AMDIS (TED) Talks

AMDIS Physician-Computer Connection

Ojai, CA

June 16, 2022

Today's Presentations…

- The Future of Scheduling & Communications: Aligning Technologies to Improve the Provider Experience.
  - Patrick Guffey MD MHA
- Proving Value With Population Health Initiatives in the Post-Pandemic Era
  - Irshad Siddiqui M.D.,M.S.
- Raw audit logs for the measurement of physician workload, cognitive burden, and burnout
  - Thomas Kannampallil, PhD
- Using AI to adjust to the "new normal"
  - Robert Budman, MD MBA

Today's Format…

- Presentation
  - Questions and discussion
- Presentation
  - Questions and discussion
- …

# *The Future of Scheduling & Communications: Aligning Technologies to Improve the Provider Experience.*

AMDIS 2022 PCC

Patrick Guffey MD MHA

Chief Medical Information Officer, Children's Hospital Colorado

Associate Professor, University of Colorado School of Medicine

DISCLAIMER: The views and opinions expressed in this presentation are solely those of the author/presenter and do not represent University of Colorado or Children's Colorado.
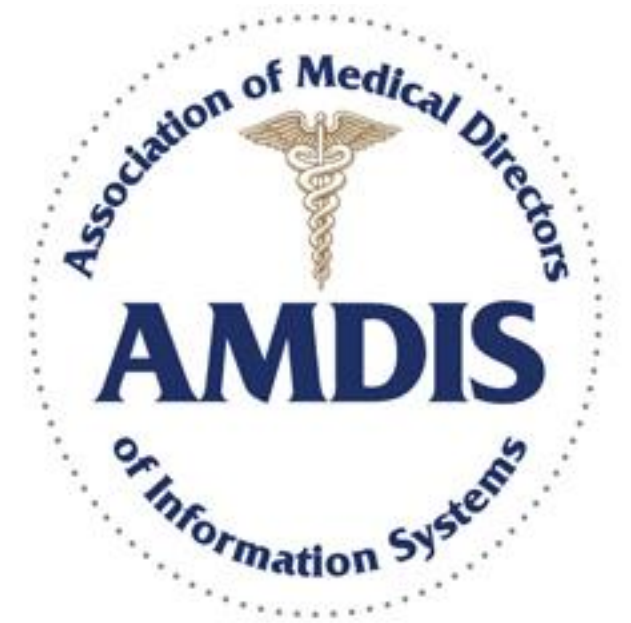
Conflict of Interest

Patrick Guffey MD, MHA

Has no real or apparent conflicts of interest to report

Uncompensated Officer of the Board of Directors:
Contexture – Regional HIE for Arizona & Colorado
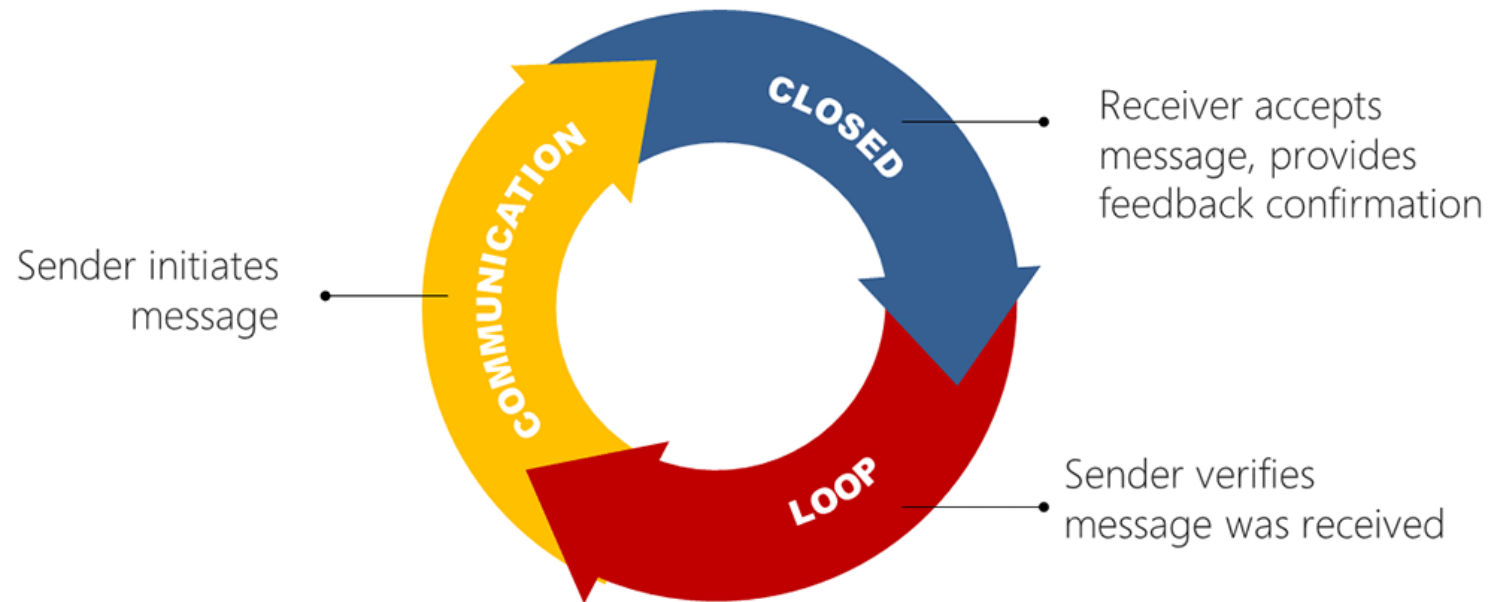Anesthesia Quality Institute

Safety and communications

- Communication failures in U.S. hospitals and medical practices were responsible at least in part for 30 percent of all malpractice claims

- JC Sentinel Event Alert 58, CRICO Strategies. Malpractice risk in communication failures. 2015.

