UNIVERSITY of WASHINGTON

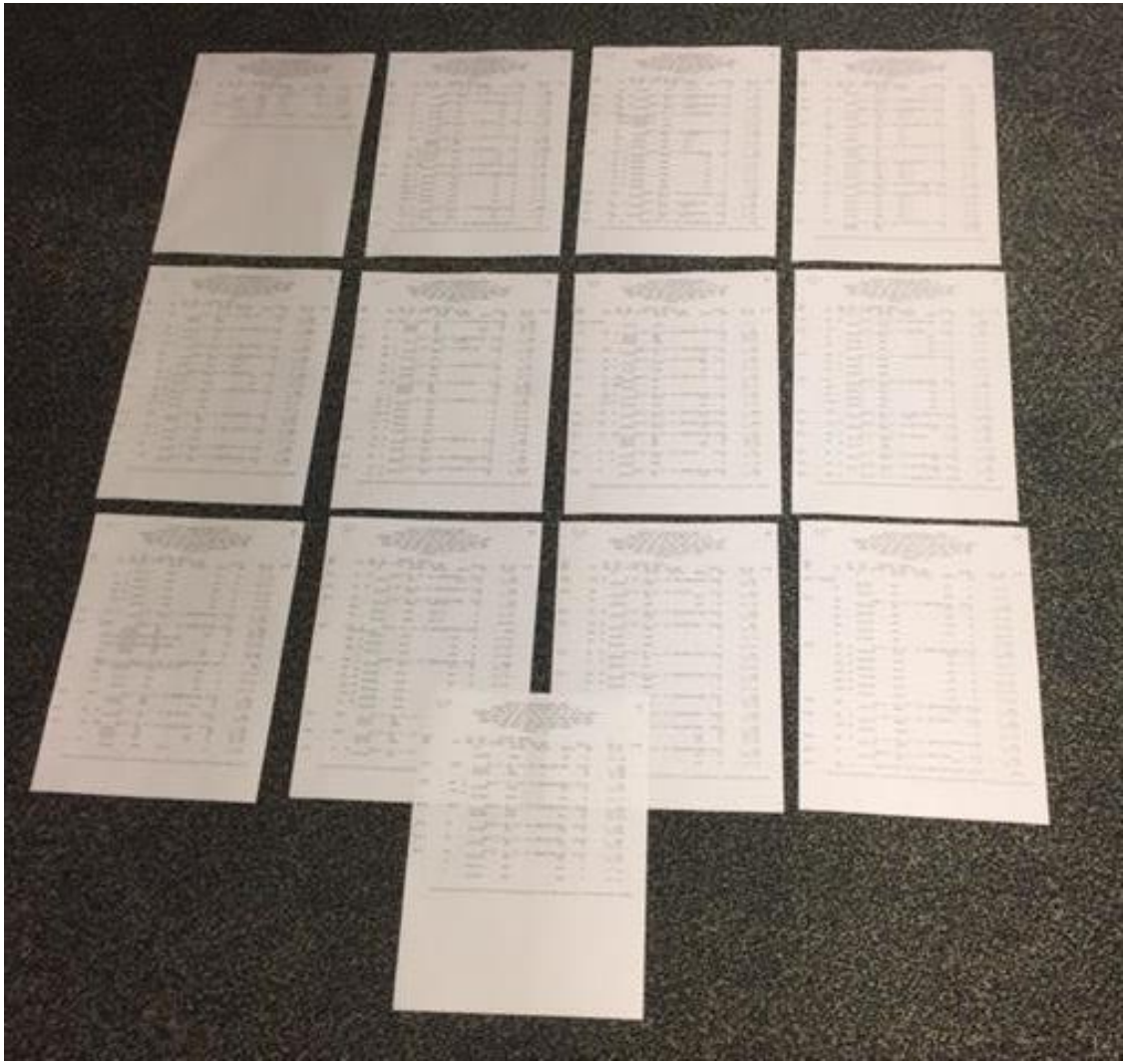
An open source web application for real-time display of pending orders

