



Healthcare process management in Python: a use case

EUROPYTHON 2011
FLORENCE, JUNE 20-26



CRS4@Polaris Park, Sardinia

Agenda

- what field do we work in?
- what's the project?
- why (and how) Python?
- did it work?
- whither?

what field do we work in?

Healthcare Flows

distributed medicine

semantic and
computational
management of biomedical
and heterogeneous data

*clinical systems
integration and traceability
in health processes*

To Err is Human
Building a Safer Health System
(Institute of Medicine, 2000)

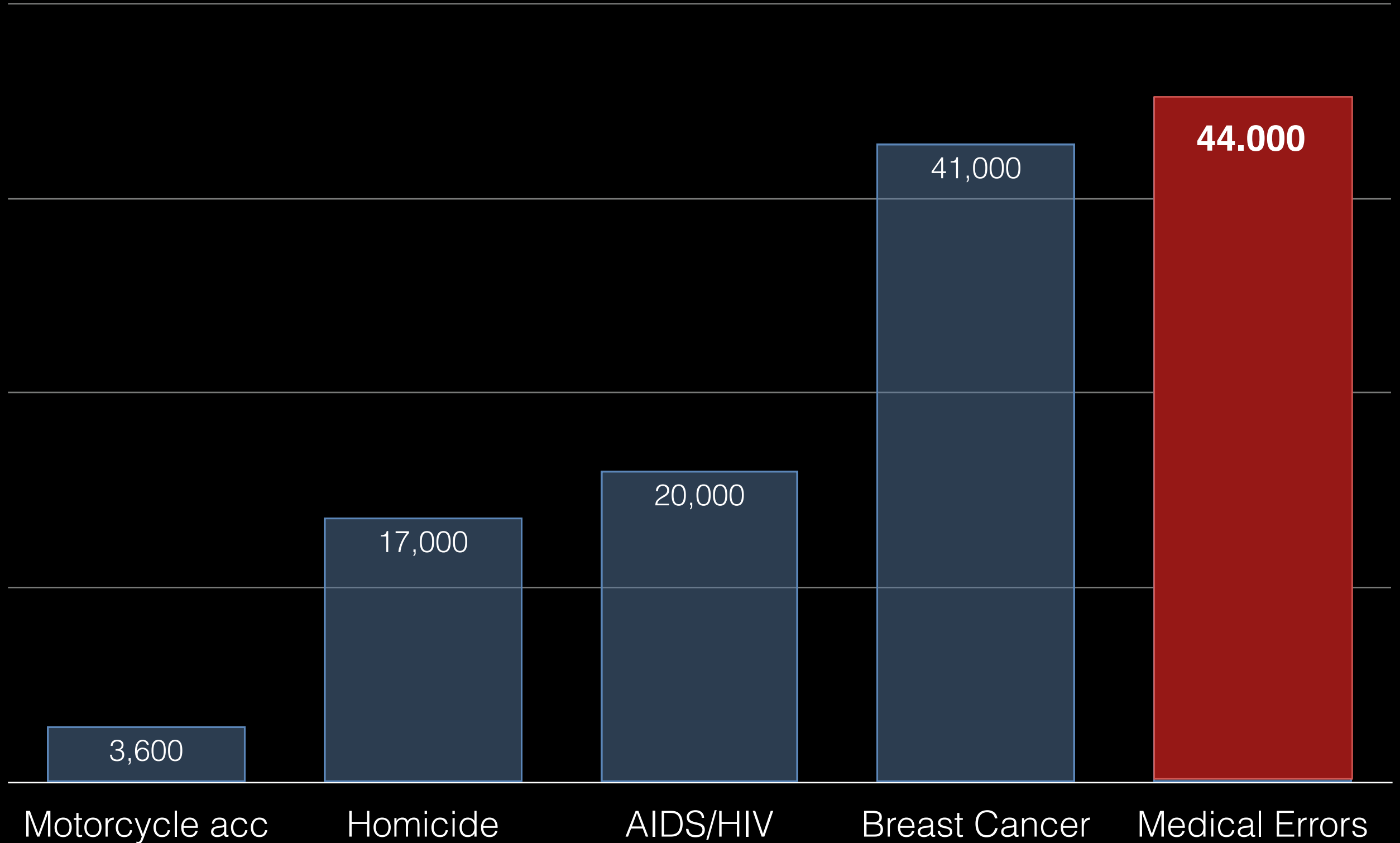
44 to 98

thousands

people die each year in US as a
result of preventable medical errors

Institute Of Medicine, *To Err Is Human: Building a Safer Health System*, 2000

Death causes in the U.S.