- A review of reports from the JC reveals communication failures were implicated as the root cause of over 70% of sentinel events

- Joint Commission Patient Safety Goals – Improving Patient Safety Through Provider Communication Strategy Elements, Dingley C, Et. Al. 2008

-

Closed Loop Communication

Exchange clear, concise communication, acknowledge receipt, and confirm understanding

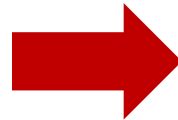Right tool for the urgency and acuity of the communication

Receiver accepts message, provides feedback confirmation

Sender initiates message

Sender verifies message was received

CLOSED

LOOP

COMMUNICATION

Mode of Communication	Priority of Message Being Relayed						Discoverability
	FYI	Routine	Important	Urgent (pager equal)	Critical	Emergency Team Activation	
Action Required	N/A (none required)	Within a day	Within 4 hour	Within 30 minutes	Immediate response or action	Immediate action	C - In patient chart D- Discoverable
Examples:	(Patient arrival, patient update that does not require action)	(Medication change request, order request, request to update family, request to update care team)	(Update patients orders, future order)	(Abnormal lab values or vital signs, pending discharge)	(Critical lab values, critical vitals)	(Code Blue, RRT, Trauma, EMCO, Delivery, MTP, Code Green, Bart, Stroke etc.)	
Emergency Team Activation	Do not use	Do not use	Do not use	Do not use	Do not use	✓	(D)
Verbal (Phone, video, in-person)	✓	✓	✓	✓	✓	Do not use	(D)
Secure Chat	✓ *Normal message	✓ *Normal message	✓ *Important message	✓ *Urgent Message	Do not use	Do not use	(D)
Tiger Connect - (External Provider)	✓	✓	✓	Do not use (Verbal Only)	Do not use (Verbal Only)	Do not use	(D)
In Basket message (Result Routing/Result Note Routing)	✓	✓	Do not use	Do not use	Do not use	Do not use	(C,D)
Clinical Correspondence (Note routing, hand off tools, fax ect.)	✓	✓	Do not use	Do not use	Do not use	Do not use	(C,D)
Clinical Communication Orders (Nursing, Care team)	✓	✓	Do not use	Do not use	Do not use	Do not use	(C,D)
Epic Sticky Note	✓	Do not use	Do not use	Do not use	Do not use	Do not use	(D)
Nurse to Nurse/Care Team Communication (Summary Reports)	✓	Do not use	Do not use	Do not use	Do not use	Do not use	(D)
Personal Text							(D)
Email		Do not use					

Asynchronous methods   **Synchronous**

Children's Hospital Colorado – Communication Matrix

10 Communication Methods
Definition of Burnout

1. Text messaging personal cell
2. Pagers
3. EHR Messaging
4. Clinical messaging apps (external use)
5. Phone call to personal cell
6. Voicemail on personal cell
7. Phone call to hospital / work phone
8. Voicemail on hospital / work phone
9. EHR In-basket
10. Email

10 Communication Methods
Definition of Burnout

1. ~~Text messaging personal cell~~
2. ~~Pagers~~
3. **EHR Messaging**
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10. Email

National Toss Your Pager in the Trash Day - October 16, 2015

Green Screen of Death: 24/7 Suggestion Box of Pure Evil

Indestructible Case: Made of Cockroach Shells

Self-Medication Buttons:
Up - Increase Xanax
Down - Decrease Xanax

Protective Glass Shield: Thwarts MRSA, Poop, Urine, Tears of Sadness

No Battery Required: Powered by Misery; Works Even If Turned Off or Destroyed

FML Button: Speed-Dials Mom for Moral Support

OMG Button: Activates Self-Destruction Sequence

Time Travel Buttons:
Left - Travel Back to a Happier, Pager-Free Life
Right - Fast-Forward to a Bar, Beach Somewhere

Pager Alerts: 45 Incredible Sounds, Ranging from Highly Annoying (Cat Shriek) to Full-On Irritating (Nails on Chalkboard)

