mechanism in order to assess the effectiveness of the system in preventing potential specimen identification incidents, and for implementing targeted quality improvement measures

Achievable Error Rates

Error rates	Error Prevention Methods	Real world Examples
1/100	Clear process Reliance on education/vigil	Errors filling out on nts
		ntification
1/ 1/1	gn + mation Error ID/ mitigation	Specimen loss Computer interface errors

To go from 1/1,000 → 1/10,000 requires automation

Resar RK. Making noncatastrophic health care processes more reliable... Health Serv Res. 2006; 41:1677-1689.

Towards Error-free Specimen Identification through Automation

Laboratory Testing	Front-end Automation	Workflow Automation	Instrument Automation
Chemistry	Yes	Yes	Yes
Hematology	Yes	Yes	Yes
Blood Bank	No	No	Available
Microbiology	N o	Evolving	Limited
Anatomical Pathology	**No**	**No**	**No**

Using 2D Barcodes in Laboratory

Why use 2D barcodes?

✓Low cost methods for printing & reading

✓May provide unique, permanent identification

✓Small footprint – required for printing onto slides and blocks

Characteristic	Manual Matching	Bar Code
Speed (12 Digits)	6 Sec	0.3 to 2 Sec
Error Rate	1 in 300	1 in 10.5 million to 1 in 612.9 million
Advantages	Human readable	Low Error Rate Low Cost High Speed
Disadvantages	Human High Cost High Error Rate Inflexible	Requires Training and Workflow Re-design