Institute Of Medicine, *To Err Is Human: Building a Safer Health System*, 2000

Kenneth D. Kochanek, M.A.; Jiaquan Xu, M.D.; Sherry L. Murphy, B.S.; Arialdi M. Miniño, MPH, and Hsiang-Ching Kung, Ph.D., *Deaths: Preliminary Data for 2009*, Division of Vital Statistics, 2011

hospitals with automated
clinical information systems had

15% less mortality

16% less post-operative
complications

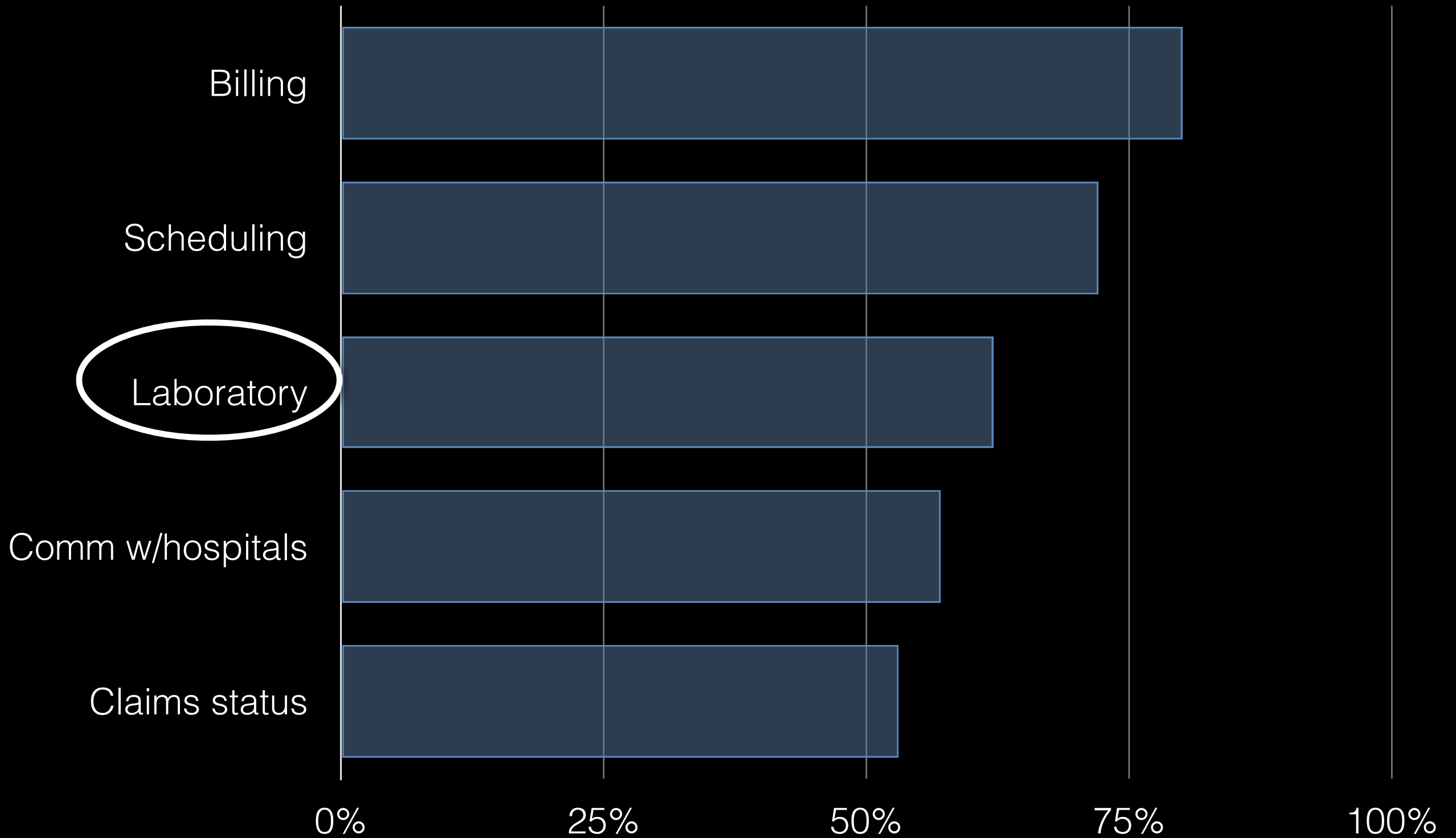
R. Amarsingham, M.D et al. *Clinical Information Technologies and Inpatient Outcomes - A multiple hospital study*; Archives