Gomerblog.com

Ideal communication strategy

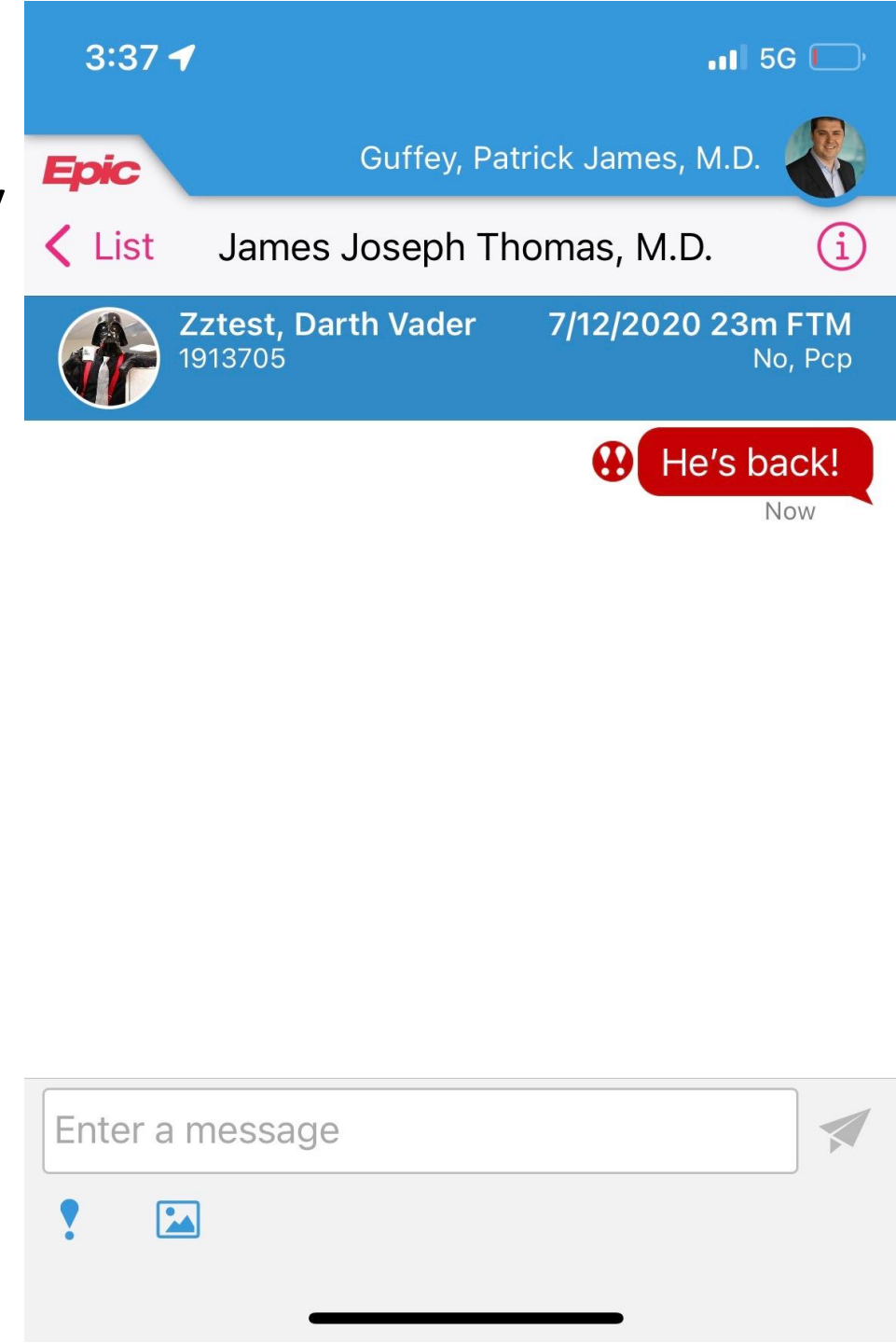- **One application for voice, messaging, clinical care**
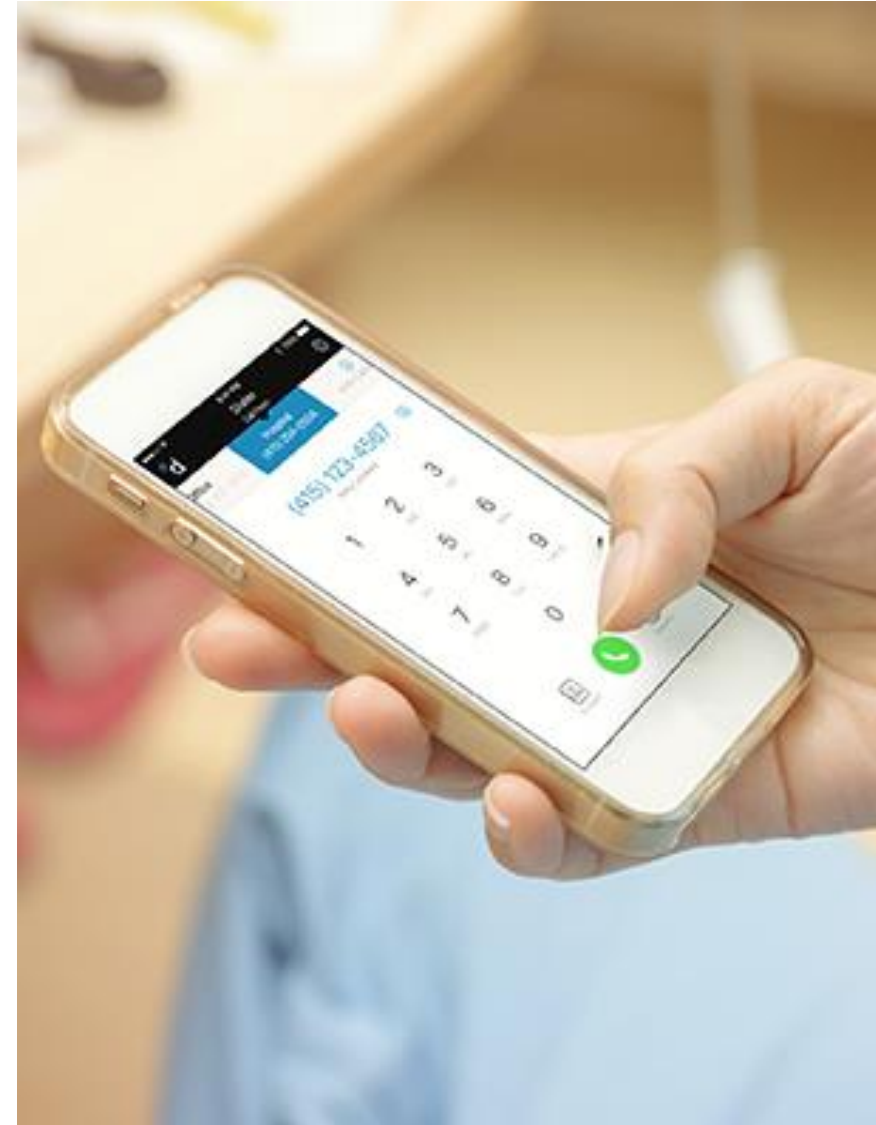
Ideal communication strategy

