Measuring EHR Usage and Patient-Provider Communication During Outpatient Visits

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Conflict of Interest Disclosure
Have no real or apparent
conflicts of interest to report.

Research funded by Veterans Administration
HSR&D Project IIR-07-196-2

Health IT Usability

Science & Engineering

- Define usability as "effectiveness, efficiency and satisfaction with which users can perform intended tasks"
  - Measuring usability (a non-functional, lifecycle property) is a science.
  - Improving usability is achieved through engineering (functional requirements)

Learning Objectives

- **Describe** EHR usage and task efficiency leveraging time-domain process measures
- **Recognize** challenges posed by current technology to providers who multitask between EHR workflow and addressing patient needs
- **Identify** and rank-order the most commonly used EHR components
- Discuss how to **Correlate** EHR usage with patient-provider communication patterns
- Recognize how to **Leverage** analysis results for EHR design improvements

PACE Study Motivation

- Little quantitative data from real clinical settings (vs. lab experiments with predetermined tasks)

- Clinical settings enable sampling realistic: variability across patients, multitasking (patient-provider-EHR interaction)

Profile EHR usage and task efficiency
Leveraging time-domain measures

- PACE study:
  - Outpatient visits; established patients
- Time-stamped visit process data:
  - EHR activity; Non-Verbal workflow; Verbal Communication
- Additional data:
  - patient & provider satisfaction; agreement; interviews

Multi-Level EHR Activity Data

Usability software logs time-stamped mouse activity + manual review of screen video:

- Screens: Notes, Labs, Medications, Reports, Clinical Reminders
- Tasks: View v. Order Entry; Current v. Previous Note
- Modes: Text Box, v. Radio Button v. Scroll Bar
- Order Entry: Meds, Labs, Consults, Imaging
- Alerts & Reminders

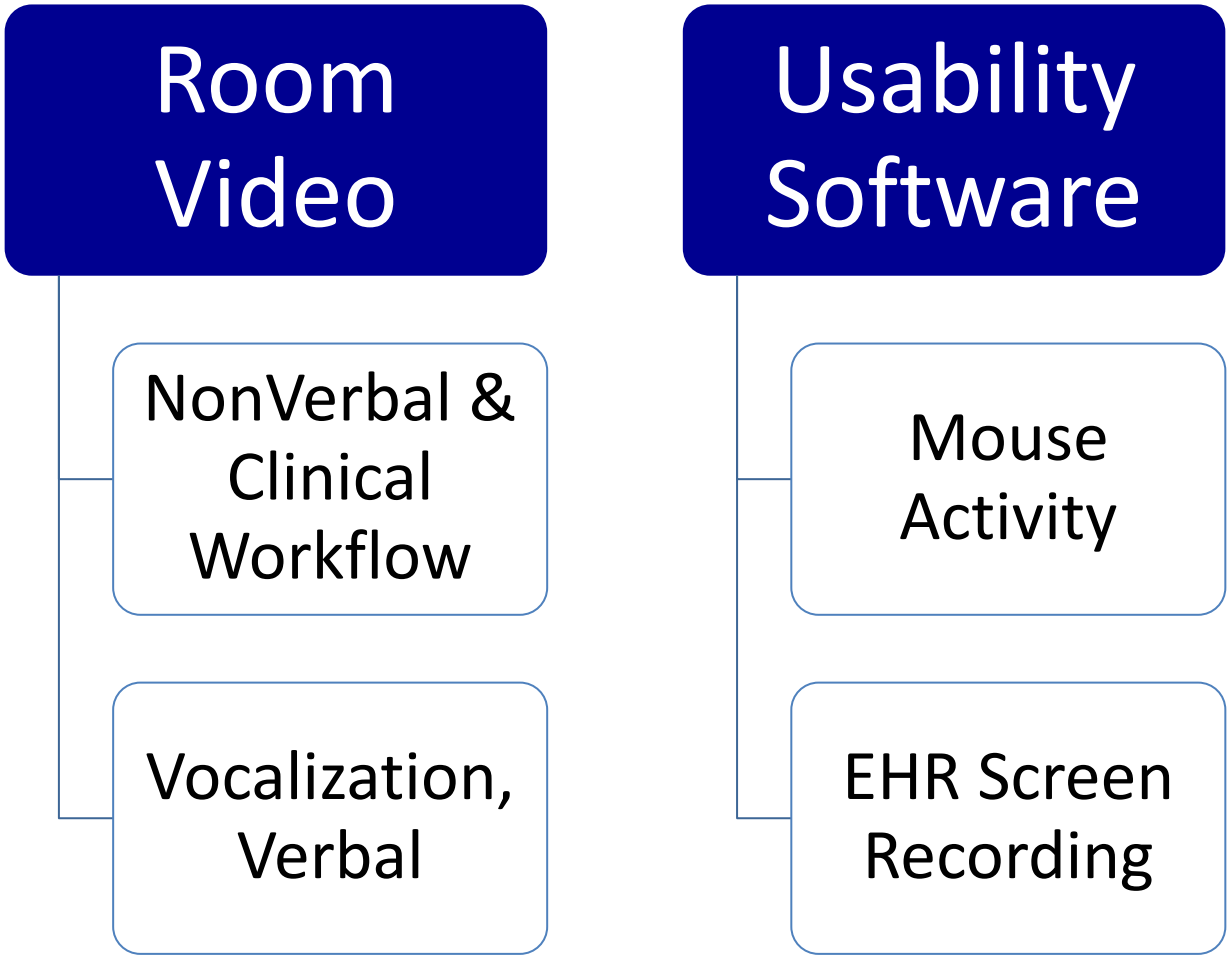
Rank-order EHR component usage

- Hierarchical Task Analysis
  - Rank-Order: screens, tasks by visit, by provider…
- Sequential Task Analysis
  - Most frequent transitions between screens, tasks…

Temporal analysis of EHR + Clinical Workflow

- Time-at-task profiling excluding physical exams, interruptions
- Conditional profiling of EHR activity while sharing screen
- Verbal analysis during 3-minute windows of highest & lowest EHR activity excluding interruptions