healthcare ICT yearly budget
in Italy is about

1 billion €

Osservatorio ICT in Sanità, *ICT in Sanità: l'innovazione in cerca d'autore*, 2011

What do physicians use computers for?



Modern Physician / PricewaterhouseCoopers survey of executive opinions on key information systems issues; Modern

3 ITA 22:57
 Homepage of the EFMI WG Assessment of Health Information Systems
 iig.umat.at/efmi/badinformatics.htm Google

Bad Health Informatics Can Kill

ICT can have positive impact on health care, but there are also examples on negative impact of ICT on efficiency and even outcome quality of patient care. Medical informaticians should feel responsible for the effects of ICT on patients and public. Systematic analysis of ICT errors and failures is the precondition to be able to learn from negative examples and to design better health information systems.

This document contains summaries of a number of reported incidents in healthcare where ICT was the cause or a significant factor. For each incident or problem at least one link to a source will be provided. With the following list, we want to rise awareness on this important issue, and provide information for further reading.

This summary was inspired by a citation of Prof. Chris Taylor found in the report "[Pathways to Professionalism in Health Informatics](#)" of the [UK Council for Health Informatics Professions](#): "Bad Health Informatics can kill". We would like to acknowledge the contribution of Dr. G.M. Hayes (President, UK Council for Health Informatics Professions; Chairman, Health Informatics Committee of the British Computer Society; President, Primary Health Care Group of the BCS) in collecting those examples.

Further reading and links: See bottom of page!

Year	Name	Description	References
April 2011	Review of Reported Clinical Information System Adverse Events in US Food and Drug Administration Databases found 120	Background: The US FDA has been collecting information on medical devices involved in significant adverse events since 1984. These reports have been used by researchers to advise clinicians on potential risks and complications of using these devices. Objective: Research adverse events related to the use of Clinical Information Systems (CIS) as re-reported in FDA databases. Methods: Three large, national, adverse event medical device databases were examined for reports pertaining to CIS. Results: One hundred and twenty unique reports (from over 1.4 million reports) were found, representing 32 manufacturers. The manifestations of these adverse events included: missing or incorrect data, data displayed for the wrong patient, chaos during system downtime and system unavailable for use. Analysis of these reports illustrated events associated with system design, implementation, use, and support. Conclusion: The identified causes can be used by manufacturers to improve their products and by clinical facilities and providers to adjust their workflow and	Myers DB, Jones SL, Sittig DF. Review of reported clinical information system adverse events in U.S. food and drug administration databases . Appl Clin Inf 2011; 2: 63-74. doi: 10.4338/ACI-2010-11-RA-0064

Bad Health Informatics can kill

HL7

- global authority
- interoperability
- HL7 v2 / v3
- documents, and more

IHE

Abbott

AGFA

CRS4

Stanford

IBM

Harvard

Inpeco TIH

US Social Security adm

Carl Zeiss

Siemens

...and 438 more

what's the project?