- One application for voice, messaging, clinical care
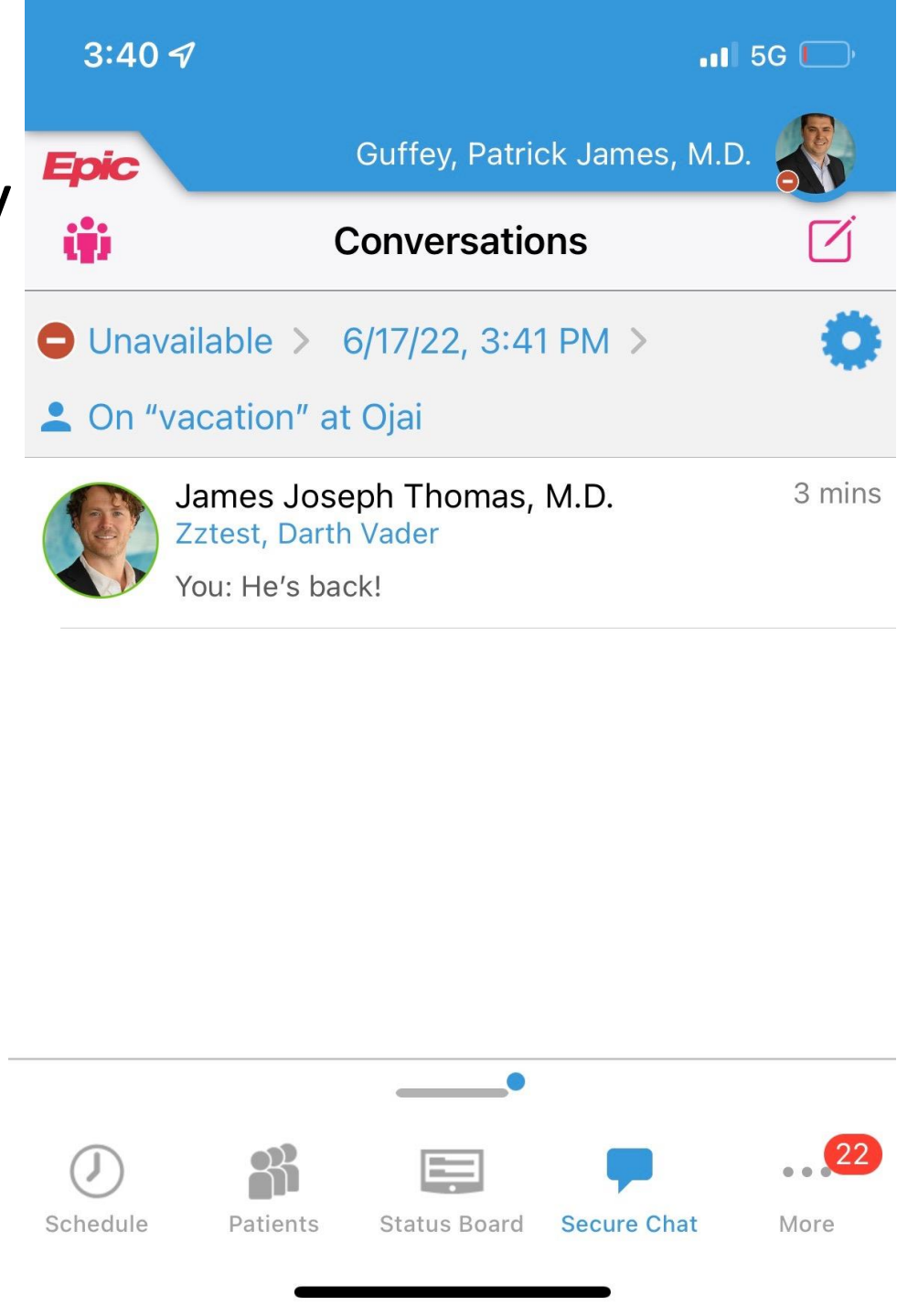- **Integrated, accurate, enterprise call schedule**

Ideal communication strategy

- One application for voice, messaging, clinical care

- Integrated, accurate, enterprise call schedule
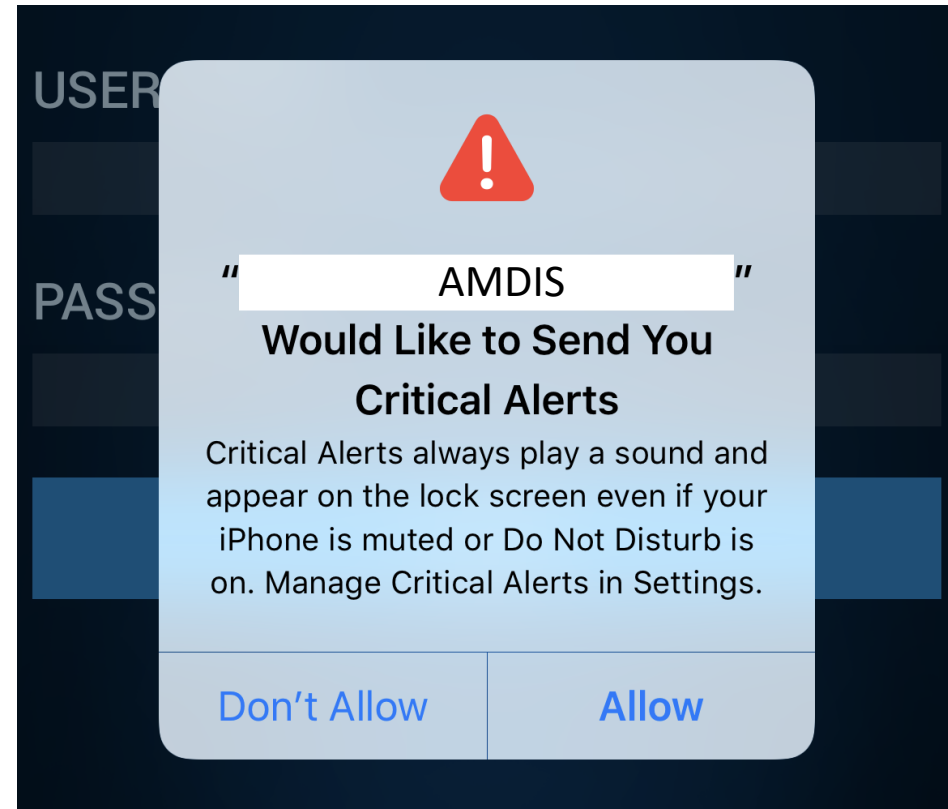
- **Messaging tied to the patient**

