



La progettazione di una cartella clinica elettronica per il Pronto Soccorso che risponda alle esigenze della pratica e della ricerca

*«Main features of the ideal medical record»*

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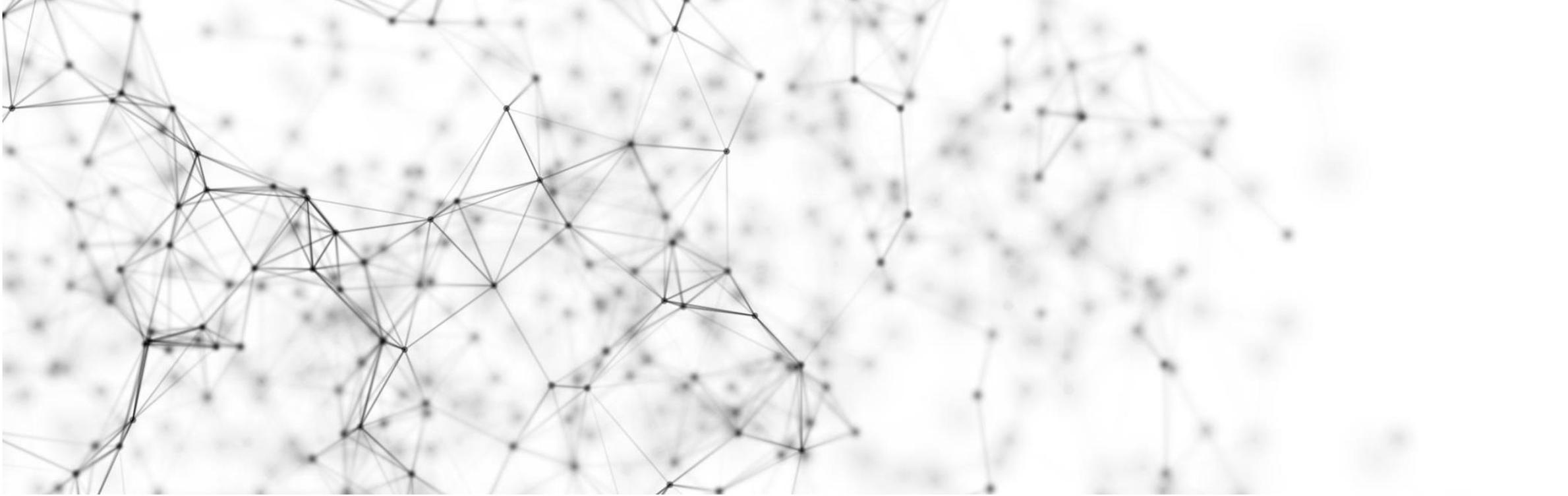
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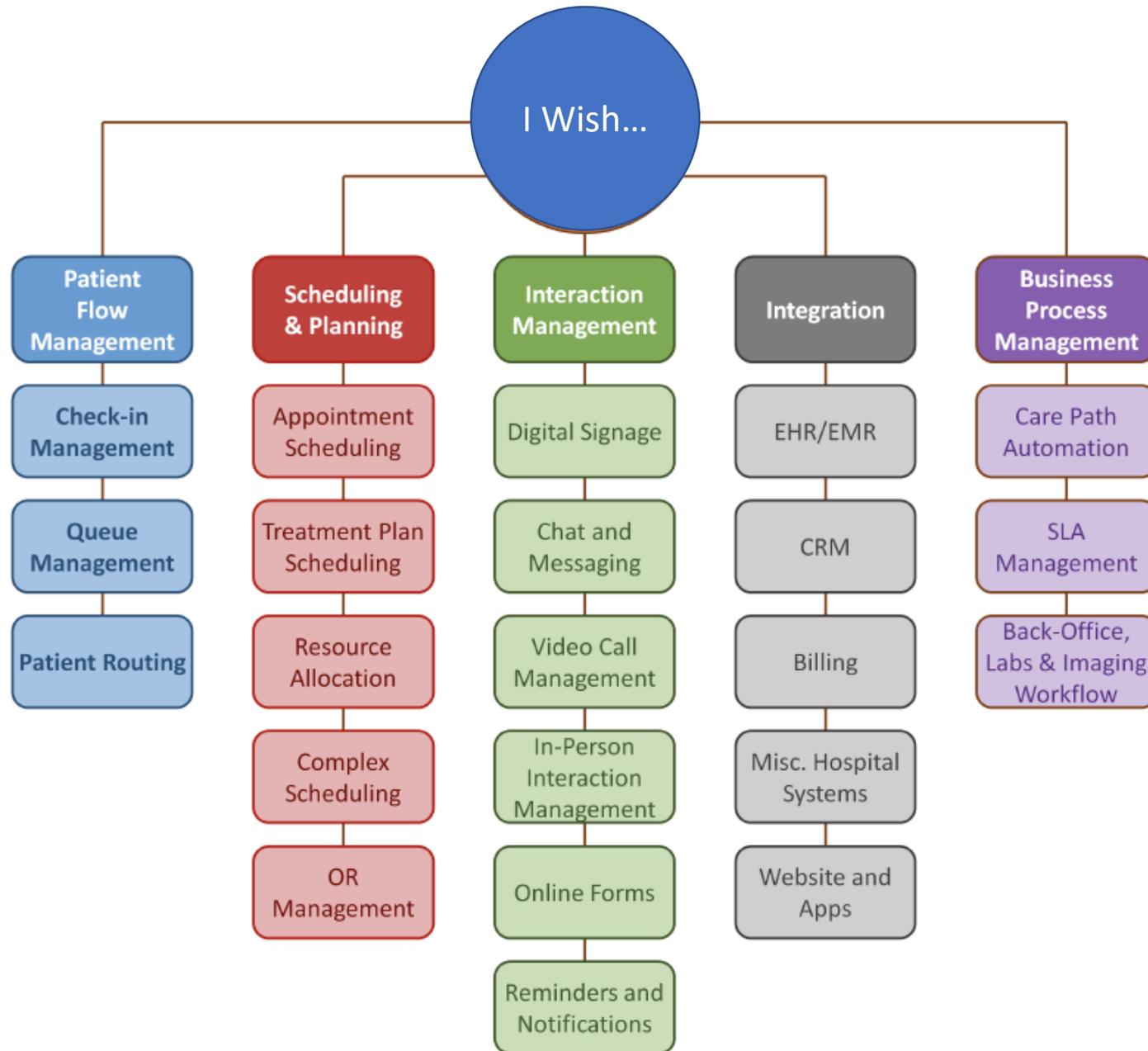