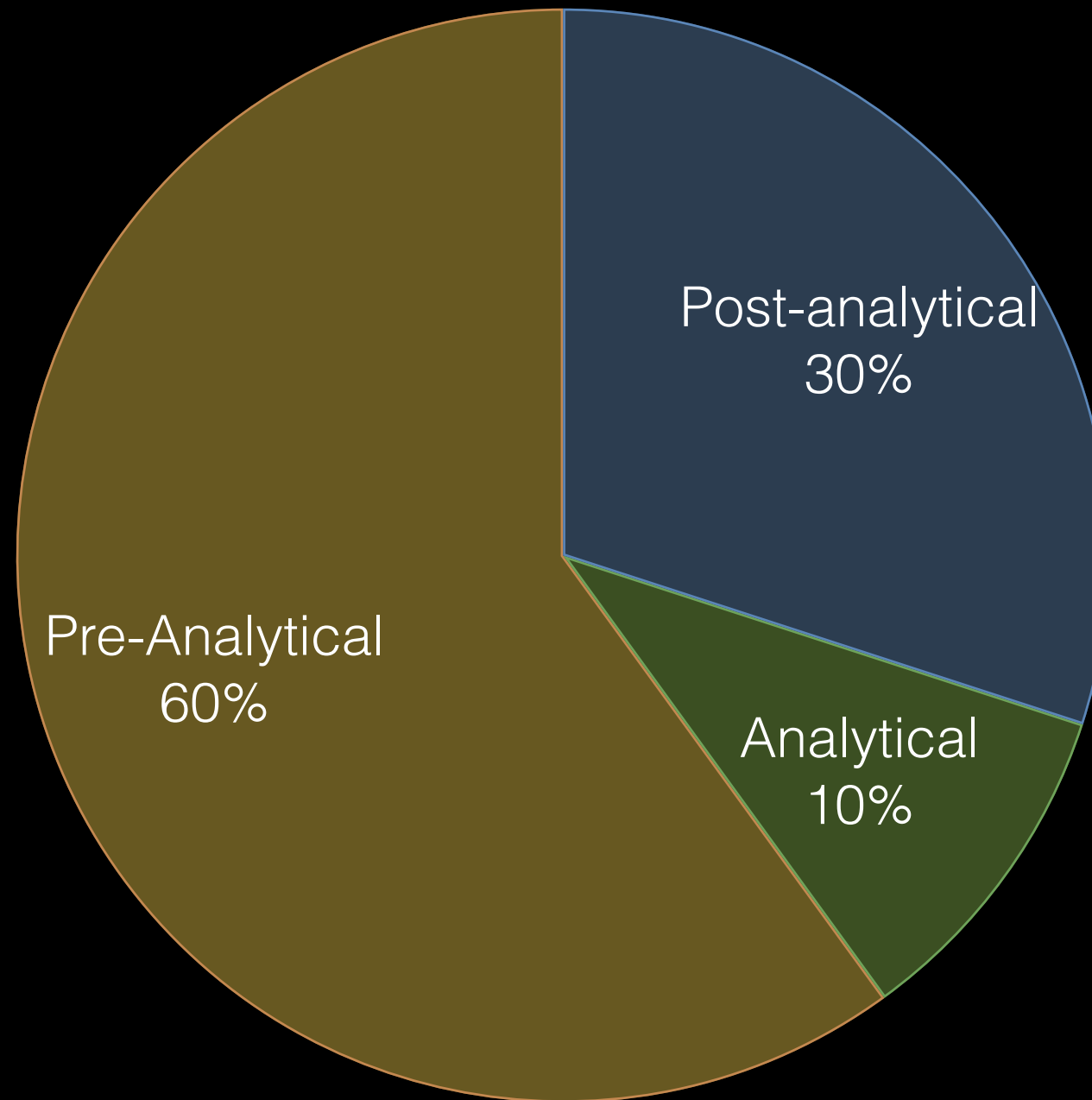
laboratory services leverage

60% - 70%

of critical decision making

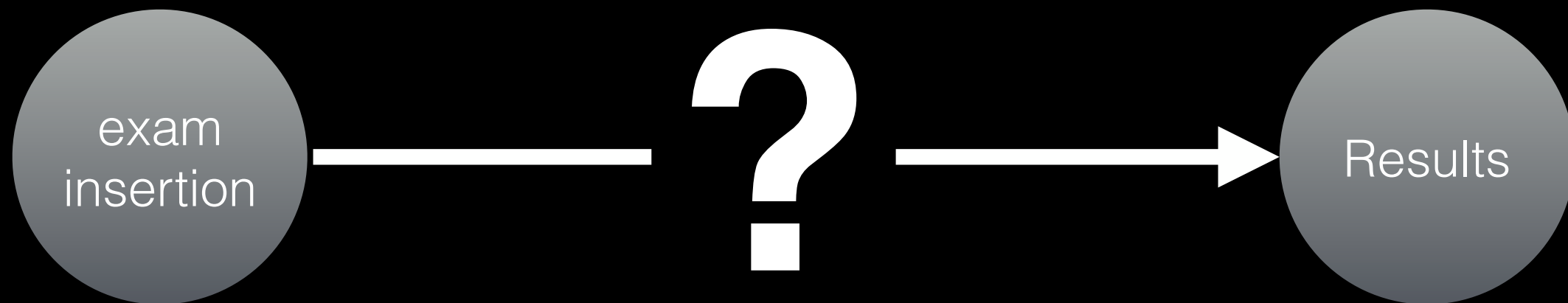
ToybertME, Chevret S, Cassinat B, Schlageter, Forsman; *Why is the laboratory an afterthought for managed care*