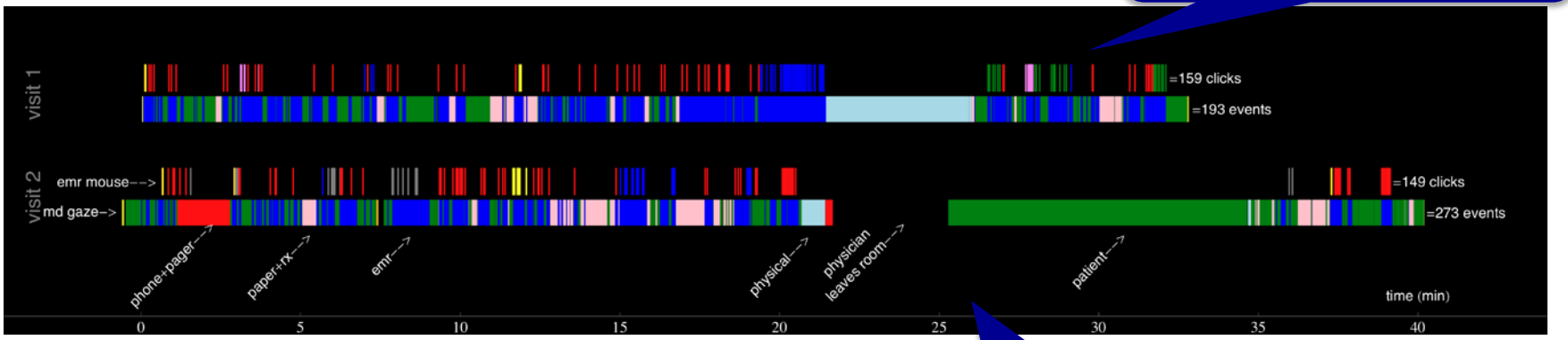
Types of Visit Process Data by Source



Synchronizing EHR Activity + NonVerbal

2 sample visits

Top Chromogram=EHR Mouse Clicks



Bottom Chromogram=NonVerbal & Clinical Workflow

Categories of User-EHR Interactions

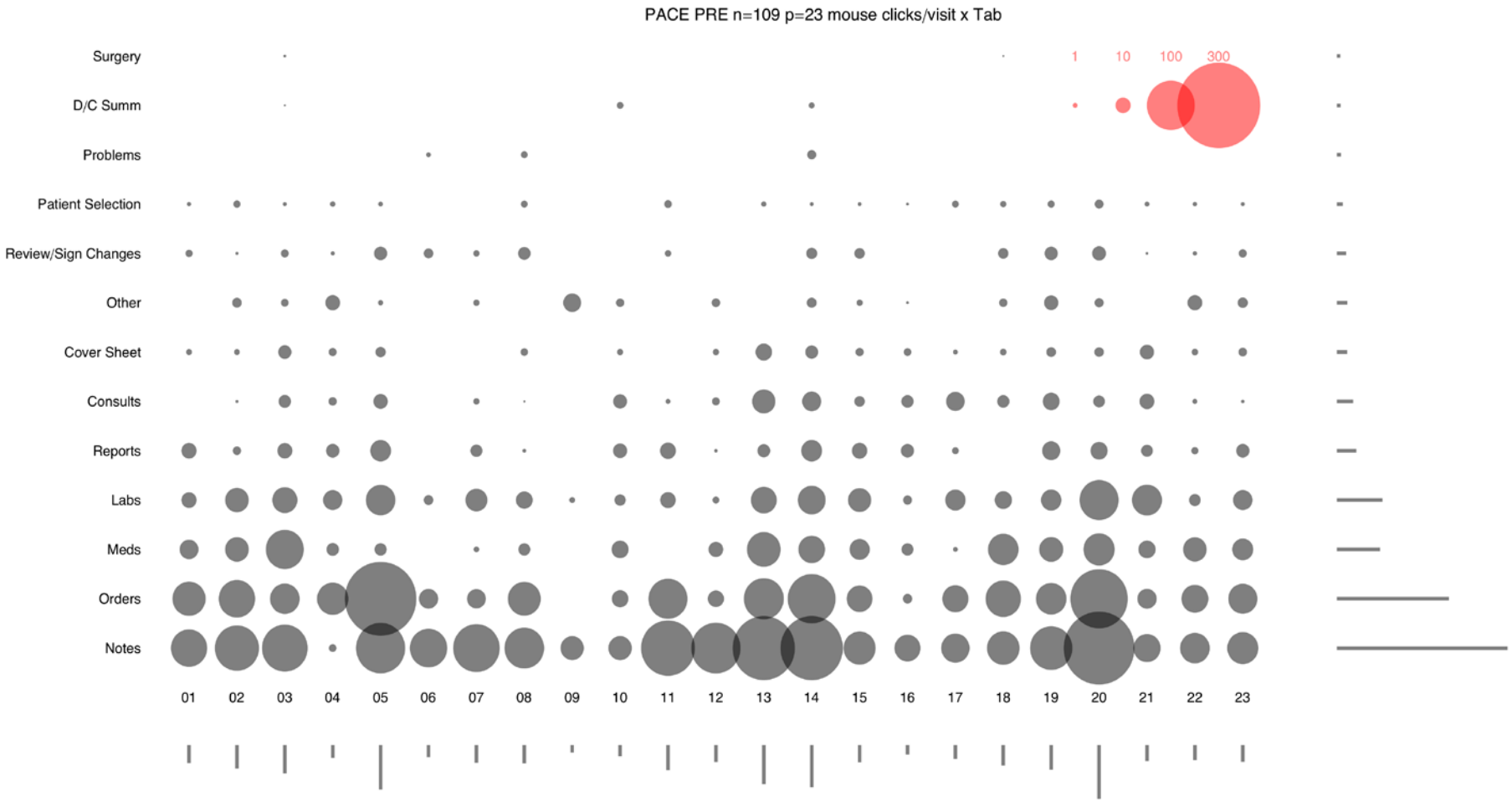
User-EHR interactions:

- Information Retrieval: browsing, searching, decision-support
- Documentation: progress notes, reports
- Order Entry: meds, labs, consults, imaging
- Coordination: reminders, care team communication

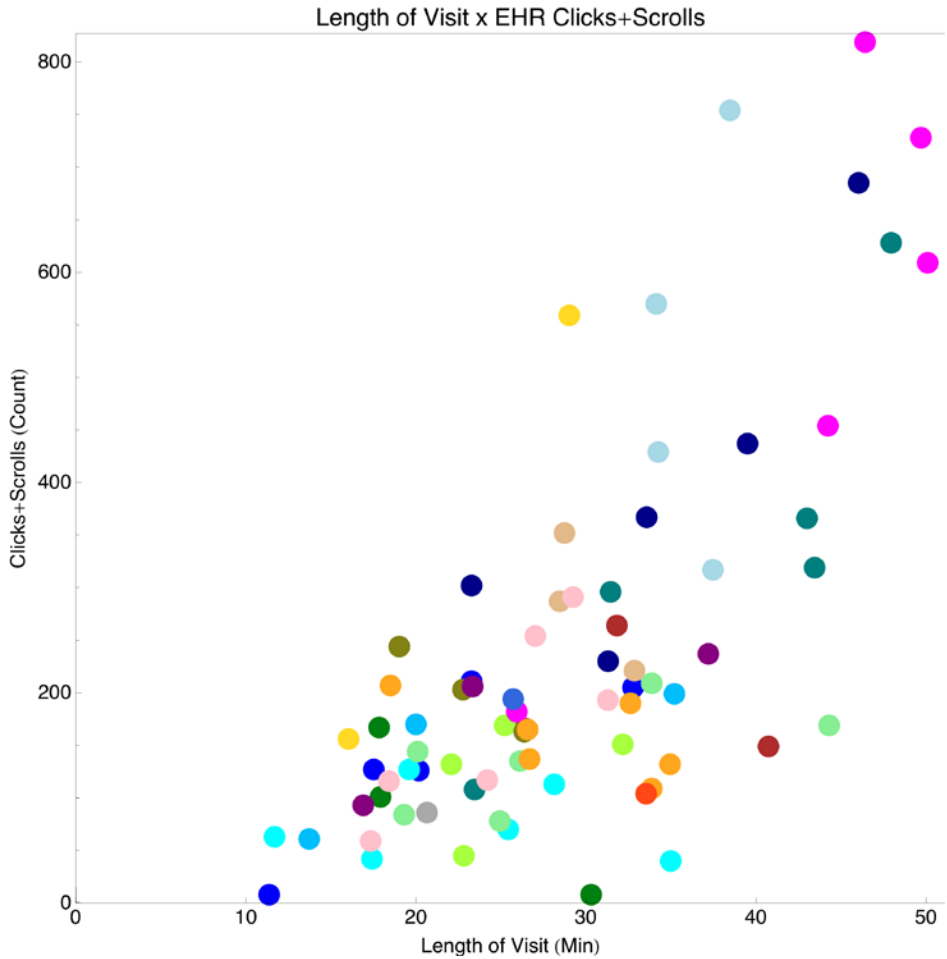
Estimate average number of mouse clicks per office visit ?