**I Wish.....**

The Clinician

The Manager

The Researcher

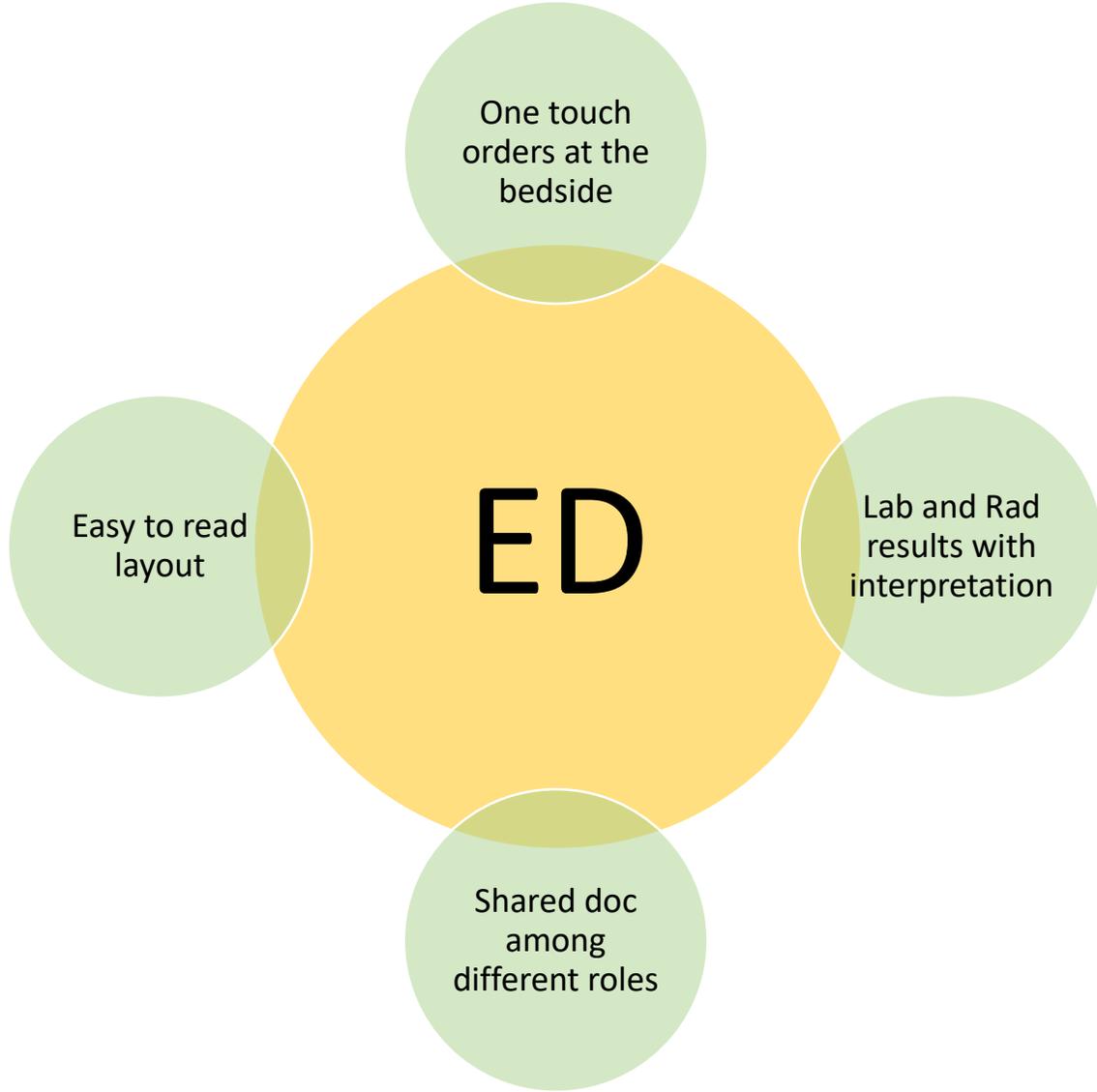




# The Clinician Whises

# ED as a gateway

The role it plays is central, expansive, and requires an all-inclusive approach.





# Doctor's wish

- Easy to switch between patients
- Easy to switch between conditions
- Rapidly enter patient data
- Minimize the opening of windows
- Intuitive

Andy Warhol in Praise of Laziness



# Doctor's wish

- Improve patient outcomes
- Save time

BRIEF REPORT | VOLUME 31, ISSUE 11, P1591-1594, NOVEMBER 01, 2013

## 4000 Clicks: a productivity analysis of electronic medical records in a community hospital ED

Robert G. Hill Jr., MD • Lynn Marie Sears, MBA • Scott W. Melanson, MD

Published: September 23, 2013 • DOI: <https://doi.org/10.1016/j.ajem.2013.06.028>

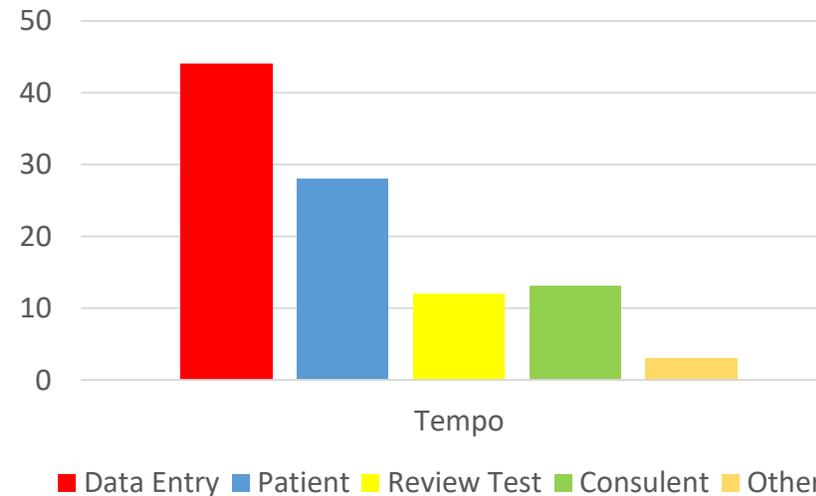
### Conclusion

Emergency department physicians spend significantly more time entering data into electronic medical records than on any other activity, including direct patient care.