Ideal communication strategy

- One application for voice, messaging, clinical care

- Integrated, accurate, enterprise call schedule

- Messaging tied to the patient

- **Dynamic "availability" – on vacation**
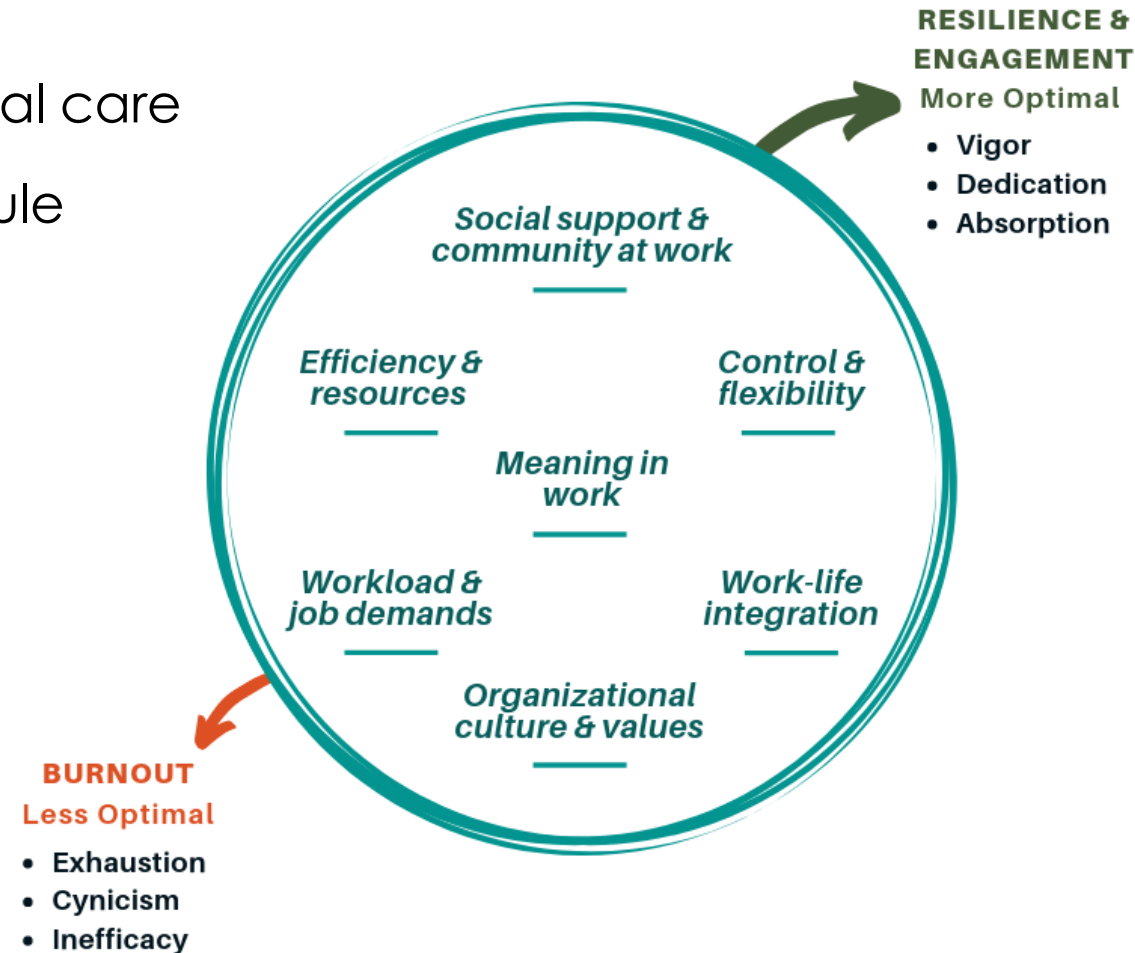
Ideal communication strategy

- One application for voice, messaging, clinical care

- Integrated, accurate, enterprise call schedule

- Messaging tied to the patient

- Dynamic "availability" – on vacation

- **Ability to control alerts and breakthrough**

Ideal communication strategy

- One application for voice, messaging, clinical care

- Integrated, accurate, enterprise call schedule

- Messaging tied to the patient

- Dynamic "availability" – on vacation

- Ability to control alerts and breakthrough

- **Respect for resiliency and burnout**

THE KEY DRIVERS OF BURNOUT

RESILIENCE & ENGAGEMENT
More Optimal
- Vigor
- Dedication
- Absorption

Social support & community at work

Efficiency & resources

Control & flexibility

Meaning in work

Workload & job demands

Work-life integration

Organizational culture & values

BURNOUT
Less Optimal
- Exhaustion
- Cynicism
- Inefficacy

VA.gov

Ideal communication strategy

- One application for voice, messaging, clinical care

- Integrated, accurate, enterprise call schedule

- Messaging tied to the patient

- Dynamic "availability" – on vacation

- Ability to control alerts and breakthrough

- Respect for resiliency and burnout

- **Ability to use a personal device (one device only)**

Ideal communication strategy

- One application for voice, messaging, clinical care
- Integrated, accurate, enterprise call schedule
- Messaging tied to the patient
- Dynamic "availability" – on vacation
- Ability to control alerts and breakthrough
- Respect for resiliency and burnout
- Ability to use a personal device (one device only)
- **As Simple as Possible**

Time for a Change

- Communication is a key factor in patient safety events (virtually every one that's serious)

- Pagers are 1990s technology – not up to date, accurate or secure

- Pagers don't live in the EHR where we work

- No dynamic context link to the patient

- **If cellphones were invented before pagers – pagers would not exist**

Our Plan

Move communication into our clinical workflow

Make it easy & seamless

Automatic, Immediate Updates

Enterprise Hospital Call Schedule
Automatic pull from department call schedules to enterprise call schedule

Link the Call schedule into the EHR
Put the call schedule where we need it
Respect the clinical workflow

Use EHR communication tools
Communicate within existing apps
Ability to link to the patient