Block Proof

Section Pickup

Slide Release

Slide Inventory

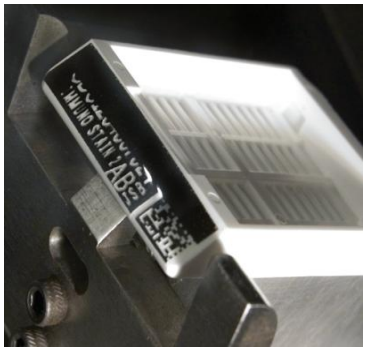
Conventional (Imprinting) Approach

Changing workflow to fit into the system

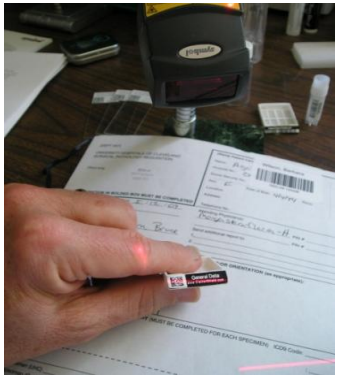
Gross Specimen is Accessioned

Gross Specimen and Paperwork are Bar Coded

Gross Specimen Bar Code is Scanned to Imprint Cassettes



Bar Coded Cassettes are Printed Using Data Directly from LIS



Bar Coded Cassettes are Scanned at the Cutting Station

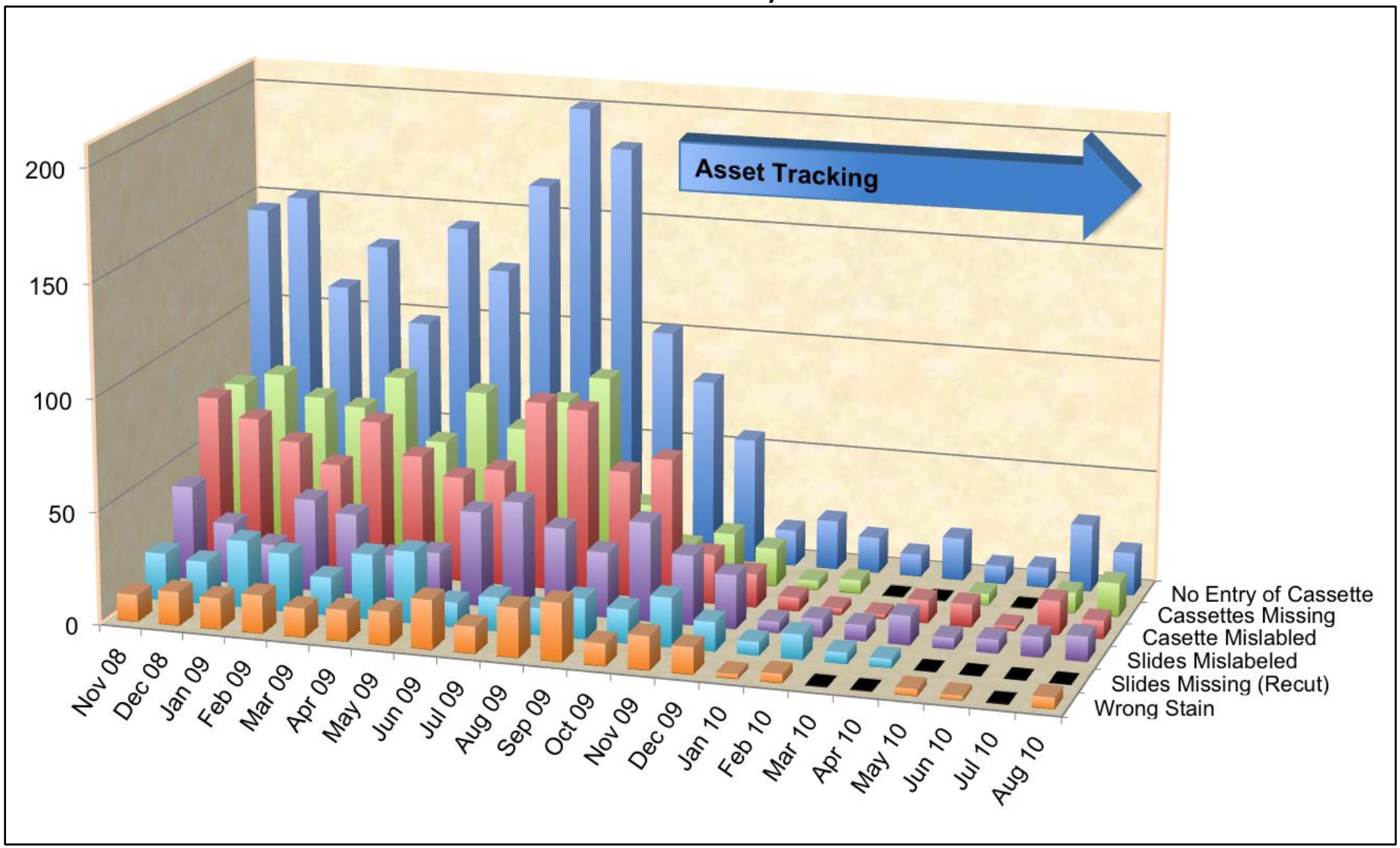
Bar Coded StainerShield Labels are Printed On-Demand at Cutting Station With Data Directly from LIS

Bar Coded Slides are Scanned By Pathologist and Transcriber for Entry of Results

Without the ability to batch processing the simple linear approach requires barcode printing at the spot of transfer, and thus costly and inefficient, and therefore is not widely used.