Noah Hoffman, MD, PhD

University of Washington

Pathology Informatics Summit 2017

One printed report of pending orders

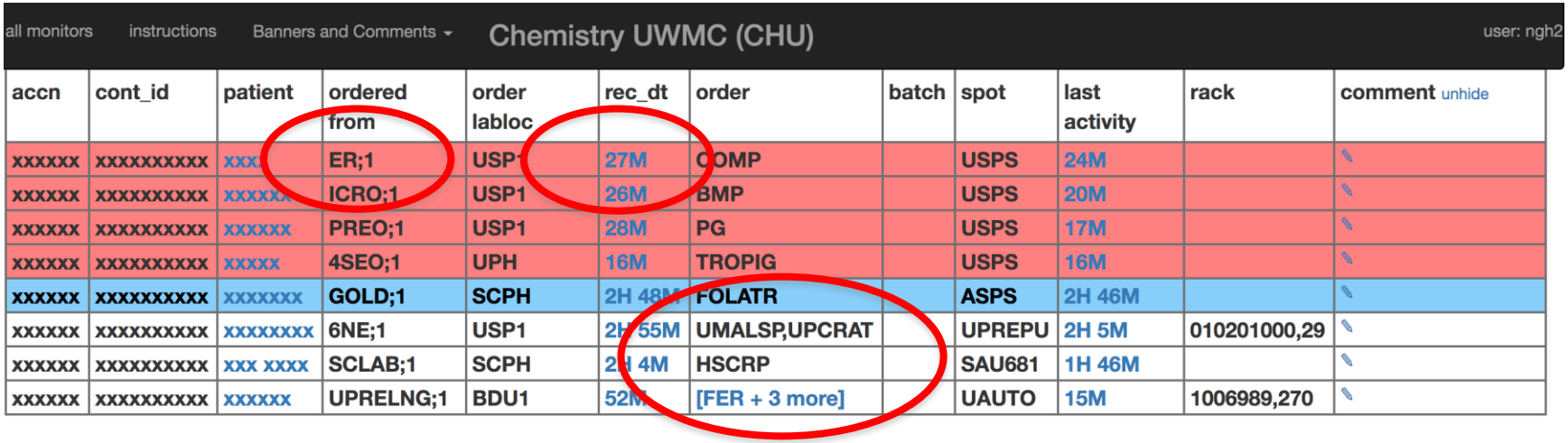



A, B & S Gates
DEPARTURES
BREAKFAST · SALADS · SOUPS · PIZZA · PASTA · PANINI · PRONTO
Exit/Pick Up

Real-time display of pending orders: operational objectives

- Improve situational awareness in the lab
  - Replace batched “pull” with real-time “push”
  - Improve visibility of **actionable** pending orders
- Reduce reliance on printed pending lists
- Improve communication related to pending orders

Less is More



all monitors instructions Banners and Comments ▾ **Chemistry UWMC (CHU)** user: ngh2

accn	cont_id	patient	ordered from	order labloc	rec_dt	order	batch	spot	last activity	rack	comment unhide
xxxxxx	xxxxxxxxxx	xxx	ER;1	USP1	27M	COMP		USPS	24M		
xxxxxx	xxxxxxxxxx	xxxxxx	ICRO;1	USP1	26M	BMP		USPS	20M		
xxxxxx	xxxxxxxxxx	xxxxxx	PREO;1	USP1	28M	PG		USPS	17M		
xxxxxx	xxxxxxxxxx	xxxxx	4SEO;1	UPH	16M	TROPIG		USPS	16M		
xxxxxx	xxxxxxxxxx	xxxxxxx	GOLD;1	SCPH	2H 48M	FOLATR		ASPS	2H 46M		
xxxxxx	xxxxxxxxxx	xxxxxxxx	6NE;1	USP1	2H 55M	UMALSP,UPCRAT		UPREPU	2H 5M	010201000,29	
xxxxxx	xxxxxxxxxx	xxx xxxx	SCLAB;1	SCPH	2H 4M	HSCRP		SAU681	1H 46M		
xxxxxx	xxxxxxxxxx	xxxxxx	UPRELNG;1	BDU1	52M	[FER + 3 more]		UAUTO	15M	1006989,270	