A) 20
B) 100
C) 250
D) 500

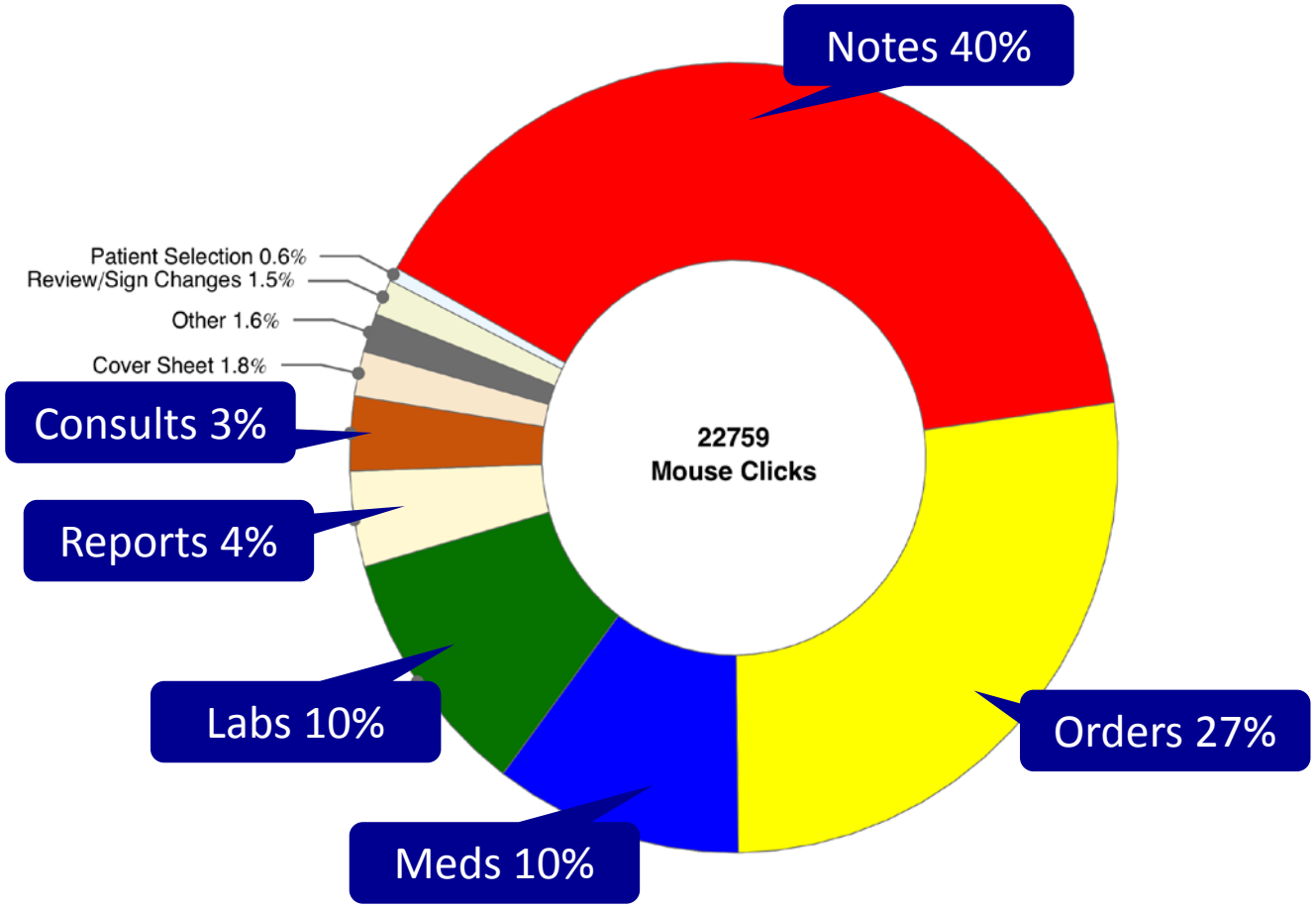
Variability in EHR Activity by Physician



Visit Length vs. EHR Activity

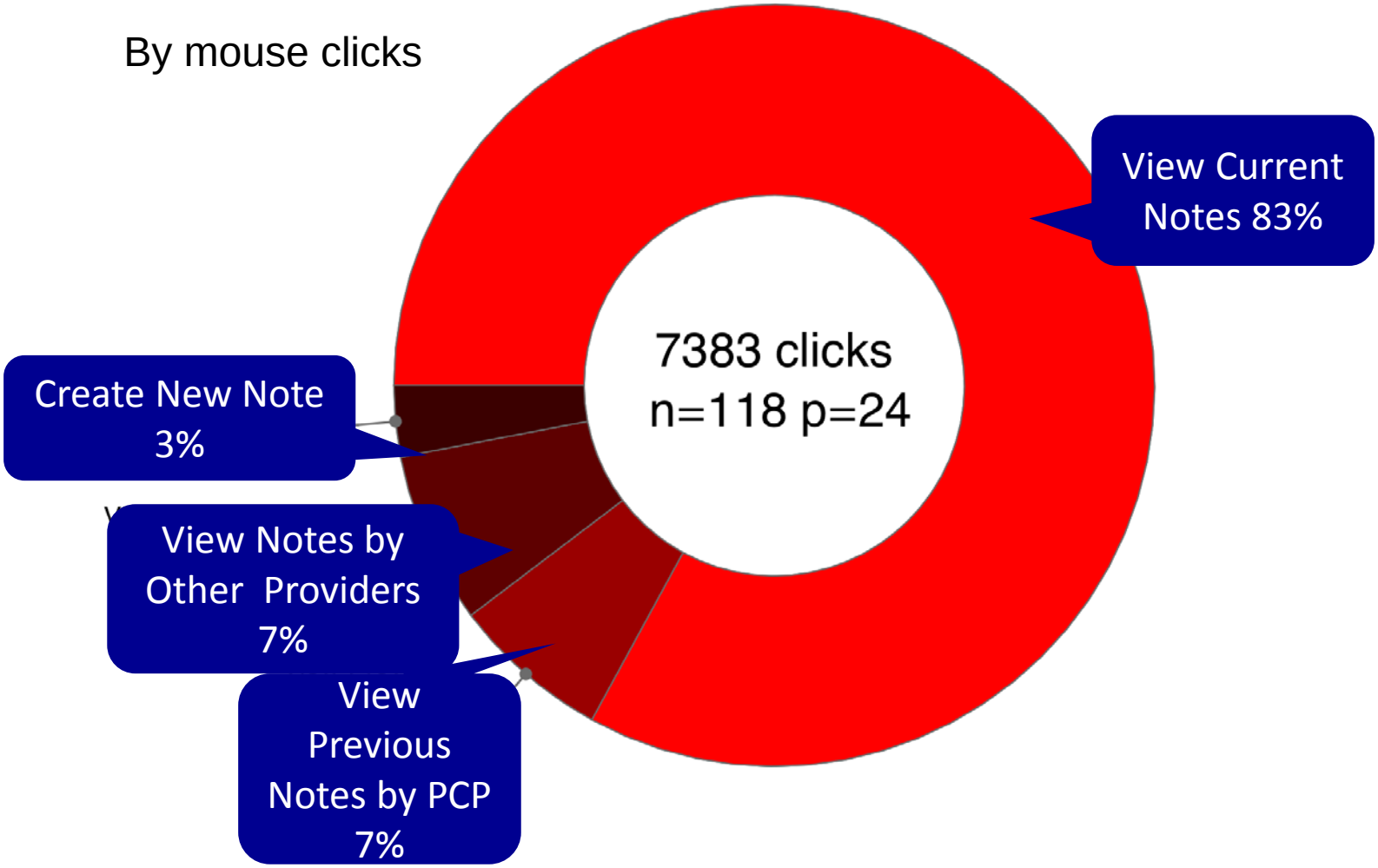


Distribution EHR Screens (Mouse Clicks)