Experience Elsewhere

Yale University 2010

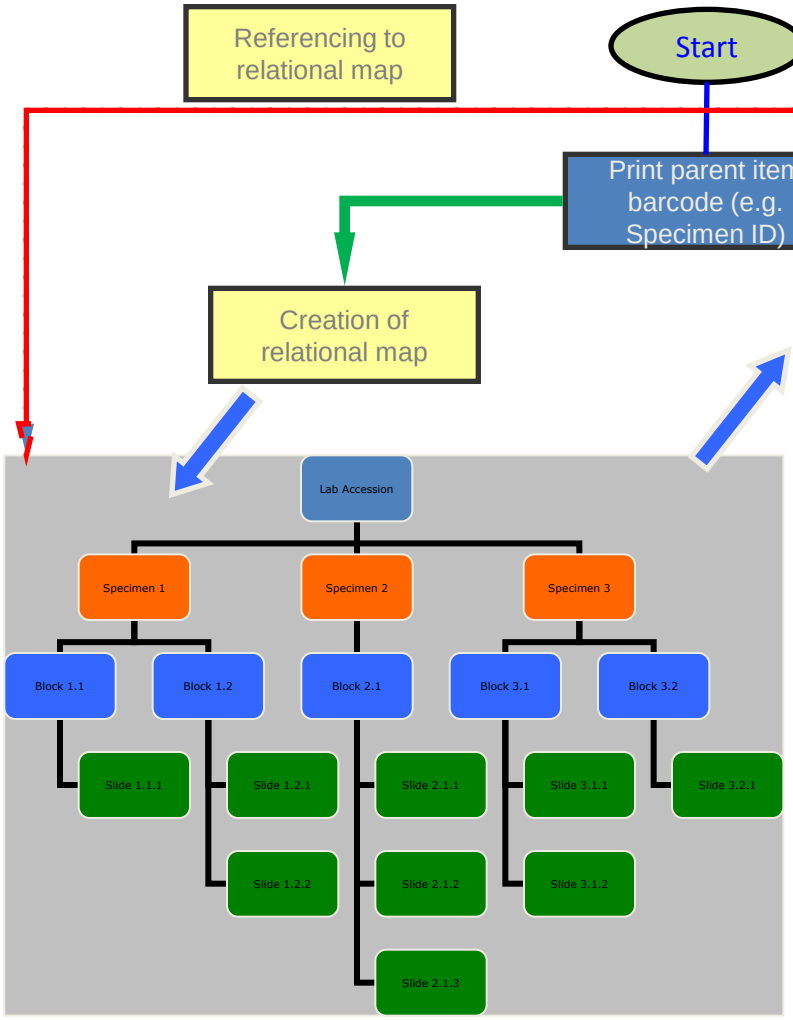


Limitations of Conventional Systems

- Commercially available systems are all conventional designs and mostly are simple with limited capability
- More comprehensive systems are expensive and requiring substantial change in workflow
  - Slide pre-print not possible or not practicable – affecting efficiency
  - May require more manpower as batch processing not possible
- Most cannot make use of existing barcode-printable slide and cassette printers
- Options for expansion of scope to support other automation needs are limited

An Novel (Relational Coupling) Design

The new design for better efficiency and cost-effectiveness



Conventional Approach
vs
Novel Design

Imprinting

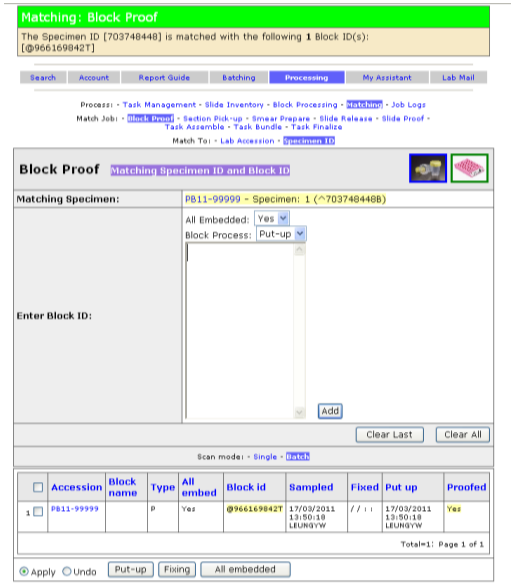
Relational-coupling

Comparison of Conventional (Imprinting) and Novel (Relational Coupling) Approaches

	Imprinting	Relational-coupling	Advantages
Specimen Transfer Sequence	Scan – Print – Transfer	Print – Scan – Transfer	Juxtapose scanning and transfer for greater security
Batch & Parallel Processing	No	Yes	Reduce cost and improve efficiency
Slide Pre-printing	No	Yes	More adaptable to different workflow
Easy Extension to Other Applications	No	Yes	Readily extensible to item tracking, slide and block inventory, specimen disposal etc.