- Rows highlighted and sorted to top based on location and priority
- Humanized time intervals
- Orders grouped by patient and accession

Improving signal:noise

- Filtering and sorting
  - Priority, time elapsed, test/order (eg, specimen stability), ordering location.
- Grouping
  - patient, accession, container
- Highlighting/formatting
  - Priority, time elapsed, ordering location

Communication via comments

all monitors instructions Banners and Comments UWMC SPS LABUND/ADDON (USPS) user: ngh2

accn	cont_id	patient	ordered from	spot	order_dt	rec_dt	last activity	order	rack	comment unhide
xxxxxx	xxxxxxxxxx	xxx xxxxxx	CHDDBIO;1	USPS	9 days		16H 5M	LABUND		ISSUE 78662, WAITING FOR LMR APPROVAL AND ADDITIONAL PAPERWORK *(mcpb 14H 12M)*
xxxxxx	xxxxxxxxxx	xxxxxxx	5SA;1	USPS	3H 3M	3H 1M	3H 1M	LADDON		
xxxxxx		xxxxxxx	5EU;1		40M			LADDON		
xxxxxx	xxxxxxxxxx	xxxxx	NSHOR;1	USPS	1 day	1 day	1 day	LADDON		CSS ISSUE. NO SPECIMEN. *(kanderto 1 day)*

user: ngh2

comment unhide

ISSUE 78662, WAITING FOR LMR APPROVAL AND ADDITIONAL PAPERWORK *(mcpb 14H 12M)*

CSS ISSUE. NO SPECIMEN. *(kanderto 1 day)*

Edit comment for monitor USPS

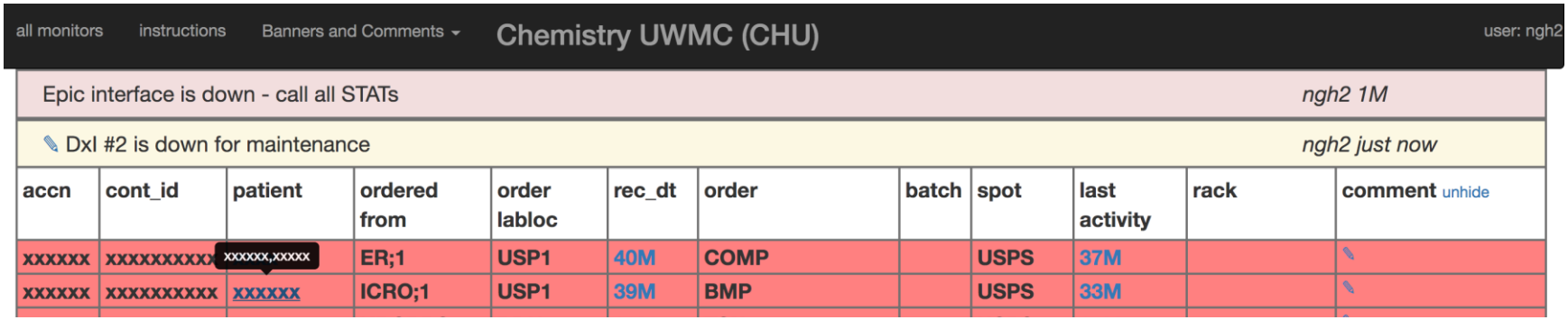
back to monitor USPS

ISSUE 78662, WAITING FOR LMR APPROVAL AND ADDITIONAL PAPERWORK

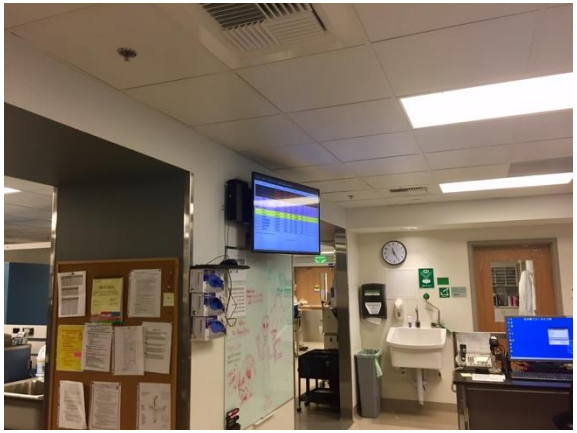
Location of this row: **Normal sort order** **Top** **Bottom** **Hidden**