Action Plan: Enterprise Call

- Real time access to who is on call

- Feed from department scheduling system to hospital system, automatic

- Up to date information

- Reduce rework and time for staff

- Preferred Communication – Cell number feeds across
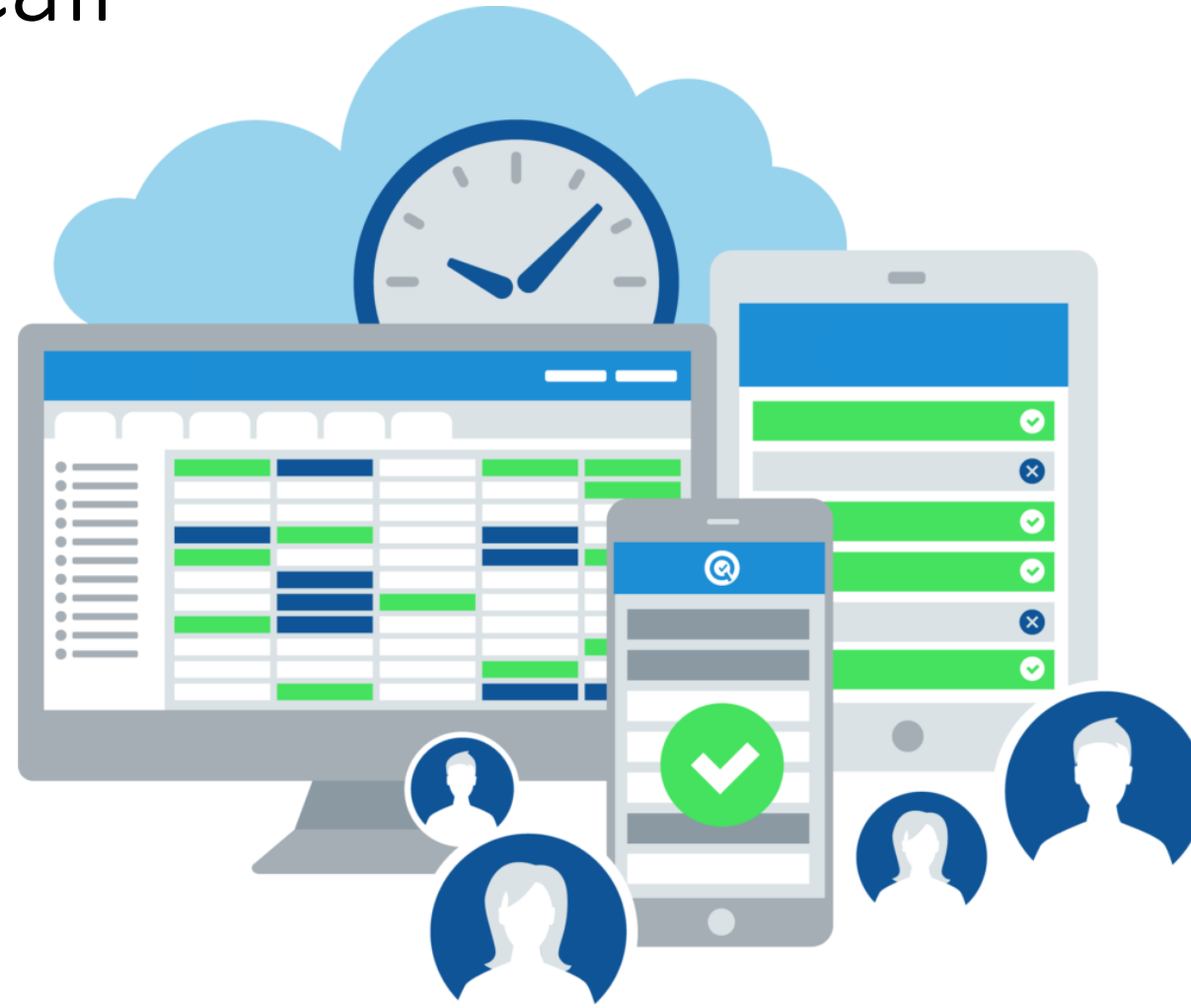
Enterprise Call Schedule

Schedules	Location	Provider Type	Care Type	Providers	Start	End	Phone Numbers	Schedule Contact Instructions
Community/Parent Phone Consults 7:30a-7:30a ⓘ	AMC	Attending						ⓘ *1st call for PARENT CALLS and phone advice for all NOC and community providers not needing admission or transfer (exception: for Colorado Springs patients and Southern Colorado community calls, contact CSH consult attending)*
COS Consult On Call ⓘ	COS	Attending	IP	Timothy			Mobile: 720-555-1212	ⓘ *ED/Inpt/Outpt Consults, call provider's cell phone. Do not Secure Chat.*
COS EMU/INPT Reader ⓘ	COS	Attending	IP	Kathleen 💬			Mobile: 720-555-1212	ⓘ *EMU consults and admissions, call provider's cell phone. Do not Secure Chat.*
CSH Outpt EEG Reader 8a-8a	COS CSH	Attending		Kathleen	8:00a	8:00a	Mobile: 720-555-1212	
EMU Fellow ⓘ	AMC	Fellow						ⓘ *1st call for patients admitted to the EMU*
General IP Floor Team Lead 6a-5p ⓘ	AMC	APP Fellow	IP	E, Elizabeth	5:00p	6:00a	Mobile 720-555-1212	ⓘ *1st Call for ED consults that may need in-person eval/EEG, all Floor consults, NOC IP telehealth consults, and admission/transfer requests from community providers and NOC; 2nd call for patients admitted to Neuro Silver (contact Silver intern/resident first). 17:15pm-7:30am only: also 1st call for PARENT CALLS and phone advice for all CHCO ED, NOC, and community providers.*
Neuro ICU Team Lead 6a-5p ⓘ	AMC	APP Fellow		E, Elizabeth	5:00p	6:00a	Mobile: 720-555-1212	ⓘ *1st Call for PICU, NICU, CICU, CPCU, stroke, and UCH NICU consults*
NOC EEG Coverage: North and Sout 7:30a-5p ⓘ	AMC	Attending						ⓘ *Call Neurology Business Line at x77575 to contact the EEG reader on call; if there is no answer, call "cEEG/EMU attending"*
Outside EEG: Billings Clinic 7:30a-5p ⓘ	AMC	Attending						ⓘ *Call Neurology Business Line at x77575 to contact the EEG reader on call; if there is no answer, call "cEEG/EMU attending"*
Outside EEG: Mercy Hospital 7:30a-5p ⓘ	AMC							ⓘ *Call Neurology Business Line at x77575 to contact the EEG reader on call; if there is no answer, call "cEEG/EMU attending"*
Outside EEG: St. Joe's/St. Mary 7:30a-5p ⓘ	AMC	Attending						ⓘ *Call Neurology Business Line at x77575 to contact the EEG reader on call; if there is no answer, call "cEEG/EMU attending"*
DOTW 7:30a-5:15p ⓘ	AMC	Attending						ⓘ *1st call for Anschutz ED consults needing phone advice only, PARENT CALLS, and phone advice for all NOC and community providers not needing admission or transfer*
AST Day Attending 8a-5p ⓘ	AMC	Attending						ⓘ *Call the Operator (x75555) to issue a Stroke Alert. The Stroke attending and Neuro ICU Team Lead receive the Stroke Alert page and will reach out to you urgently.*
AST Night Attending 5p-8a ⓘ	AMC	Attending		Timothy	5:00p	7:00a	Mobile: 720-555-1212	ⓘ *Call the Operator (x75555) to issue a Stroke Alert. The Stroke attending and Neuro ICU Team Lead receive the Stroke Alert page and will reach out to you urgently.*
EMU Attending 8a-8a ⓘ	AMC	Attending		S, Scott	8:00a	8:00a	Mobile: 720-555-1212	ⓘ *2nd call for patients admitted to the EMU*
EMU APP AM 8a-12p ⓘ	AMC	APP						ⓘ *1st call for patients admitted to the EMU*
EMU APP PM 1p-5p ⓘ	AMC	APP						ⓘ *1st call for patients admitted to the EMU*
cEEG/EMU Night Attending 5p-8a ⓘ	AMC	Attending		S, Scott	5:00p	8:00a	Mobile: 720-555-1212	ⓘ *1st call (unless an EMU Fellow is listed) for patients admitted to the EMU; 1st call for STAT EEGs at UCH NICU, St. Joe's, St. Mary's, or Billings*