Errors in laboratory medicine

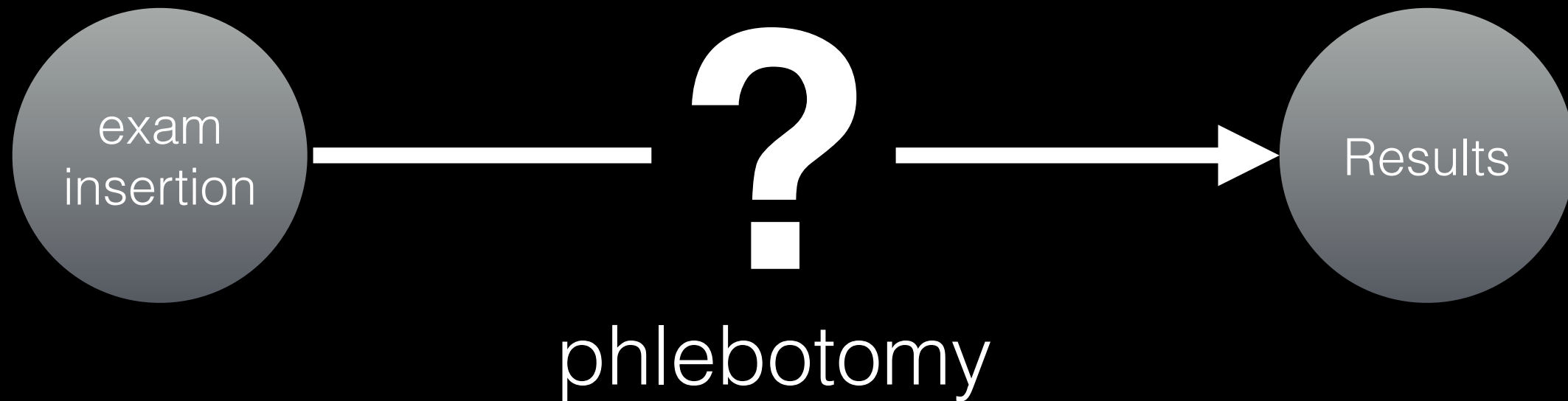


J. Kalra, *Medical errors: impact on clinical laboratories and other critical areas*; Clinical Biochemistry 37 (2004) 1052-1062