System Development & Implementation

- A web-based Relational Coupling system implemented in PMH since 1st May 2010
- Successfully implemented in the Anatomical Pathology laboratories of 5 hospitals: PMH, YCH, PYNEH, TMH and POH



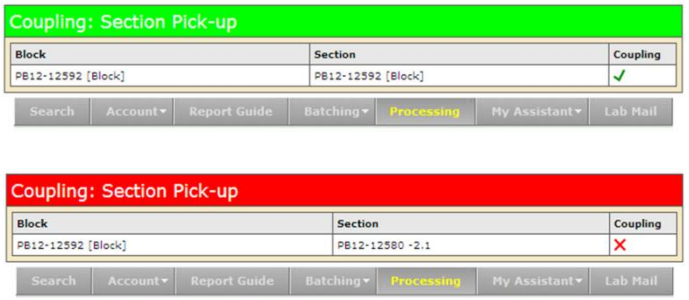
Barcode Tracking & Error Prevention

1

Preparation

2

Scanning

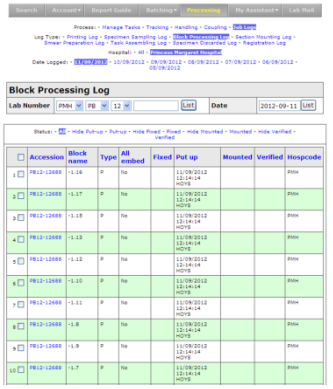


3

Coupling

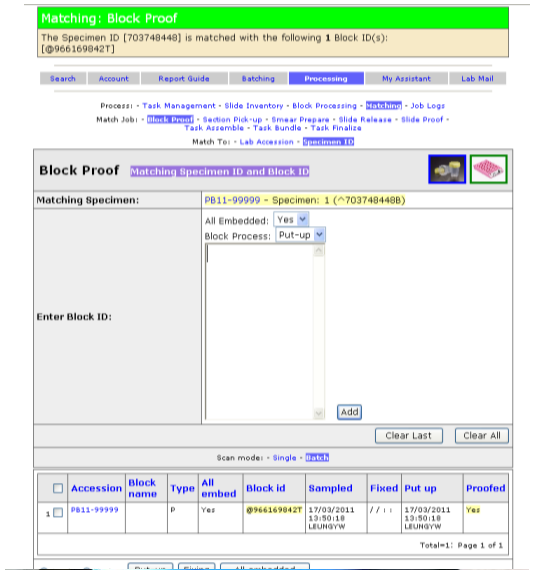
4

Logging



Results (1)

- Over 500,000 specimens, tissue cassettes, and slides with unique 2D barcodes printed
- At PMH, in 12-month period from Feb 2012 to Jan 2013, a total of 35,934 laboratory requests were processed
- Efficient and readily adapted to different workflow



Results (2)

No identification incident had been encountered

All mismatch errors were correctly signaled to the operating technician for immediate correction

Feb 2012 – March 2013 (PMH)

Results (3)

Potential errors **Prevented** by the tracking system

Coupling	Mismatches	Item Processed	Percentage
Specimen Sampling	117	46,386	0.38
Section Pickup	442	66,605	0.66
Slide Release	310	134,305	0.38
Task Finalizing	265	25,973	1.02

Feb 2012 – March 2013 (PMH)

Conclusion

- A novel design barcode tracking system has been successfully developed and implemented to fit into the complex workflow of Anatomical Pathology laboratory
- The system, with automatic error capturing, is highly effective in ensuring correct patient specimen identification.
- The automatic process-specific error reporting, with information hitherto unavailable by manual means, would be very useful for implementing further targeted measures for continuous quality improvement.