Action Plan: EHR Integration

- Enterprise schedule feeds to EHR automatically

- On Call information where we work

- All clinical team members have access

- One of the first in the nation

On-Call Finder

Su	Mo	Tu	We	Th	Fr	Sa
27	28	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Facility

Search facilities 🔍

Specialty

Search specialties 🔍

Provider Team

Search teams

- NEPHROLOGY - DIALYSIS
- **Neurology**
- Neurology - EEG/EMU
- Neurology South
- Neuromuscular Consult
- Neuromuscular Consult
- Neuropsychology
- Neuropsychology Inpatient...
- Neurosurgery
- Neurosurgery - Neuro Interv...
- NUTRITION
- Nutrition MD Consult
- OPHTHALMOLOGY
- OR - North Campus
- OR - South Campus
- ORTHOPAEDIC NORTH
- ORTHOPAEDIC SOUTH
- ORTHOPAEDICS
- PATHOLOGY

Currently on-call for Neurology

Doctor of the Week
Jessica Christine, M.D.
07:30 Mar 2 to 17:15 Mar 2

💬 Chat

Phone
720-555-1212

Notes
7:30am-5:15pm -1st call for phone advice only for Anschutz ED, NOC and community providers not needing admission or transfer.|||DOTW

2nd Contact - General IP Attending
Ryan Michael, M.D.
08:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
2nd Call if no response from General IP Floor Team Lead|||General IP Floor Attending

2nd Contact Neuro ICU Attending
Ricka Denise, M.D.
08:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
2nd Call if no response from Neuro ICU Team Lead|||Neuro ICU Attending

Acute Stroke Attending
Ricka Denise, M.D.
08:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
Call the Operator (x75555) to issue a Stroke Alert. The Stroke attending and Neuro ICU Team Lead receive the Stroke Alert page and will reach out to you urgently.|||AST Day Attending

St. Joe NICU consult
Padmini, M.D.
08:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
For consults only on St. Joe's NICU patients. For St. Joe's EEG, please call x77575 to contact the EEG reader on call.|||St. Joes NICU Consults

1st Contact - General IP Fellow
Ellen Marie, CPNP-PC
12:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
1st Call for in person ED consults, EEG requests, all Floor consults, NOC IP consults, and admission/transfer requests from community providers and NOC; 2nd call for patients admitted to Neuro Silver (contact Silver intern/resident first). 8:30pm-7:30am only: 1st call for PARENT CALLS and phone advice for all CHCO ED, NOC, and community providers.|||General IP Floor Team Lead

1st Contact - Neuro ICU Fellow
Jill M, CPNP-AC
12:00 Mar 2 to 17:00 Mar 2

💬 Chat

Phone
720-555-1212

Notes
1st Call for PICU, NICU, CICU, CPCU, stroke, and UCH NICU consults|||Neuro ICU Team Lead

Action Plan:
EHR Messaging

Ability to attach patient

Auto forward messages

Set your availability

Send priority message that is loud, repeats and breaks through phone settings

Auto Forward

◉ Don't Auto Forward Messages

○ Auto Forward Messages

ⓘ Forwarding messages will add the selected recipients to all conversations that receive messages during the selected time range.

Availability   Clear

[🟢 Available] [🟠 Busy] [⛔ Unavailable]

Until

| 4/11/21 📅 | 6:43 PM 🕐 | 1h | 2h | 4h | 8h | 12h |

Message

[   ]

ⓘ Once your availability status expires it won't appear to other users.

Action Plan: Urgent Situation

- Team needs help with a patient

- Planning a procedure in the next 30 minutes

- Select On-Call

- Attach Patient

- Send Priority

Training

SBAR Communication

Secure Chat is NOT Snap Chat

Situation Background Assessment Recommendation

Before sending a chat message ensure you have:

- ☐ Preformed a recent assessment of the patient, including vital signs
- ☐ Discussed the situation with the charge RN or resource RN
- ☐ Reviewed the latest provider note

S: *Includes an introduction of yourself, the patient (name and admitting diagnosis and primary care team/ provider) and a concise statement of the problem*

Hi this is _____and I'm calling about patient _____ in room number _____. I am calling you with concern for _____.

B: *Brief- objective data and assessment findings*

Examples of abnormal findings or changes in the following:

☐ Vital signs	☐ Feeding Intolerance / Tolerance
☐ Oxygen Requirements	☐ Pain
☐ I&O	☐ Lab results

Resiliency

- Workshop with Resiliency committee

- Marketing campaign

- 10 key messages

- Nursing and physician leader collaboration

Clinical Communications Tip

Keep it brief, no thanks required.

Be as concise as possible and reduce the overall number of messages across platforms. It's nice to be thanked, but skip the message — it just fills up an inbox even more.

Learn more on MyChildrensColorado.

Clinical Communications Tip

Reduce the channels.