Laboratory test



Laboratory test



What can go wrong

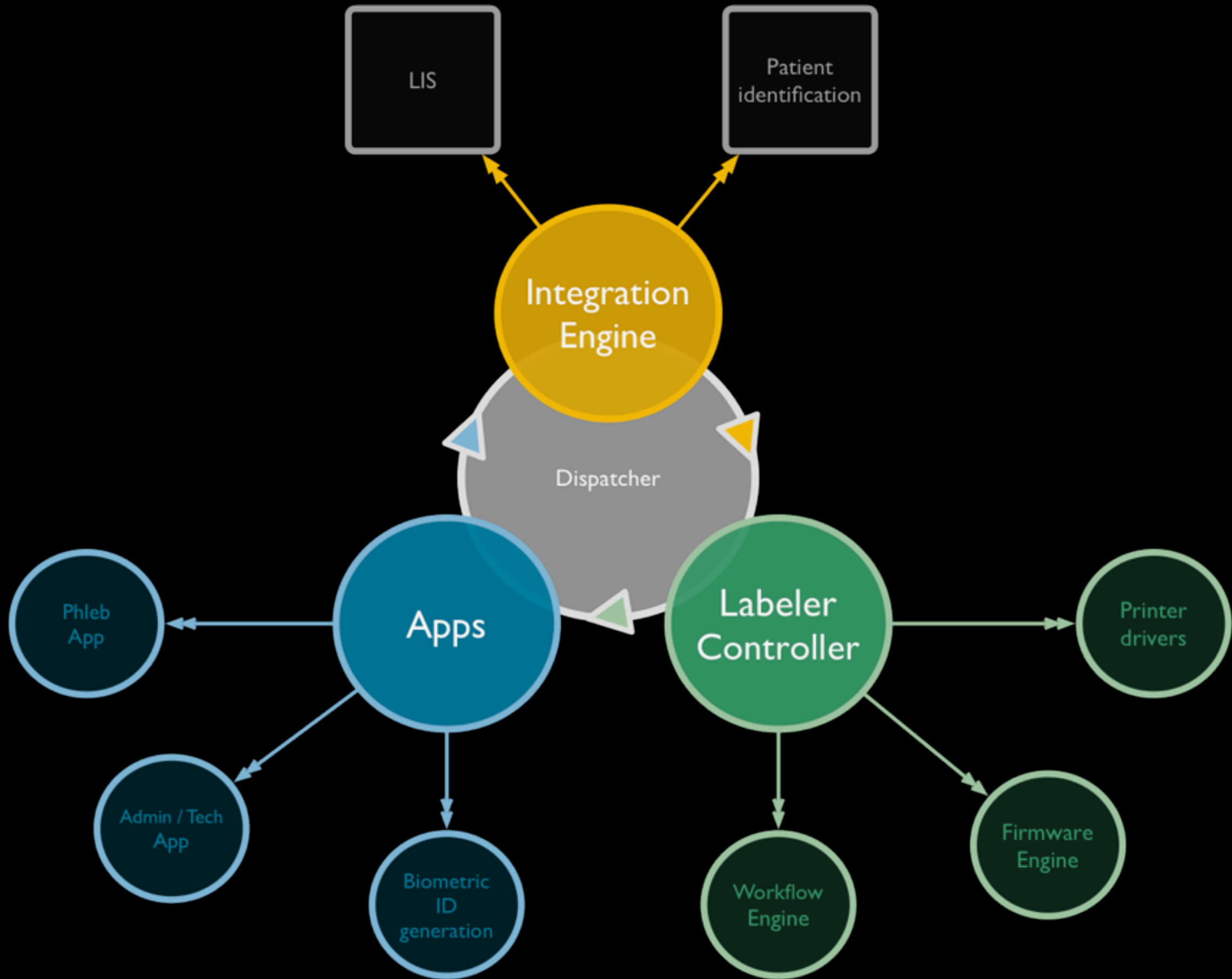
- typing errors
- patient misidentification (and swapping)
- wrong test order entry
- wrong tube type / number
- problems in associating samples with patients
- ...



tubes and labels

Our scenarios

- new patient and exam insertion
- query mode in phlebotomy room
- query mode in ward room
- request mode at GP's office



why (and how) Python?

why?

1. readability

not everyone involved is a developer;
code audits should be easy to do

2. agility

lots of ever-changing standards, laws and requirements

3. portability

must support different operating systems and environments

4. completeness

lots of different ICT needs in a project of this scope

5. ease of deployment

as self-consistent as possible;
as few external packages as possible

Our requirements

- 1. readability
- 2. agility
- 3. portability
- 4. completeness
- 5. ease of deployment

Python's best features

- 1. readability
- 2. agility
- 3. portability
- 4. completeness
- 5. ease of deployment

how?