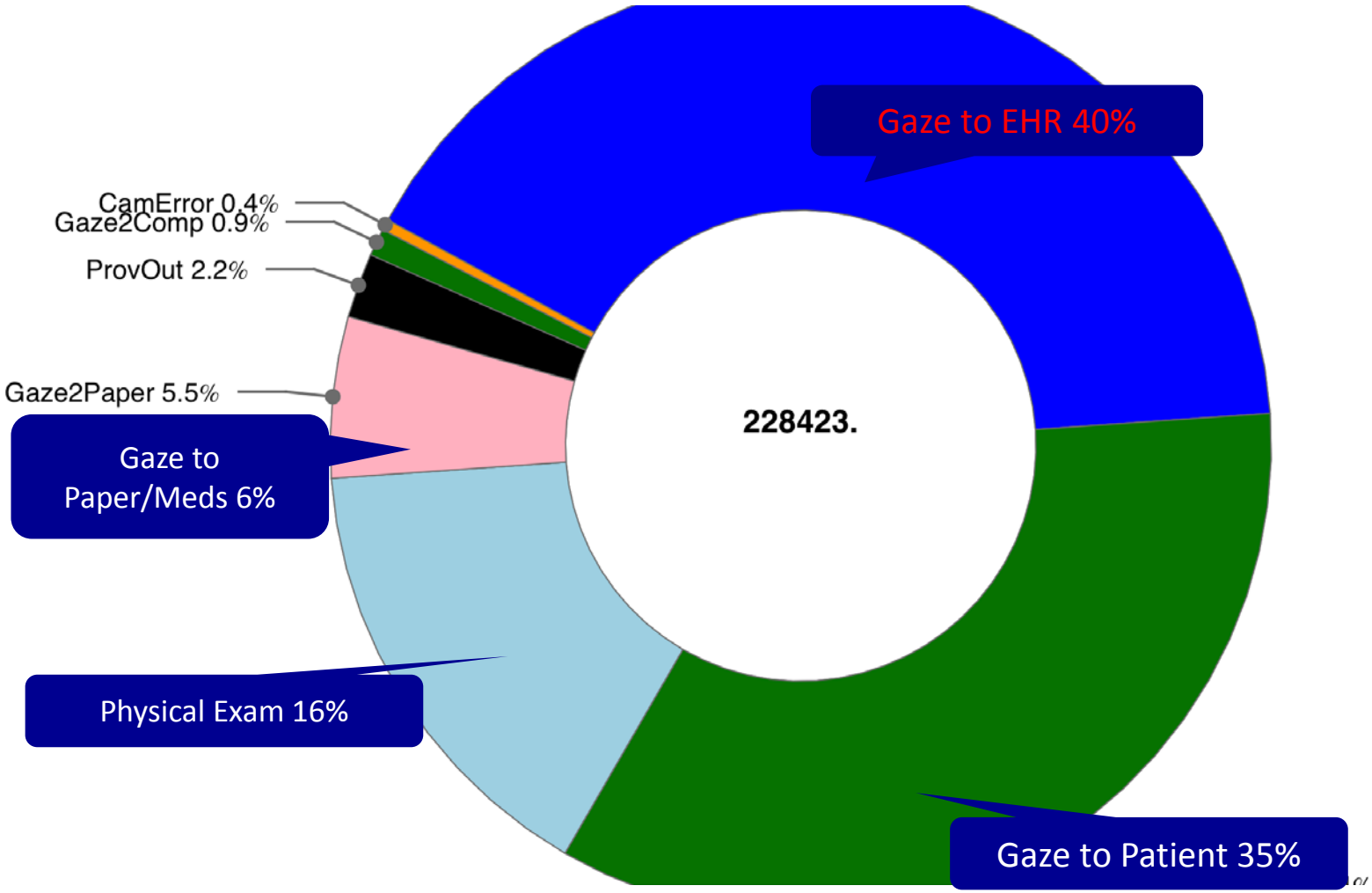


Distribution of View Tasks while in Notes

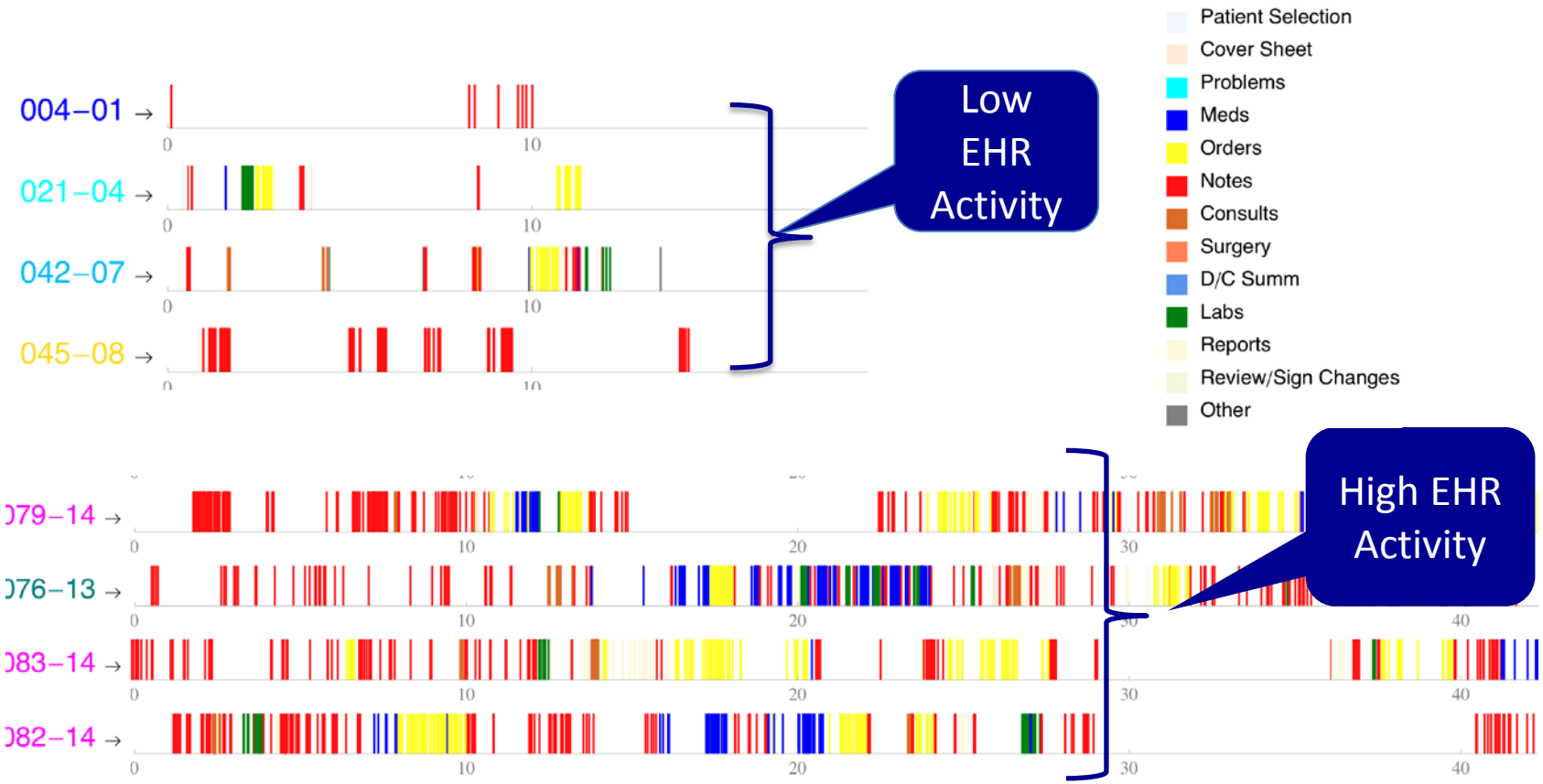
By mouse clicks



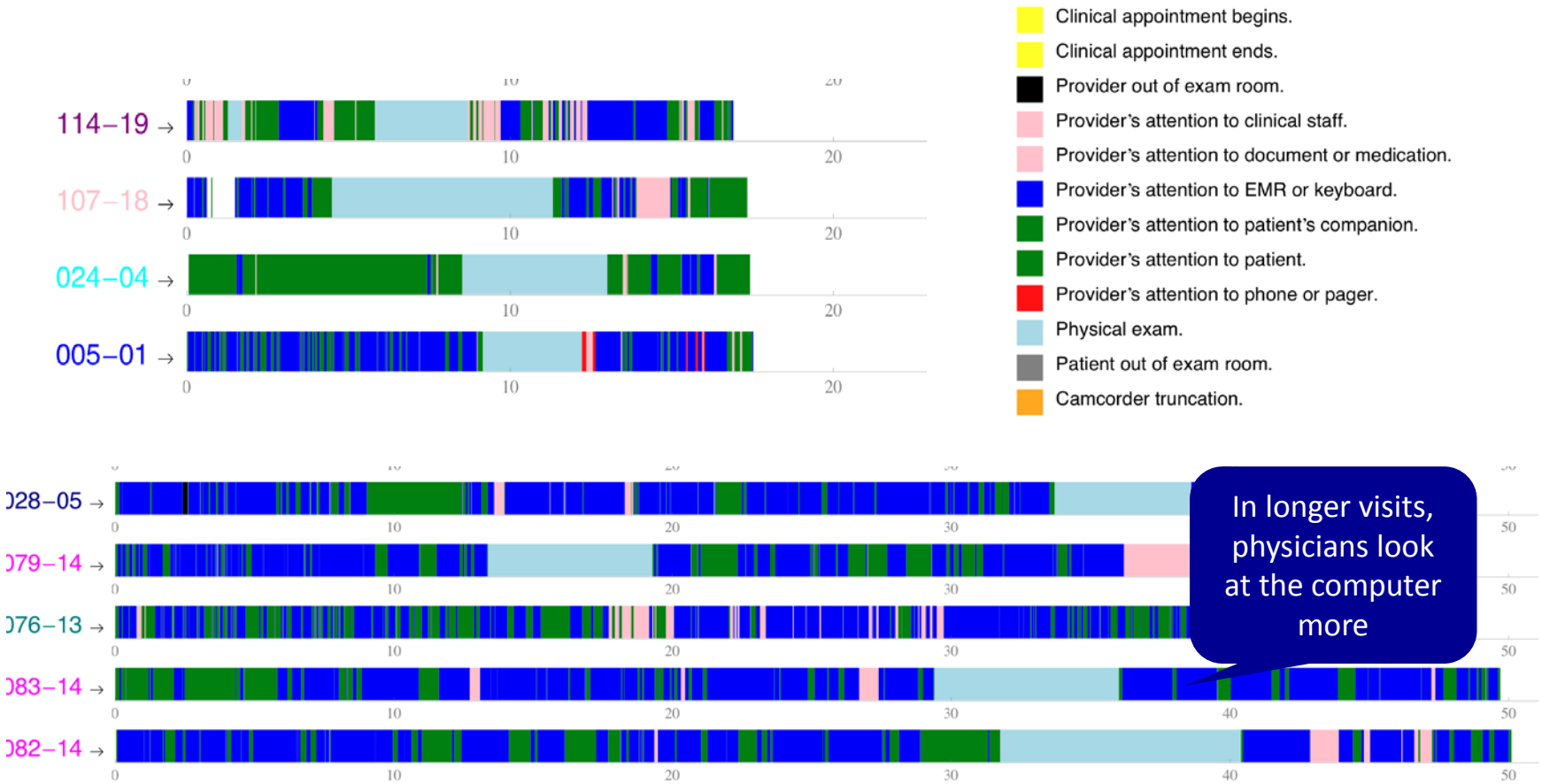