Save Delete

Banners


all monitors
instructions
Banners and Comments
Chemistry UWMC (CHU)
user: ngh2
Epic interface is down - call all STATs
ngh2 1M
Dxl #2 is down for maintenance
ngh2 just now
accn
cont_id
patient
ordered from
order labloc
rec_dt
order
batch
spot
last activity
rack
comment unhide
xxxxxx
xxxxxxxxxx
xxxxxx,xxxxx
ER;1
USP1
40M
COMP
USPS
37M
xxxxxx
xxxxxxxxxx
xxxxxx
ICRO;1
USP1
39M
BMP
USPS
33M

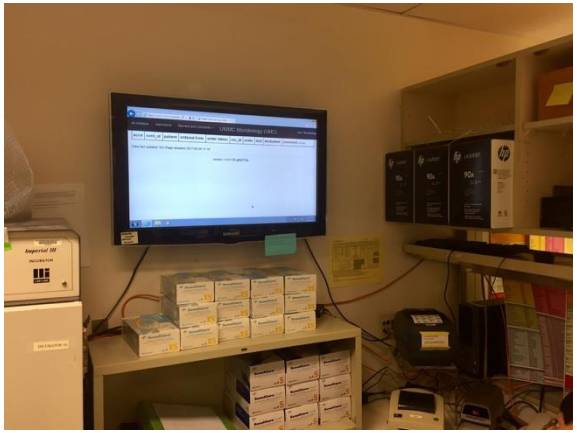