"it's not Java"

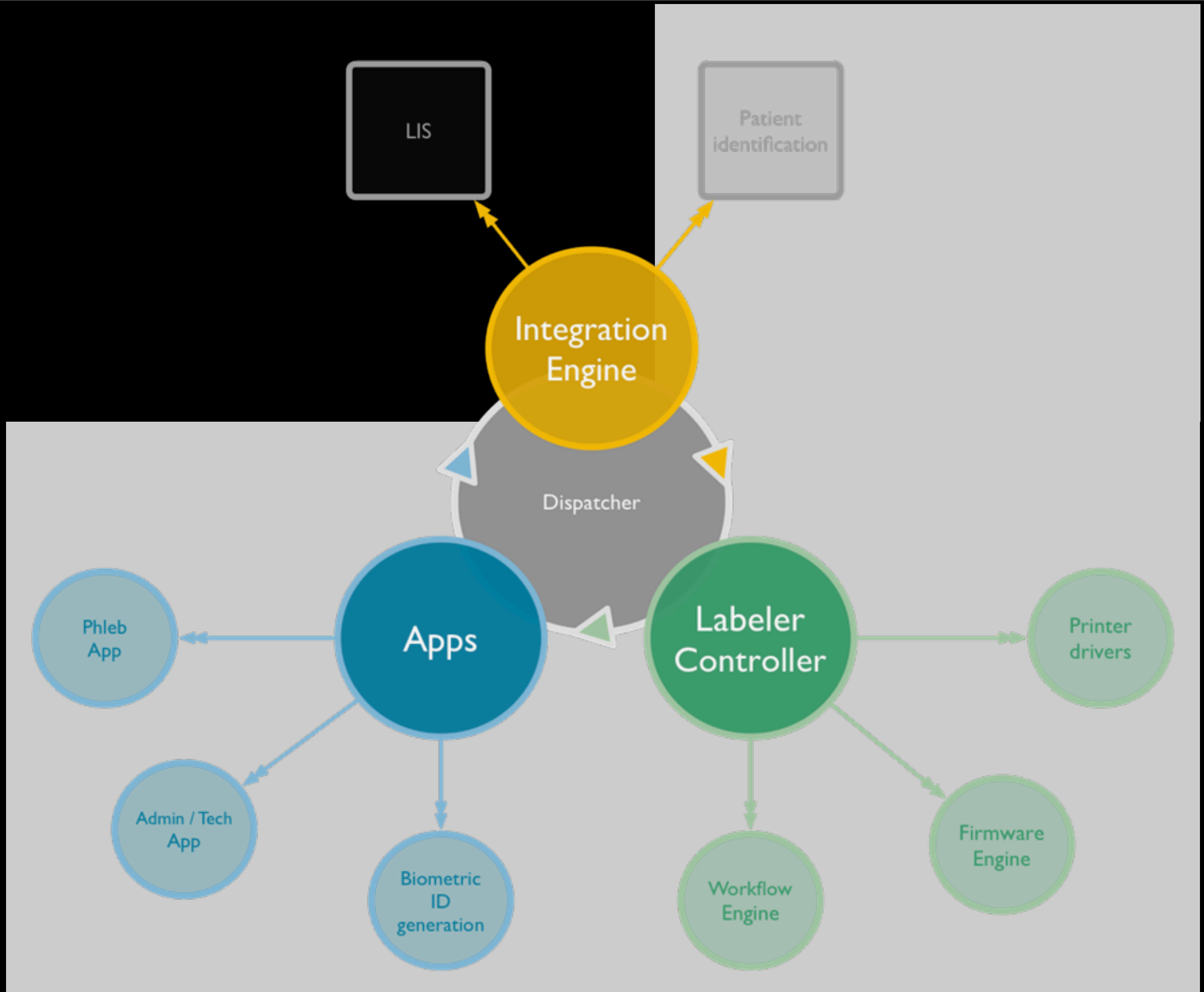
First Law of Python advocacy

shut up and show
them the prototype

Zeroth Law of Python advocacy

you are probably
already using Python

did it work?