Distribution of Clinical Work



Variability of EHR Activity Across Visits

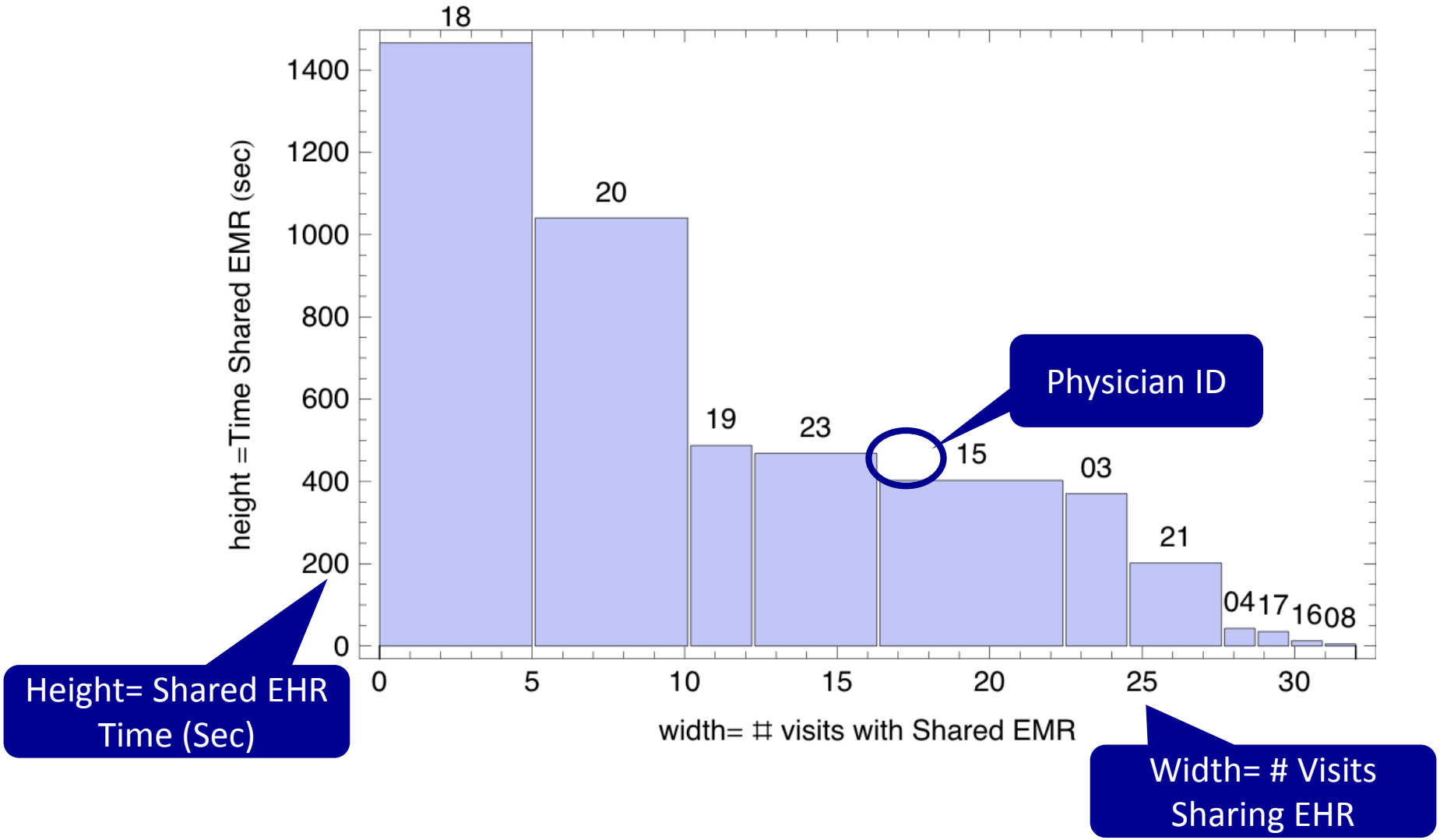


Longer Visits, More Gaze to EHR

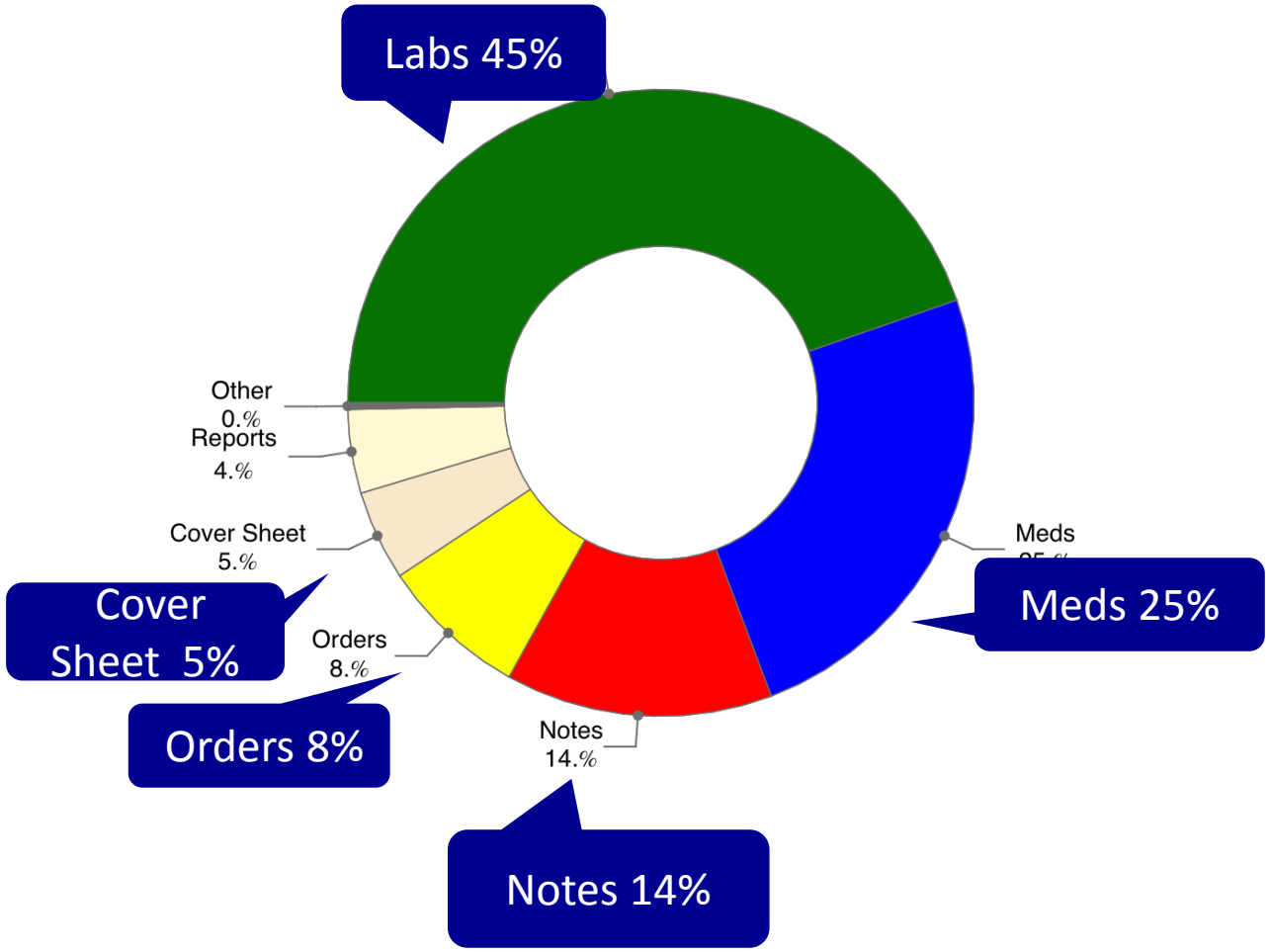