Improved efficiency in data entry would allow emergency physicians to devote more time to patient care

*4000 mouse clicks during a 10-hour shift!!!*  
*2.5 pt/hour*

Time distribution



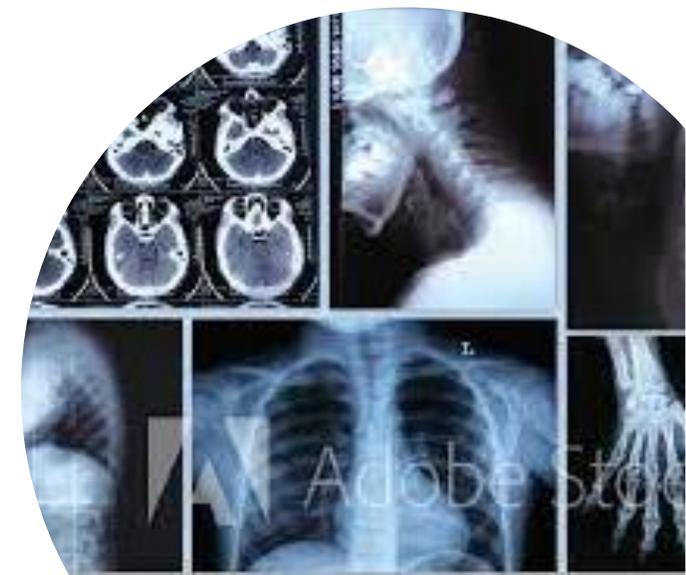
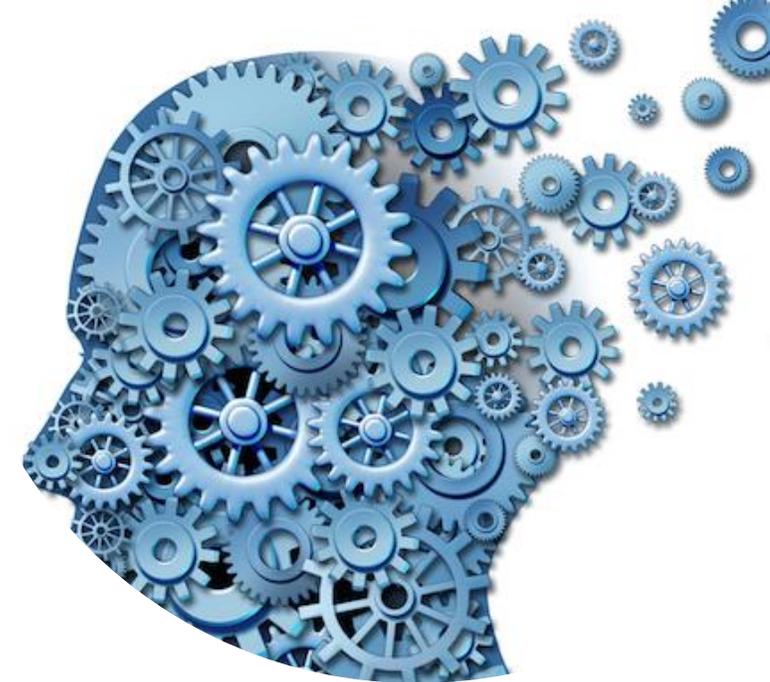
# SYSTEM SPEED

- Drag-and-drop
- A system that works just as fast as doctor do.
- expedite patient care
- simplified documentation
- Track patient status
- LAYOUT!!!!!!!!!!!!!!



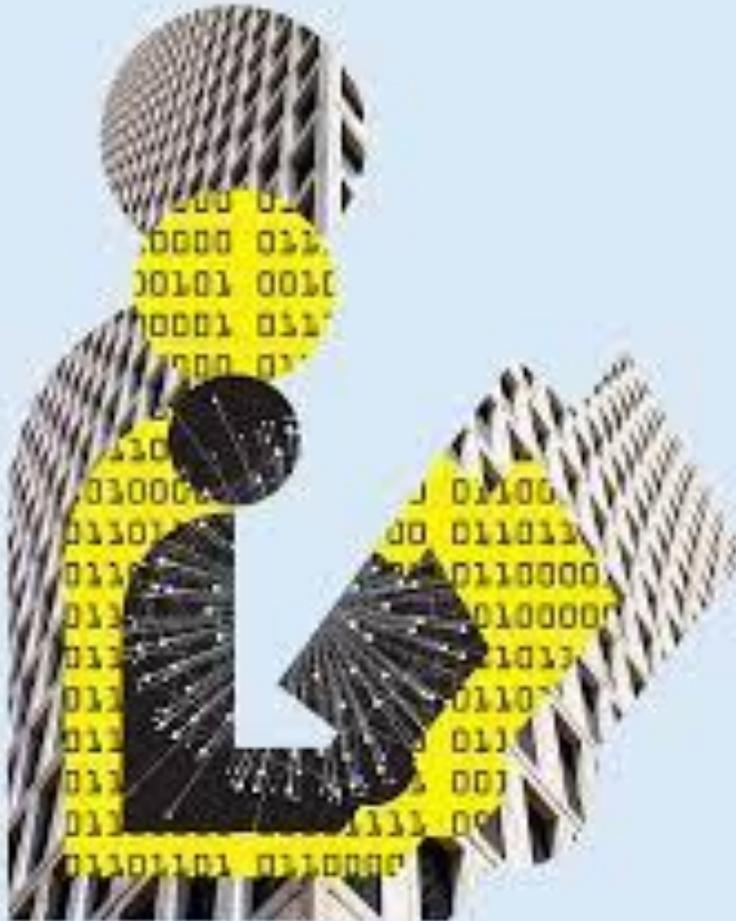
# Interface - Connectivity

- Radiology
- Lab
- Consultant from other specialty
- Mental Health Services
- Police
- Home Care
- Palliative Care
- Etc.....