1.hardware drivers

Managing hardware with Python

- PySerial, python-usb, ctypes...
- use struct!
 - see lightning talk @ 18:30 :-)
- hardware CLI
- fast scripting for hardware testing
- build second/third level APIs

2. asynchronous messages and networking

One word: Twisted

- one of Python's killer apps
- write new protocols in minutes
 - once you finally *get it* :-)
- non blocking, asynchronous
- look, ma: no Apache!
- very robust and quite scalable
- XMLRPC, SOAP, SSL come for free

3. applications

Why web apps

- no deployment or client maintainance
- support several usage and business models
- modern interfaces: RIA, AJAX, etc.
- Django of course!
- MVC, reusable components
- very useful even outside the web
 - loose coupling always a good idea

Dashboard

- Commands
- Procedures
- Logs

Configuration

- Colours
- Tubes

System Info

Firmware version
4.3.0
Machine ID
1001
Machine type
Automatic

Current status and configuration

Save configuration

System Status/Configuration

Frequency scaling	2%
Length threshold	1492 mV
Presence threshold	1192 mV
Rotation Speed	Final: 10 Edge: 12
Labeling angle	30
Label detection	Type: Delta Threshold: 470 mV
White calibration	RED: 3743 GREEN: 3726 BLUE: 2691 CLEAR: 5929
Process State	Idle

Sensors

Tube presence	NO
Tube length	Short







Autolabeler state

Number of hoppers	6
Transport motor state	Stopped
Transport motor period	65535
Transport motor error	No error
Tube on sequencer	NO

System

 Calibration
  Configuration
  Reset errors

Transport

 Start
  Stop
  Move Sequencer
  Path width
  Stepper
  Pusher/Extractor

Labelling

 Start system
  Print label
  Rotate label
  Barcode

Tubes

 Detect tube
  Eject tube
  Gate
  Good/Bad
  Hoppers

Logs

Save Clear HEX view

Timestamp	Command	Parameters	Result
2010-12-20 16:29:04	resetErrors		ACK
2010-12-20 16:30:07	startTransport		ACK
2010-12-20 16:30:09	stopTransport		ACK
2010-12-20 16:30:10	moveSequencer		ACK
2010-12-20 16:30:20	isTubePresent		NO
2010-12-20 16:30:23	getTubeLength		Short

admin's application

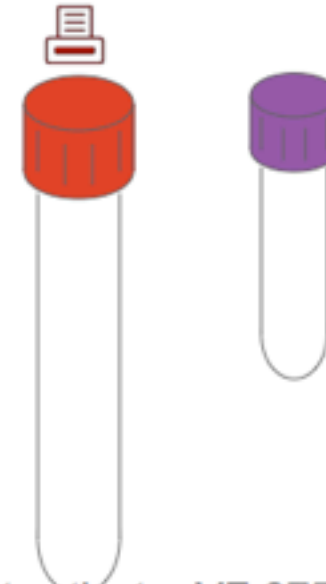
Menu

Patient: PHILIP MARLOWE
Date of birth: 30 October 1939
City of birth: Los Angeles
National ID: MRLPLP39R30Z4040
Gender: Male

Tests

WAALER-ROSE

PRINTING TUBE



Terumo Venosafe gel+clot activator VF-075SAS (4.50 ml) with Cherry
Red cap

phlebotomist's

IHE certification

- our system was certified as IHE-compliant during Connectathon Europe 2011
- LB, LIP, PDQ-S, PDQ-C



AO G. Brotzu

whither?

Python in Healthcare SIG

- established on march 2011
- last edit of wiki on 2011-03-17
- mailing list
 - 18 messages in 4 months
 - last message in April

No Country for Old Snakes...

- HL7 implementations
 - we only have v2...
 - ...and it's quite limited
- everyone uses Java
- Mirth
 - made in Java
 - scriptable in Javascript

...or is it?

- we must work together
- Healthcare ICT is important
 - philosophically
 - and economically -in fact we're hiring ;-)
- show them prototypes; use Trojan horses
- have a good list of use cases

questions, thoughts,
suggestions

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