How do we explain the variability in EHR usage ? Discuss factors that may explain this.

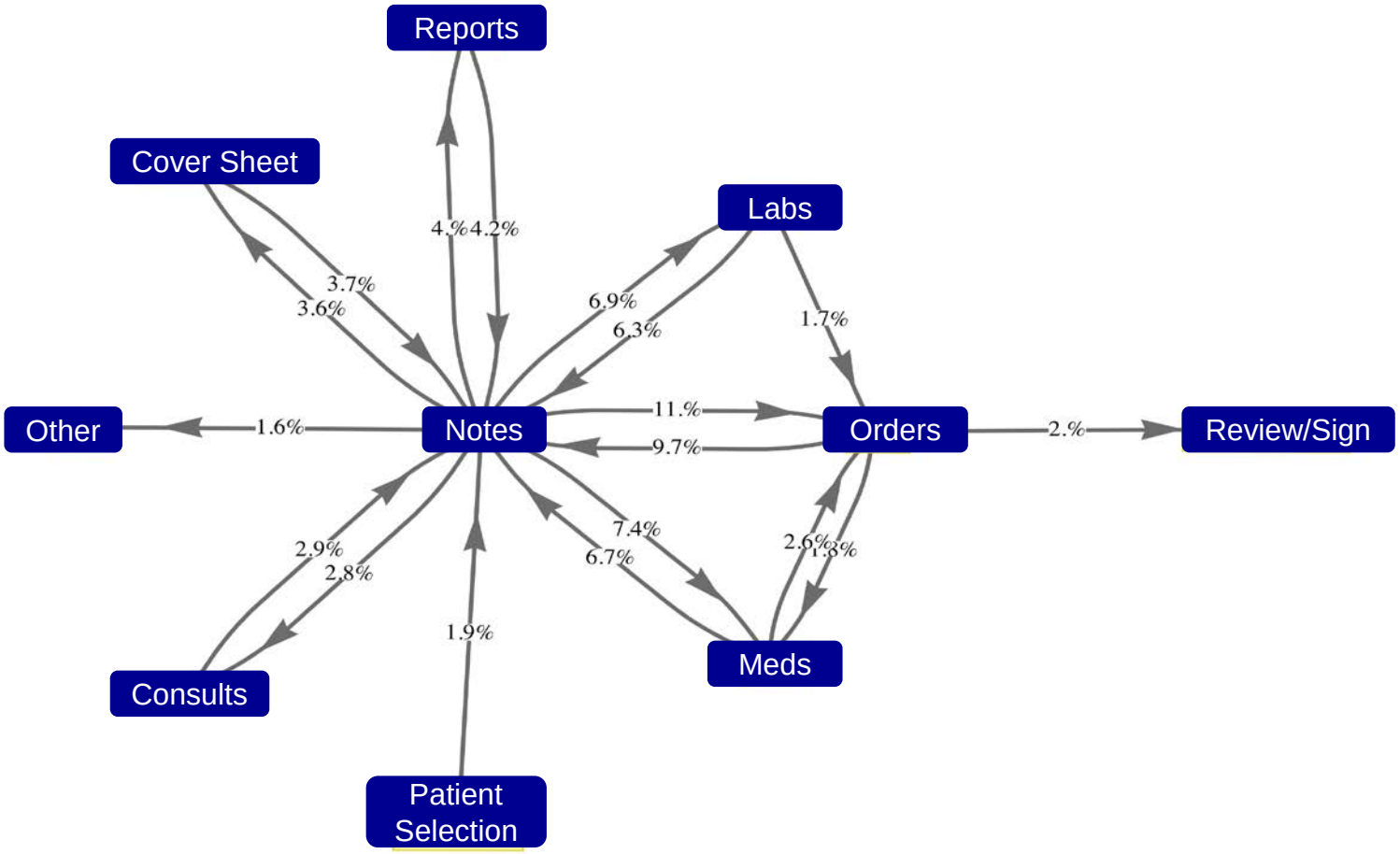
Variability of EHR Sharing by Physician



What Screens Do Physicians Share?