Hematology Line



Transfusion Services

Processing

Chemistry Line

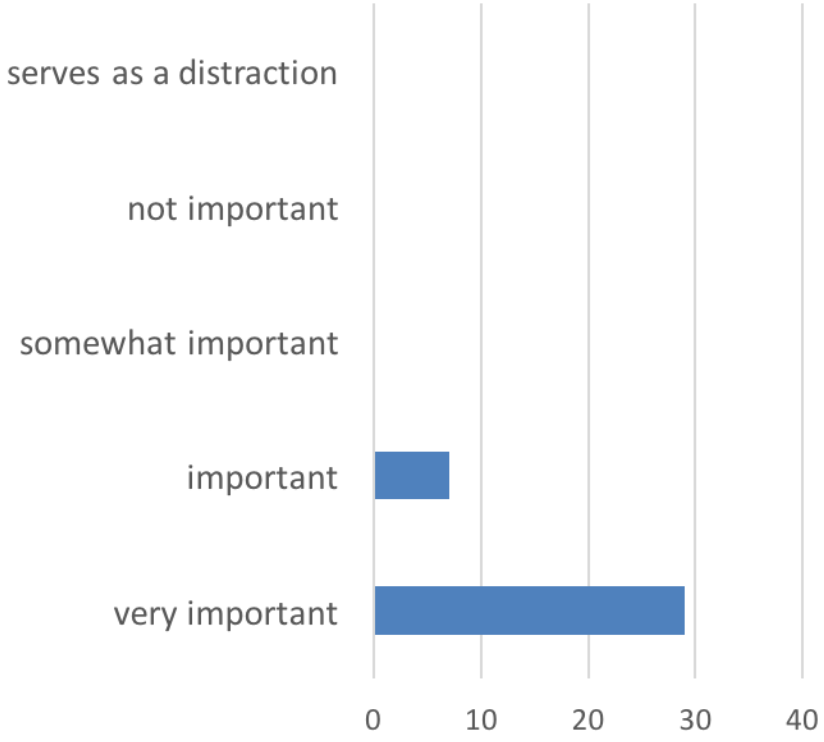


Microbiology

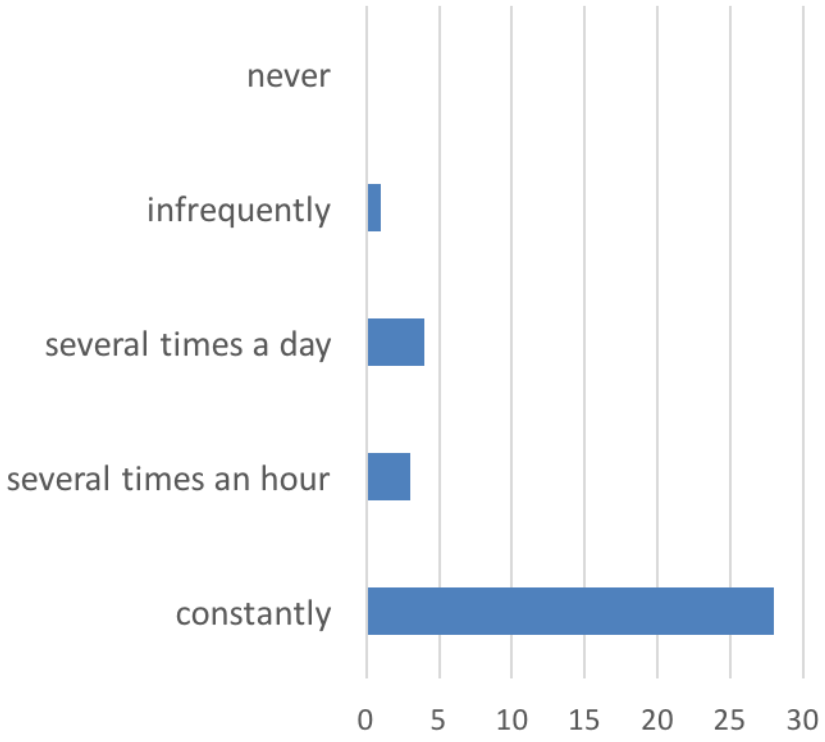
My Laptop

- > 30 worksheet groups in production since April, 2016
- 13 permanent displays across three hospitals

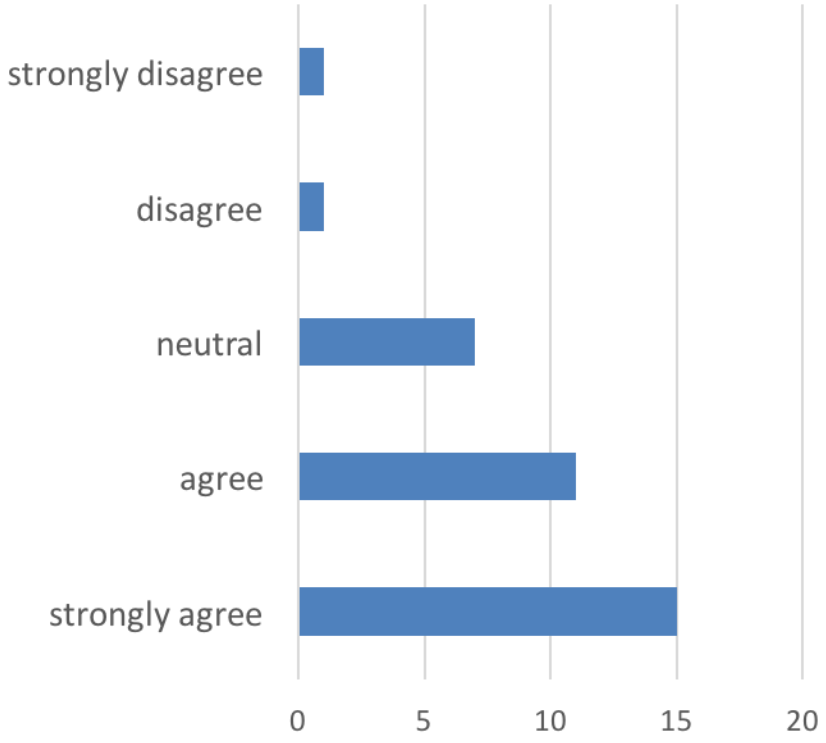
How would you characterize the **importance of the PLM** in the daily operation of your lab area?