# All Information Available

- Patient Volume and Disposition
  - Hour
  - Shift
  - Day of Week
  - Month
  - Quarter
  - Year
- List of all patients and disposition in a selected time frame
- Return Visits
- In a selected time frame, this report list all patients returned in 24, 48, and 72 hours



# Reports

Includes the patient name, chief complaint, Physician, Primary Nurse, Disposition and

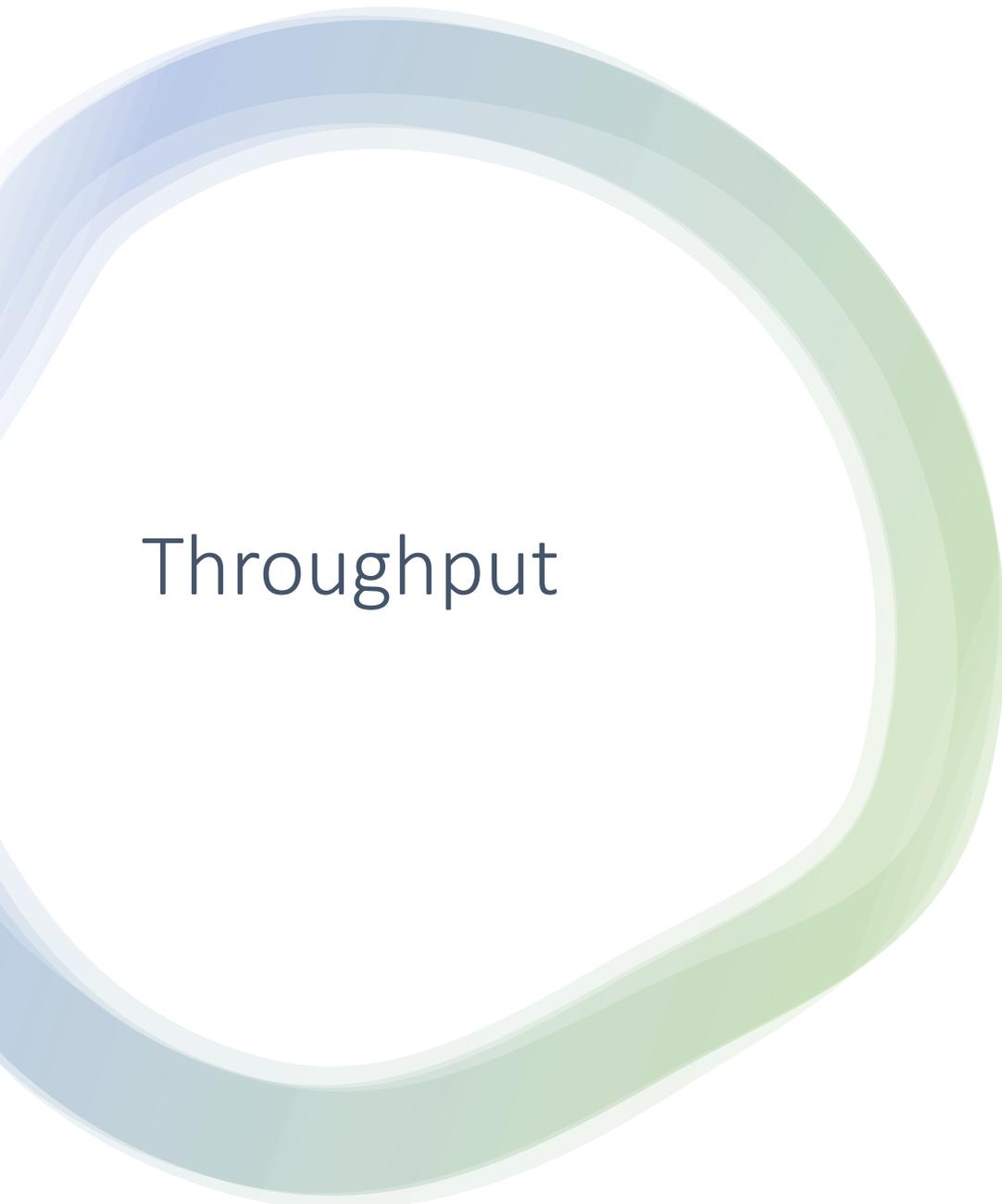
Total Number

Specific Time frame of listing of patients

Sort / Filter by Chief Complaint

Sort / Filter by Mode of Arrival

Sort / Filter by Provider



# Throughput

- Time points are: Registration, Triage, To Room, To Nurse, To Doc, Disposition, Time Out of ED
- Length of Stay Average times
- LOS specific to patient
- Sort by Provider
- Sort by Disposition
- Sort by layout
- Admission Holds



# Interventions to Safeguard System Effectiveness During Periods of Emergency Department Crowding

ACADEMIC EMERGENCY MEDICINE 2011; 18:1313-1317

Keith E. Kocher, MD, MPH, Steven A. Shane, MD, MS, Arjun K. Venkatesh, MD, MBA,  
Dominik Aronsky, MD, PhD, Brent R. Asplin, MD, MPH, and Niels K. Rathlev, MD

## THROUGHPUT: COGNITIVE OVERLOAD

potential interventions that may  
combat the challenges presented by  
cognitive overload

- 1) team training,
- 2) electronic alerts,
- 3) care plans,
- 4) protocols for specific diseases,
- 5) information technology (IT)  
systems.



# Requirements on an ED-EHR

## Challenges to deal with in EDs:

- Working in a “noisy environment”
- High-acuity patients
- Lack of predictability of patient flow
- Overcrowding
- Necessity of easily usable tools, which requires few passages and clicks
  
- Administrative and organization needs
- Clinical needs of the healthcare professionals
- Tool for clinical research

Conflicting requirements deriving from the needs



# Clinical needs

Design of the core services to support the minimal set of procedures common to the management of patient in an ED, e.g.:

Definiton of profiles

- actors
- roles
- Teams

Defintion fo the minimal set of common ptocedures

- Patient registration
- Triage and code/track/intensity of care decision
- Visit and outcome decision
- Prescription of therapies



# Clinical needs

Definition of configurable services (and their APIs) easily adaptable to the local setting:

- Managing teams, team change, shifts, etc.
- Managing the passage of information between teams at the shift change
- Adoption of standard communication protocols (HL7-FHIR, DICOM, etc.) for two-ways interoperability with the other hospital systems, e.g.,
  - Fast retrieving of laboratory and diagnostic imaging results
  - Effective communication of patient data to other wards
- Supporting communication and interaction with consultants



# Clinical needs

Design of «smart» multilingual UI ensuring:

Support to data input to minimise clicks and navigation steps

- Free text input vs structured data input (supported by terminologies, taxonomies, etc.)
- Auto-completion
- Active error prevention

Effective presentation of relevant information

- At-a-glance overview display of ward situation and patients' status according to different dimensions
- Avoid data and information clutter on the screen



# Clinical Needs

GDPR compliance, privacy by design

- Management of personal and high risk data
- Data treatment compliant with GDPR and local policies
- Implementation of authentication and authorization procedures for different profiles
  - Definition of different privileges for different actors on specific resources
  - Providing access (with restricted privileges) to consultants



# Clinical needs:

Implementation fo Decisione Support services (T3.4):

- Suggestions of further investigation based on the patient situation
- Reminder to perform tasks at the right time
- Signalling of possible critical situations (alarming parameter patterns, drug interactions, allergies to drugs, etc.)