Transitions Between EHR Screens



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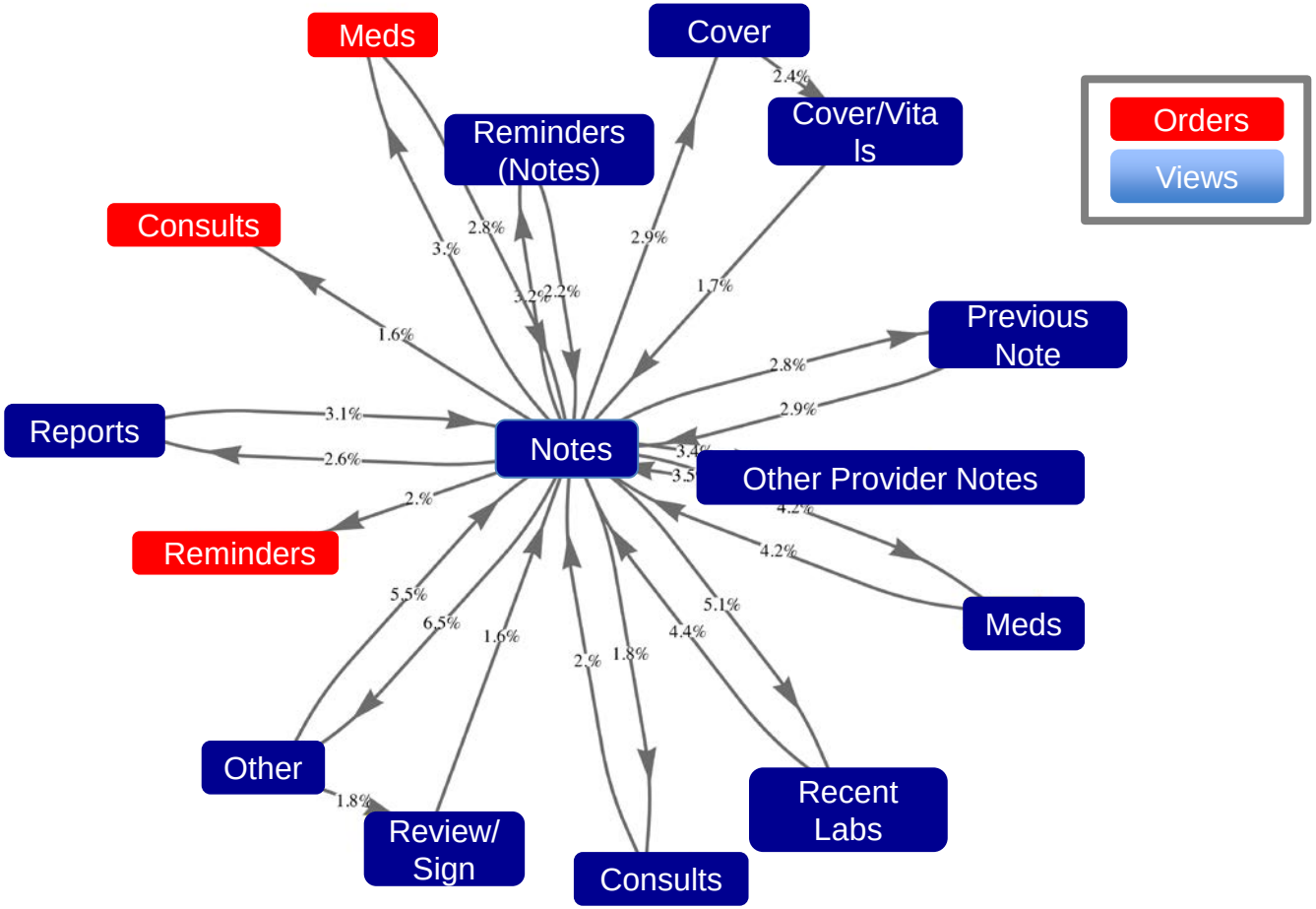
Transitions Between EHR Tasks



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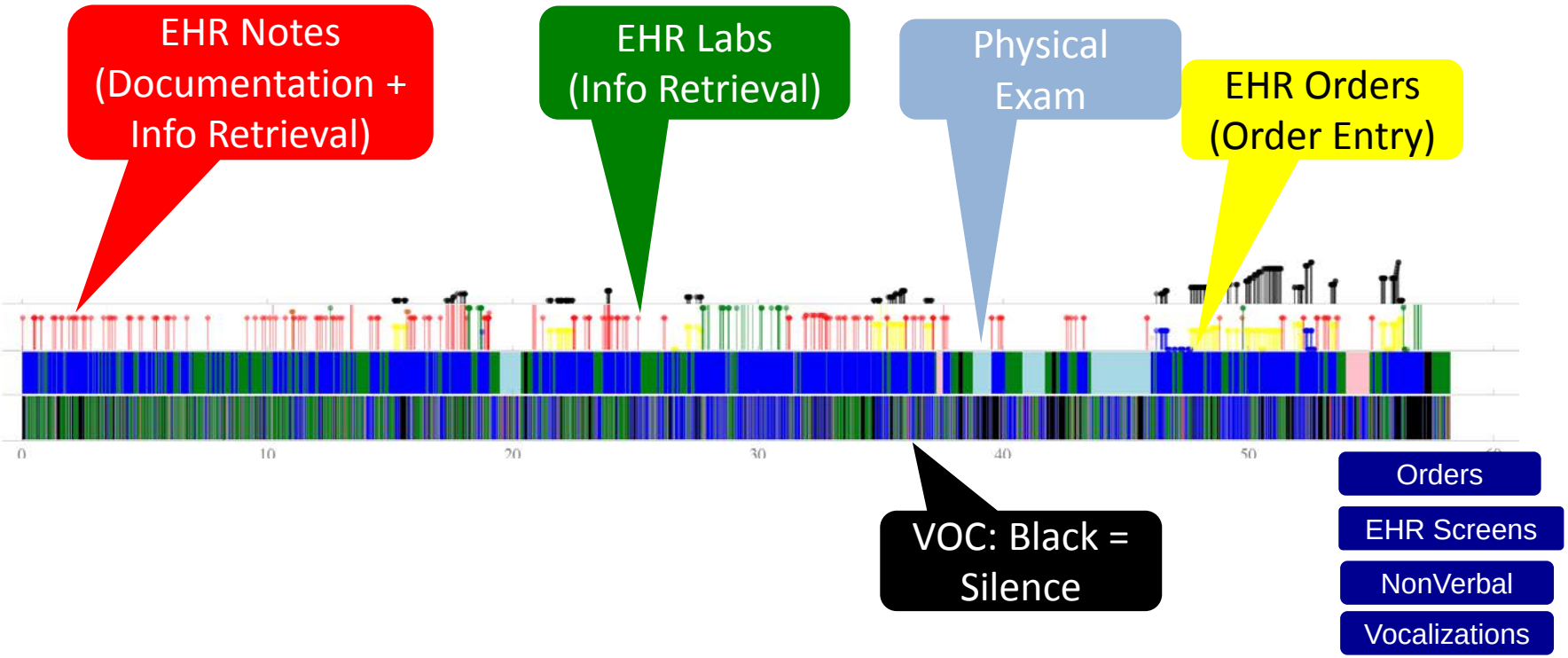
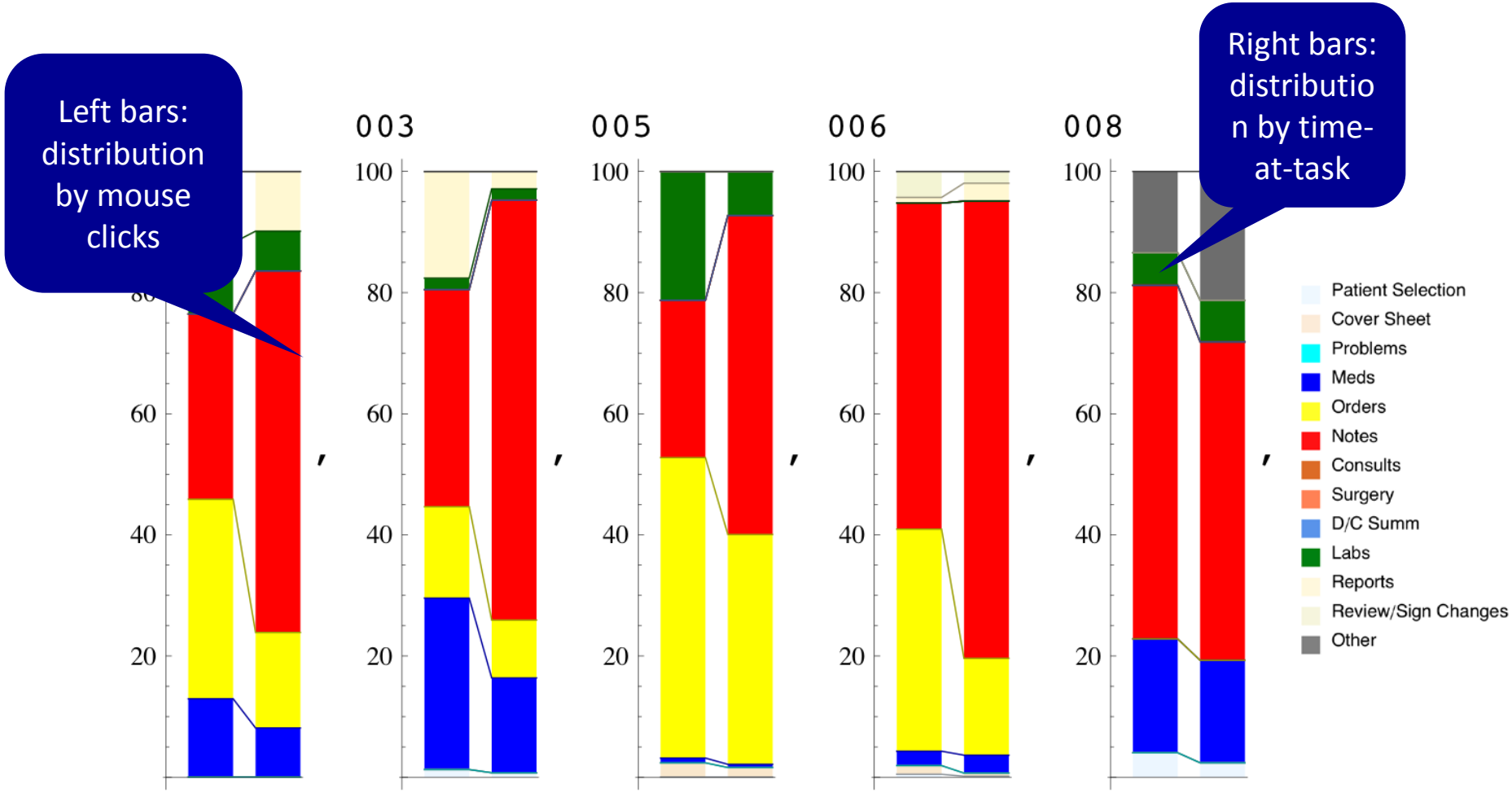
Physicians Multitask Throughout Visit