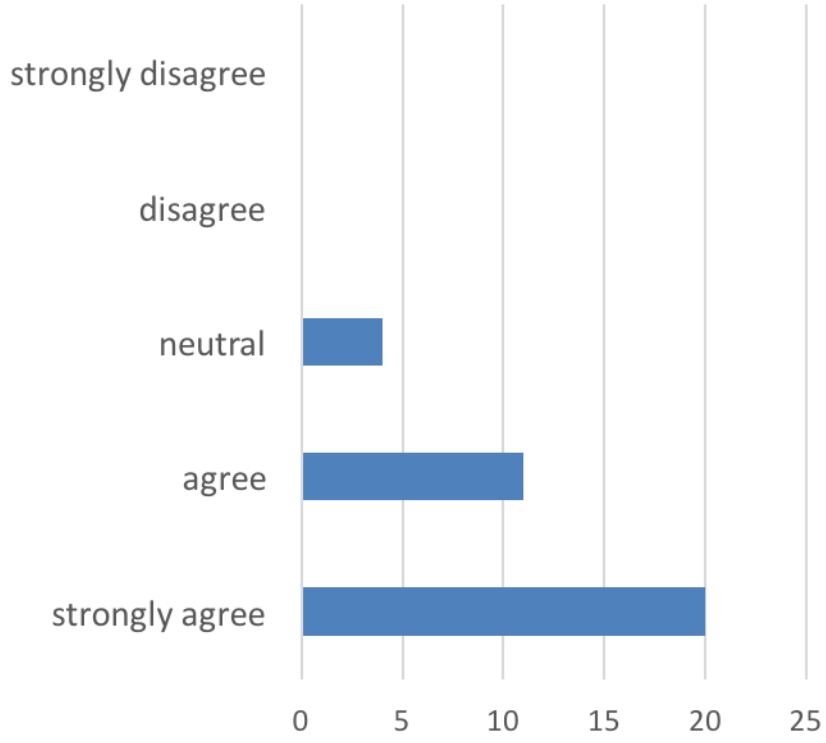
How often is the PLM consulted in your lab area?



The PLM mostly **replaces functionality in the LIS** for monitoring pending tests (such as printed pending lists).



PLM Comments provide an important **mechanism of communication** in my lab area.