This requires the modeling of considerable domain knowledge exploited by DSS

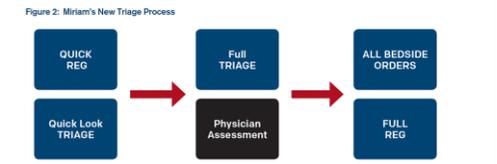
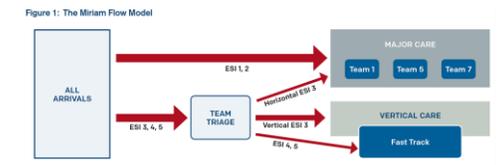
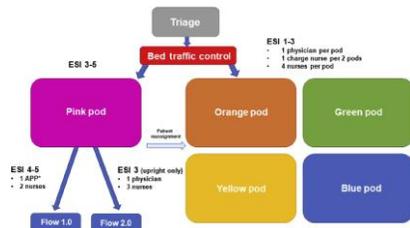
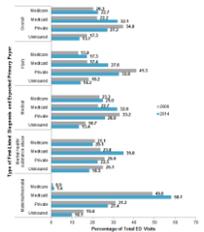
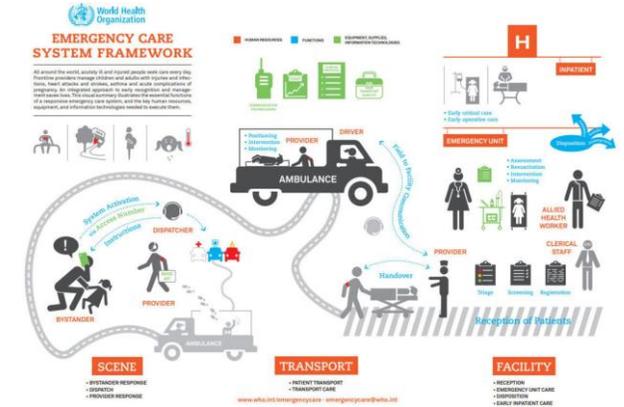
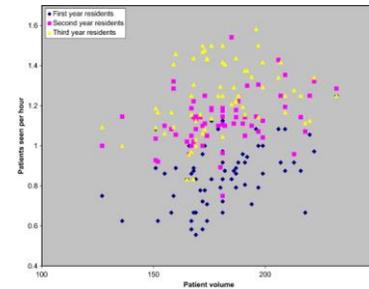
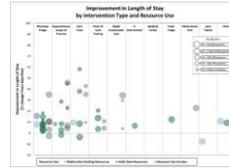
- Vocabularies,
- Taxonomies
- Ontologies
- Rule systems



# The Manager

# The Manager

- Organization
- Flow
- Clinical Risk Management
- Efficiency
- Productivity
- Revenue



# Queue Management

Real Time



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Average Time from Arrival to Disposition

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Average Time to See Provider

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Average Time in Waiting Room

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Average Time per Patient by Provider

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Average Time by Chief Complaint

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Average Time by Acuity Level

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Average Triage Time

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Length of Stay by Disposition

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Length of Stay by Diagnosis

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Admission Delays

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Patients per Hour per Room

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# Resources

- Top Prescribed Medications
- Top Prescribed Medications by Physician
- Medications per Chief Complaint and Diagnosis
- Top Lab Orders
- Top Lab Orders by Physician
- Orders by Chief Complaint
- Disposition by Chief Complaint
- Provider Procedures
- Nursing Procedures
- Syndrome Bio-surveillance

Resource utilization



# Quality

- Clinical reports for operational efficiency
- Productivity reports for all providers
- JCAHO core measure reporting
- Quality assurance measurement



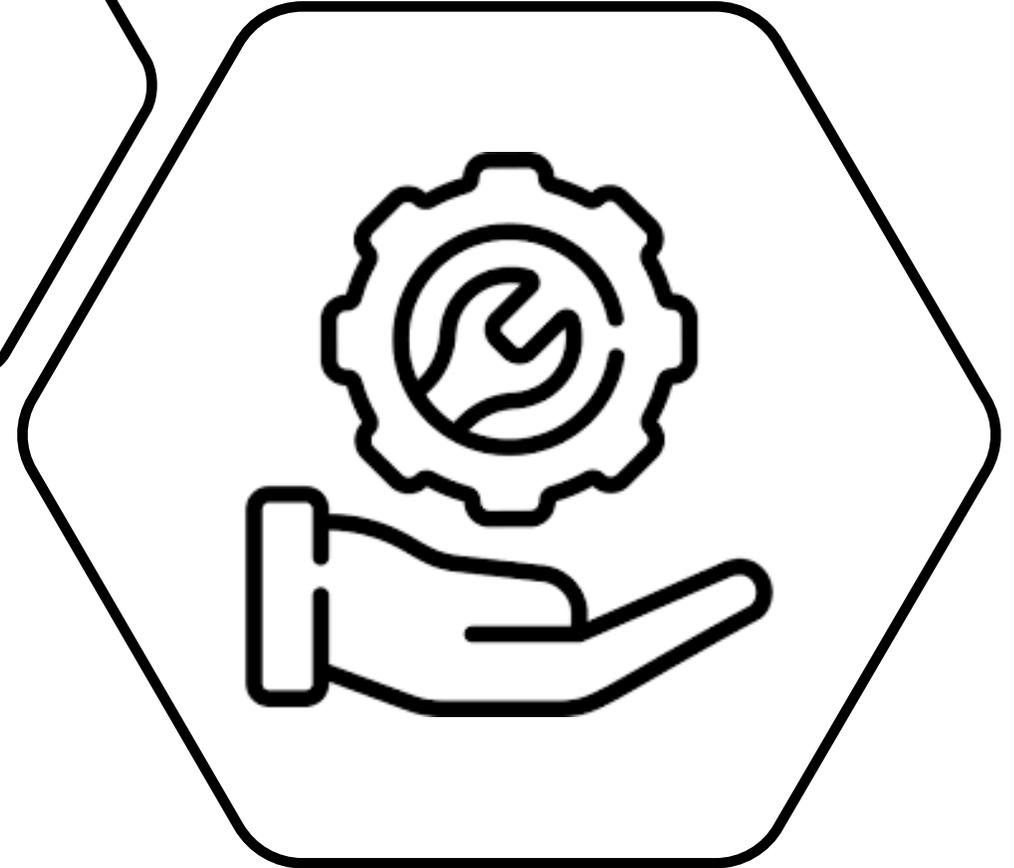
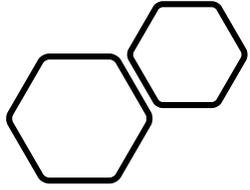