Example ~60 min visit



EHR Activity: Mouse vs Time-at-Task



Order Entry Analysis (Mouse Activity)

Order Entry Analysis (Meds)

```
021-04 → { , 0}
022-04 → { , 0}
023-04 → {1111122222222222222222, 22}
024-04 → {111111111, 9}
025-05 → {11111112222222222222333333333, 27}
026-05 → {1111111111111111111111111111112222222222222222222, 46}
027-05 → {11111111111111112222222222222222333333333333334444444444555555555555555555, 72}
028-05 →
 {1111111111111111111111111111111111111111111111111111111111111111111111111122222222222222222222222333333333333
   333333334444444444445555555555555555555555555555666666666666666666666666666666666666, 165}
029-05 → {1111111111111111, 16}
030-05 → {11111111112222222222222233333333333333333333444444444444444444444444555555, 70
031-06 → { , 0}
038-07 → { , 0}
041-07 → { , 0}
042-07 → {1111111111111111111, 19}
043-08 → {11111111111111111111111122222222222222222, 39}
```

Each row = 1 visit
This one has no Meds Orders

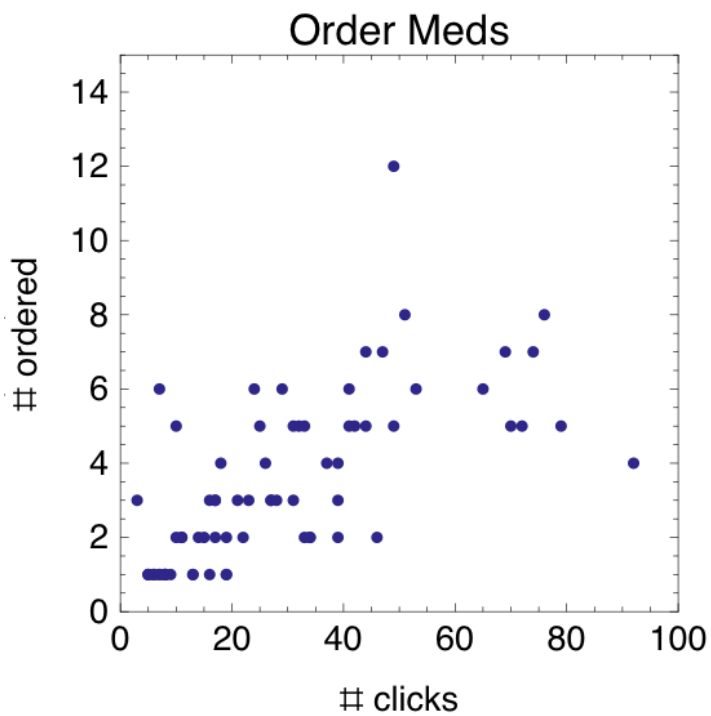
165 mouse clicks to order 6 meds

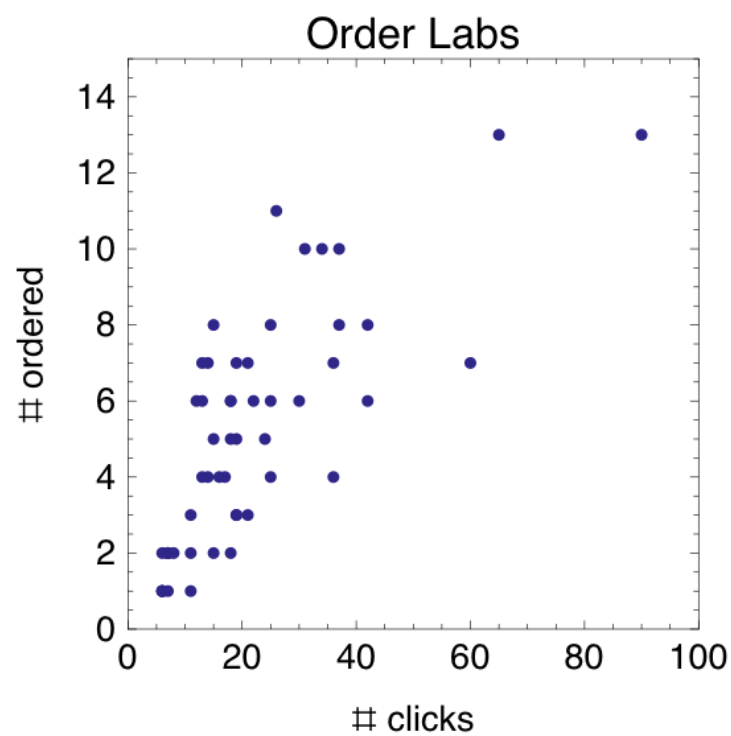
Order Entry Analysis (Consults)

We also profile Labs, Imaging, Reminders…

```
074-13 → { , 0}
075-13 → {1111111122222222222233333333333333, 34}
076-13 → {111111111111122222222222222233333333333333333333333333333333333, 61}
077-13 → {111111111111122222222222222233333333333333333333333333344444444444, 64}
078-13 → {111111111111, 12}
079-14 → {111111111111122222222333333333333333333333344444, 47}
080-14 → {1111111111222222222222, 23}
081-14 →
 {1111111111111222222222222
```

Order Entry Analysis Summary





Leverage Results → Drive EHR redesign

- Documentation & Order Entry
  - Notes: unstructured ASCII file → Structure data searchable tags, links, autocomplete
  - Pull down lists → Automate direct order entry
- Information Retrieval & Visualization:
  - Better Formatting, help Share
  - Labs, Meds, clinical events on multiple screens → leverage visualization like ZUI timeline browsers

Thank You!

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