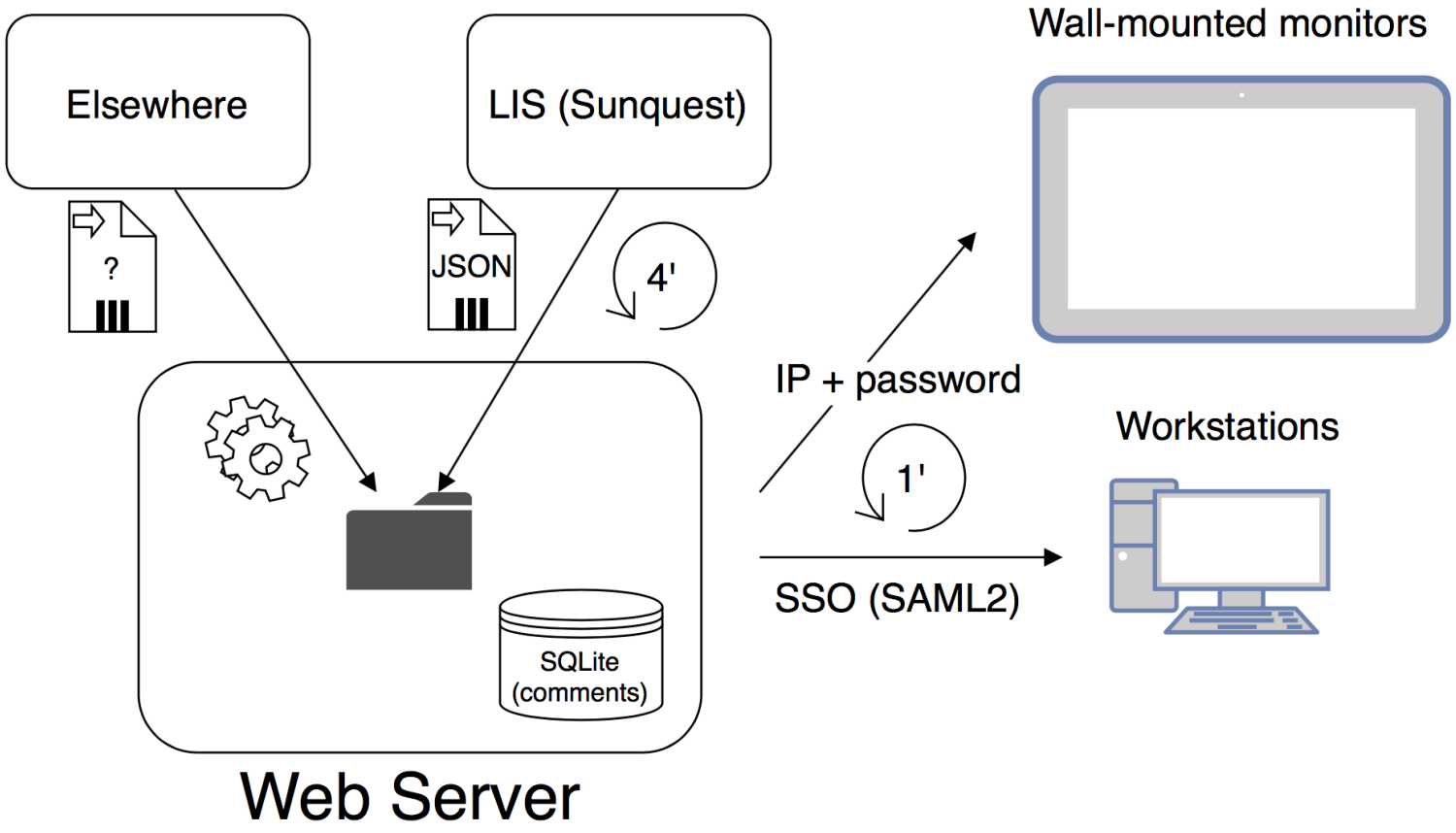
Use cases

Area	Use cases
Microbiology	Notification of stat gram stain orders
Transfusion services	Identify delayed testing, workload management
Automated Chemistry Line	Complex logic to display only delayed or time-sensitive orders; still use printed pending log at the end of the day
Hematology/coagulation	“We use it to anticipate coming work from the outside areas and to see when a sample is still pending”
Specimen Processing	Replaces printed pending list for write-ins
Mass Spectroscopy	Estimate workload; prompts to collect specimens before beginning a batch

Implementation details

- Intersystems Caché (LIS data extracts from worksheets)
- Application code in Python 2.7
  - Around 5000 LOC (rules comprise about half of total)
  - Flask web framework
- SQLite database (comments)
- Apache (web server)
- Bootstrap (CSS)
- Ansible (deployment, config. management)
- Ubuntu 14.04 (virtualized)

Architecture



Rules engine

```python
def filter_rows(row):
    """
    Externally called function to determine whether or not to display
    a test on the monitor.
    Returns True to display, or False to not.
    """
    # discard any rows with a very long spot dwell time
    if too_long_ago(row.spot_dt):
        return False

    if row.order == 'HBB':
        if row.package == 'DVP1' and row.test == 'IN2':
            # Flag patients on dialysis that have a hepatitis B interpretation.
            return True
        return False

    # discard based on various criteria - we short-circuit execution
    # by exiting at the first true value
    functions = [is_test_patient, is_cap_specimen, _is_uninteresting_location]
    for function in functions:
        if function(row):
            return False
```

Rules implemented as Python functions

- 😀 Flexible, components can be unit tested
- 😐 Implemented by developer (no user interface)

Summary

- Simple web application developed with relatively little effort and very low direct costs
- Depends on access to data from the LIS; the rest is easy
- Provides flexible platform for creating real-time displays of events from the LIS and other systems
- Plays important role in lab operations
- People like it

Thank you

- Thomas Ekberg
- University of Washington Department of Laboratory Medicine