# Quality

*Age and gender specific templates*

*Intelligent Medical Record that will drive the Clinician toward proper diagnosis and care, reducing the risk of medical error and adverse outcome.*

- ED Documentation Template System centered around Patient Safety and Risk Management.
- High quality care in a risky environment.
- Real time Clinical Decision Support at the bedside
- Malpractice claims reduction.
- Optional Discharge Instructions
- Electronic Prescription Writer



## Support

- 24 x 7 x 365 Backend Support Team for System and Interfaces
- Personal Project Representatives Assigned to Every Client for the Life of the Account

# Administration

Coding

Billing

Primary Care Provider

- Medical Record can be electronically stored, retrieved, and transferred to host
- Comprehensive Administrative Reporting Module with standard and customizable Reports.



### Spend More Time with Patients

Increased efficiency and an intuitive workflow give you more time to spend practicing medicine.

- ✓ Less frustration and time spent searching for patient data
- ✓ Save time by easily prioritizing tasks and decreasing disposition time
- ✓ Fast and easy to use, giving you more time with your patients



### Improve Patient Throughput

Reduced patient wait time and quick access to more accurate chart data means happier, safer patients.

- ✓ ePrescribing solution enables providers to quickly and compliantly prescribe any medication from within the application
- ✓ Decrease the time patients have to wait
- ✓ Reliable chart accuracy ensures patients' safety



### Measure & Document with Accuracy

Accelerate and simplify the process of measuring performance, quality of care, costs and charges.

- ✓ Track department metrics in near real time to help manage resources
- ✓ Built-in notifications improve documentation by reminding caregivers of important clinical documentation requirements
- ✓ Scribe workflow support allows authorized users to assign themselves as the scribe for specific patients and enter documentation for the physician.



### Get Support When You Need It

Our dedicated support team and operational dashboard allow you receive quality support throughout our partnership.

- ✓ 24/7 365 days a years telephone support
- ✓ Dedicated account manager

# Manager needs

If the system collects high quality, structured data it is possible to evaluate in real time the quality and effectiveness of the ED processes

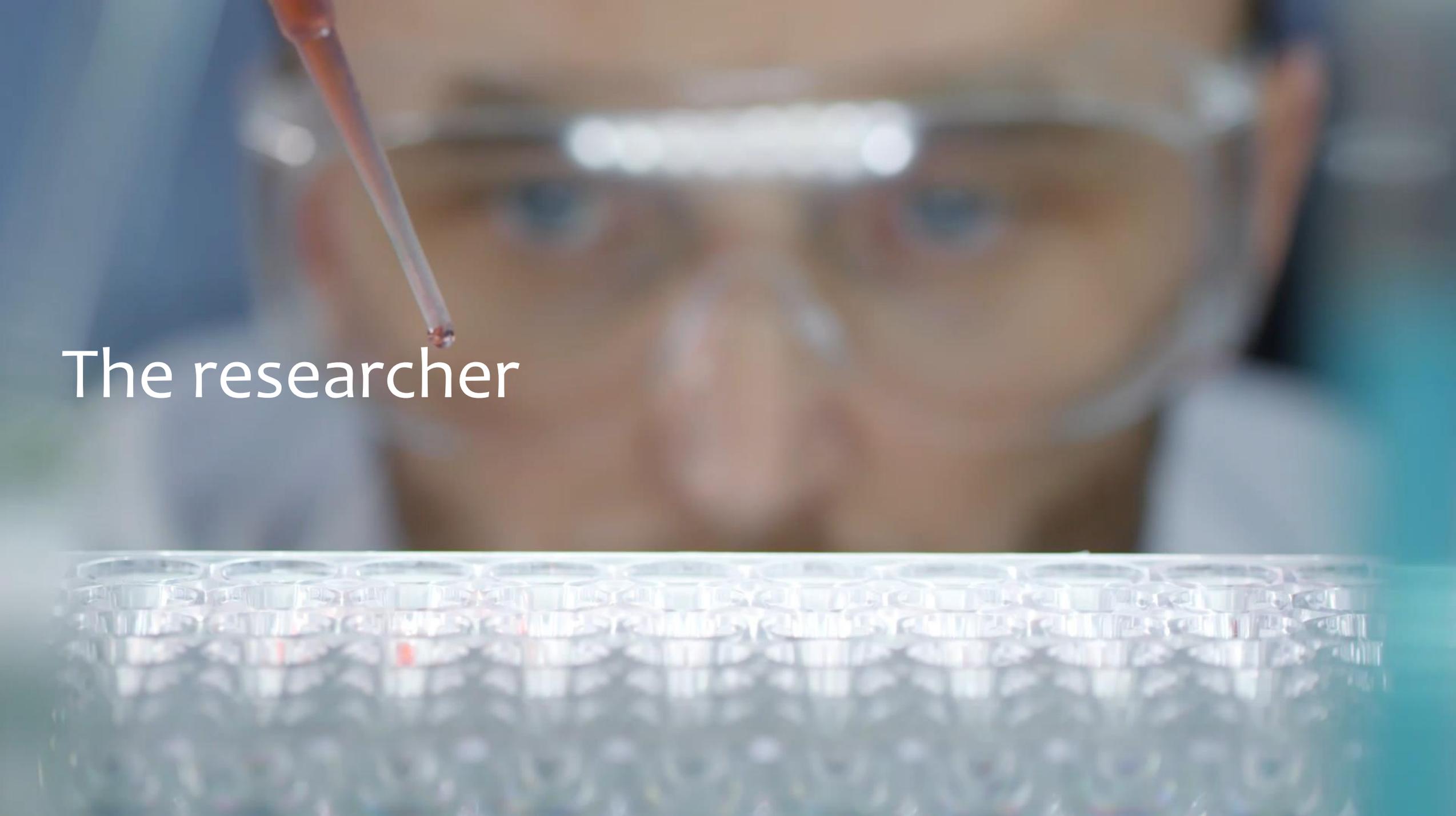
Real time evaluation of ED situation:

- Visualisation of activities and resource
- Visualisation and evaluation of queue, time (per patient, per activity, per provider, etc.)
- Use of resources

# Manager needs

## Ex-post analysis of the ED care process

- Process Mining techniques for evaluating process efficiency and care effectiveness
- Evaluation of the quality of the real process respect to a «ideal» process modelled in some process modelling language
- Summary reports of resource consumption, costs, resource availability, etc.

A close-up photograph of a scientist in a laboratory. The scientist is wearing safety glasses and a lab coat, looking intently at a multi-well plate. A pipette tip is positioned above one of the wells, with a small drop of liquid hanging from it. The background is blurred, showing other lab equipment and a clean, professional environment.

The researcher

# Research

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Big Data

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Millions of people passing through  
Emergency Departments

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What do we know about outcomes of our  
patients?

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What do we know about impact of our  
interventions on major outcomes?

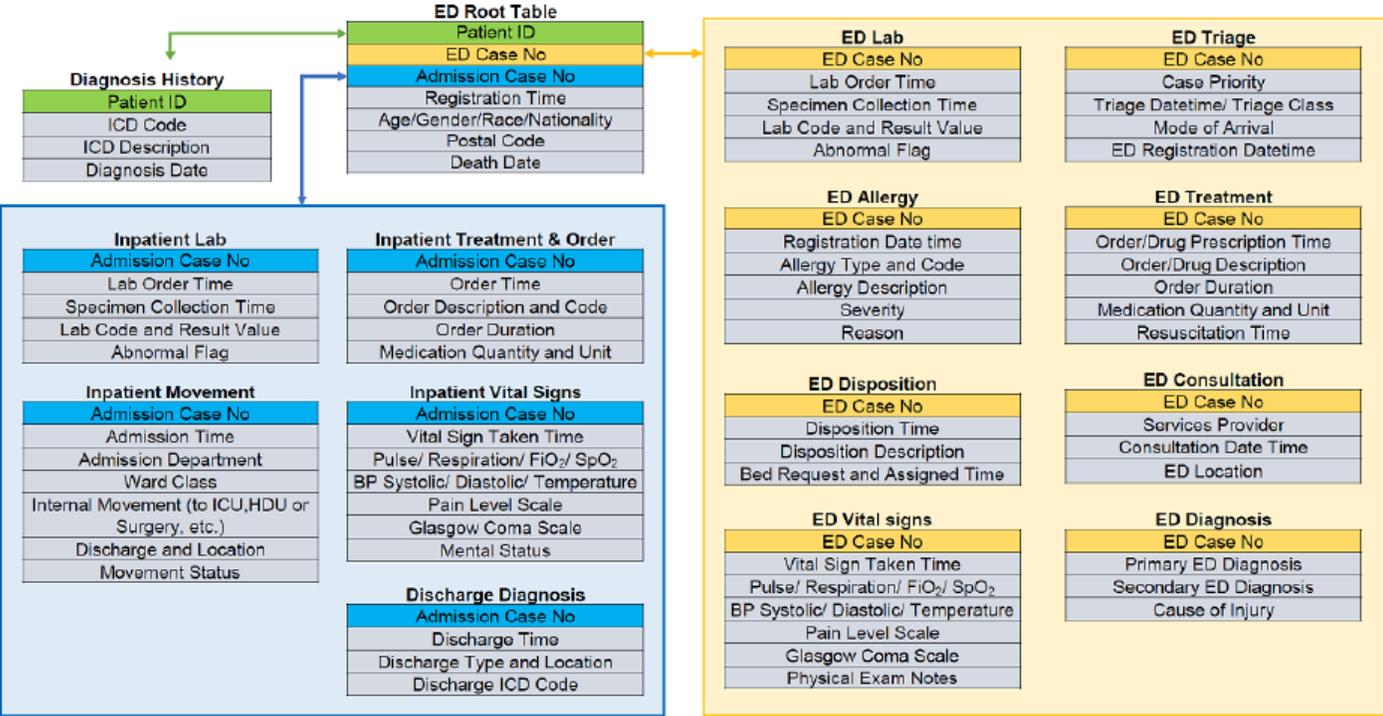
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Which are the determinants of outcomes  
depending on the chief complaints

# Leveraging Large-Scale Electronic Health Records and Interpretable Machine Learning for Clinical Decision Making at the Emergency Department: Protocol for System Development and Validation

Nan Liu<sup>1,2,3,4</sup>, PhD; Feng Xie<sup>1</sup>, BSc; Fahad Javaid Siddiqui<sup>1</sup>, MBBS, MSc; Andrew Fu Wah Ho<sup>1,5</sup>, MBBS, MPH; Bibhas Chakraborty<sup>1,6,7</sup>, PhD; Gayathri Devi Nadarajan<sup>5</sup>, MBBS; Kenneth Boon Kiat Tan<sup>5</sup>, MBBS; Marcus Eng Hock Ong<sup>1,4,5</sup>, MBBS, MPH

**Figure 2.** Illustration of the data linkage process of raw data tables through 3 primary identifiers. BP: blood pressure; ID: identification; ICD: International Classification of Diseases; ED: emergency department; ICU: intensive care unit; HDU: high dependency unit; SpO2: peripheral oxygen saturation; FiO2: fraction of inspired oxygen.





S. Yang, M. Njoku, C.F. Machenzie,

Big data' approaches to trauma outcome prediction and autonomous resuscitation,

British J. of Hospital Medicine, 2014; 75(11):637-41.

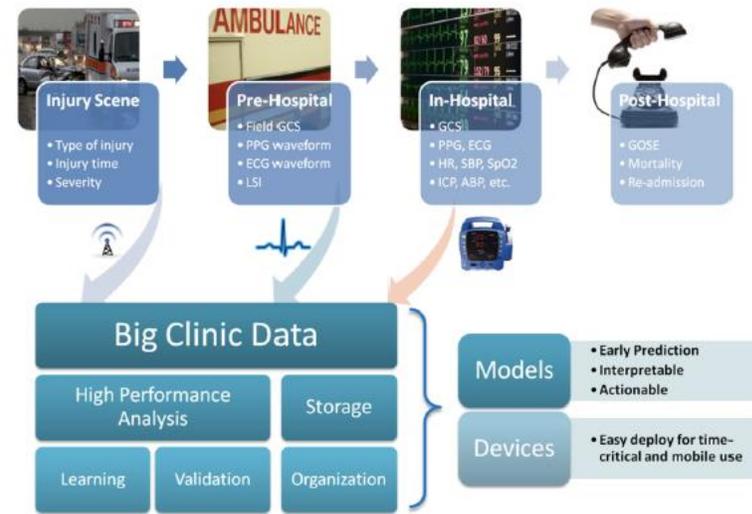
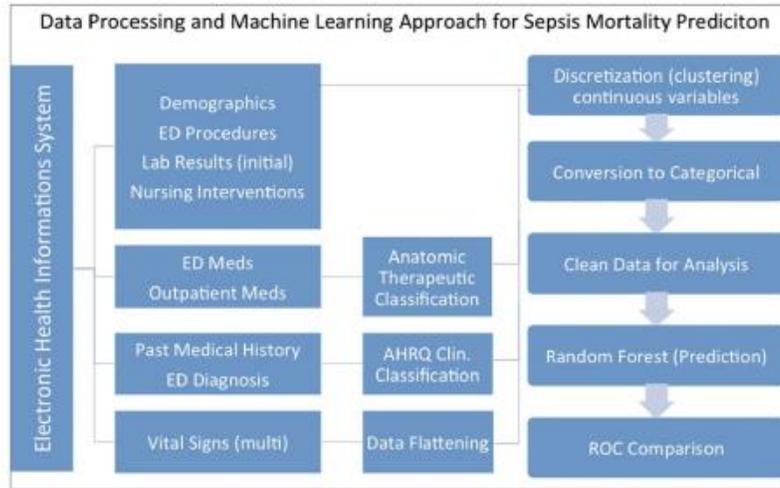


Figure 1. Data streams collected while a patient is transported, treated and discharged from a trauma centre. Critical components of the big data approach in handling those massive data are shown and the expected outputs.



## Prediction of In-hospital Mortality In Emergency Department Patients With Sepsis: A Local Big Data-Driven, Machine Learning Approach

R. Andrew Taylor, MD, MHS, Joseph R. Pare, MD, Arjun K. Venkatesh, MD, MBA, MHS, Hani Mowafi, MD, MPH, Edward R. Melnick, MD, MHS, William Fleischman, MD, and M. Kennedy Hall, MD, MHS

Department of Emergency Medicine, Yale University, Yale-New Haven Hospital (RAT, JRP, AKV, HM, ERM, WF, MKH), New Haven, CT

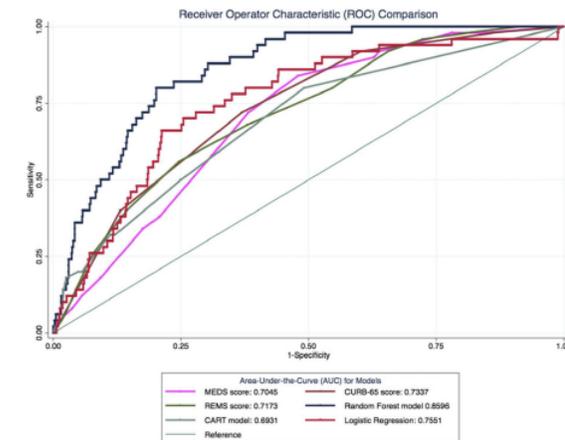
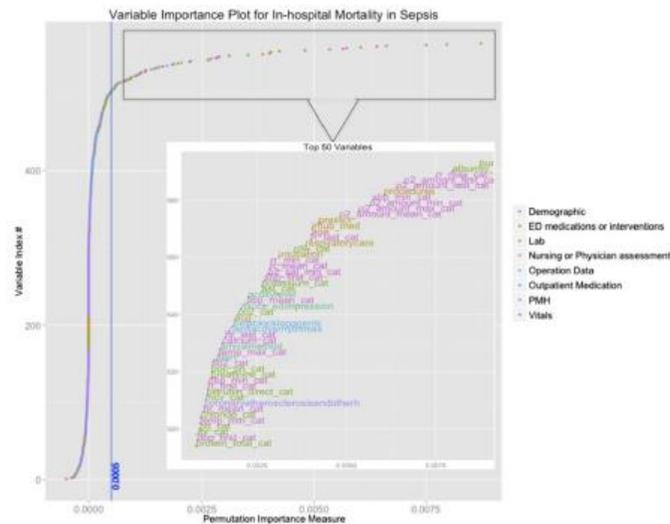


Figure 3. Receiver operator characteristic (ROC) curves with area-under-the-curve (AUC) values for random forest, traditional models, and existing sepsis clinical decision rules.

# Research needs: Data collection and use

## Minimum data set for researches

- It would be necessary to have in mind ex-ante which research could be carried out and which data could be needed

## Unambiguous, high quality data easily retrievable

- Data as much structured as possible, free text kept at minimum
- Precise semantic of the data, allowed by the adoption or standard terminologies, vocabularies, taxonomies, etc. and definition of data models
- High quality, error free, complete data: use of compilation assisted tools
- Avoid missing information

# Research needs: Data collection and use

Where unstructured text data are unavoidable (e.g., HIP)

- «While typing» information extraction and concept classification
  - Use of rules, domain ontologies, etc.
- Ex-post extraction of meaning from the whole text
  - e.g., of ML based NLP/NLU technologies

Privacy issues and GDPR compliance

- Data anonymization: can be a difficult task if data are non structured (text, images)



We have a  
dream....  
...and a plan