Consolidate clinical communication into secure, Epic-based tools and move away from avenues like texting and email. Always use Epic Secure Chat, in-basket messages and work phone numbers.

Learn more on MyChildrensColorado.

Resiliency

- Workshop with Resiliency committee

- Marketing campaign

- 10 key messages

- Nursing and physician leader collaboration

Clinical Communication Tip

Skip the email.

Your email is inaccessible to other team members and is vulnerable to hacking – all clinical communication should exist on secure platforms like Epic Secure Chat.

See more clinical communication tips on MyChildrensColorado.

Clinical Communications Tip

Respect the group.

Avoid group messages whenever possible. Send group messages only to individuals who need the information and avoid sending messages to entire teams.

Learn more on MyChildrensColorado.

Success

- Fully integrated call schedule

- Most pagers eliminated

- $200K in pager savings / year

- Messaging safe and legal

- Improved Communication

- Decreased number of methods

- Resiliency Support

Long way to go

1. Text messaging personal cell
2. Pagers
3. EHR Messaging
4. Clinical messaging apps (external use)
5. Phone call to personal cell
6. Voicemail on personal cell
7. Phone call to hospital / work phone
8. Voicemail on hospital / work phone
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1. ~~Text messaging personal cell~~
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7. Phone call to hospital / work phone
8. ~~Voicemail on hospital / work phone~~
9. EHR In-basket
10. ~~Email~~

Discussion

Association of Medical Directors of Information Systems
AMDIS

Please reach out for additional information

patrick.guffey@childrenscolorado.org

Children's Hospital Colorado

CU University of Colorado Anschutz Medical Campus

Proving Value With Population Health Initiatives in the Post-Pandemic Era

Irshad Siddiqui M.D.,M.S.

Blessing Health System

Blessing Hospital Founded in 1875
- 327 Licensed Bed Not-For-Profit, Sole Community Hospital
- Regional Medical Provider
  - Open Heart Surgery
  - Cancer Center
  - Level II Trauma Center
  - Neuro Surgery
  - Acute Services: Med/Surg., OB, Peds, Surgery, Critical Care, Psychiatry, Cardiac, etc.
  - Sub-Acute: SNU, Rehab, Home Care, Hospice, etc.

Blessing Physician Services
- 200+ Providers from 5 Providers in 2005
- 6 Rural Health Clinics
- Walk-In Clinic; Express Clinic
- Be Well at Work (Employer Clinic)

Illini Community Hospital
- 25 Bed Critical Access Hospital
- 1 Rural Health Clinic

Denman Services, Inc. - For-Profit
DME's
Denman Linen
Denman Biomedical Services
Illini Health Services (retail pharmacy)

Blessing Corporate Services
Member of the BJC Collaborative Affiliation Agreement with Scotland County

The Blessing Foundation
Fund-raising entity of Blessing

Blessing Rieman College of Nursing and Health Sciences

The Hannibal Clinic, LLC – For-Profit
Acquired on January 11, 2018
50+ Providers

Blessing Health Keokuk
Acquired on March 1, 2021
1 Rural Health Clinic

Number of Blessing Health System Employees 4,400+

Blessing Health System Medical Staff 390+
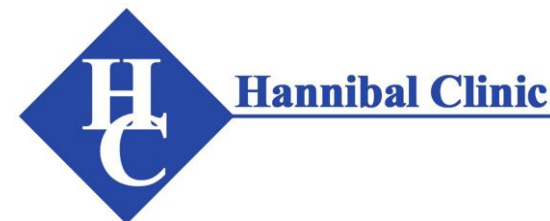
A CIN allows multiple parties to come together into a single network on a shared Value Proposition.
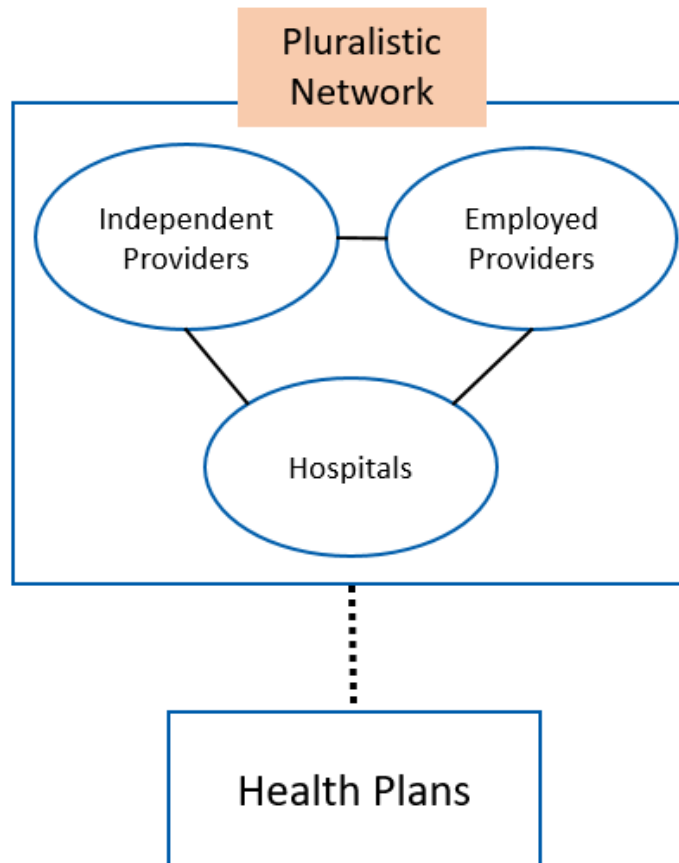
Value Proposition

- **Improved quality of care and reduction in total cost of care** through clinical integration between inpatient and outpatient, and between employed and independent providers

- **Population health management** is possible with the large regional provider network of a CIN
  - Centralized analytic, IT, and quality improvement infrastructure

- **Joint contracting :** the CIN structure enables employed and independent providers to join with the hospitals to contract as a group with insurers
  - Value-based contracts will reward providers for quality and high value care

Be Well with Diabetes Program

CROSSRIVER QUALITY HEALTH PARTNERS

https://www.crossriverquality.org/

Be Well With Diabetes Program
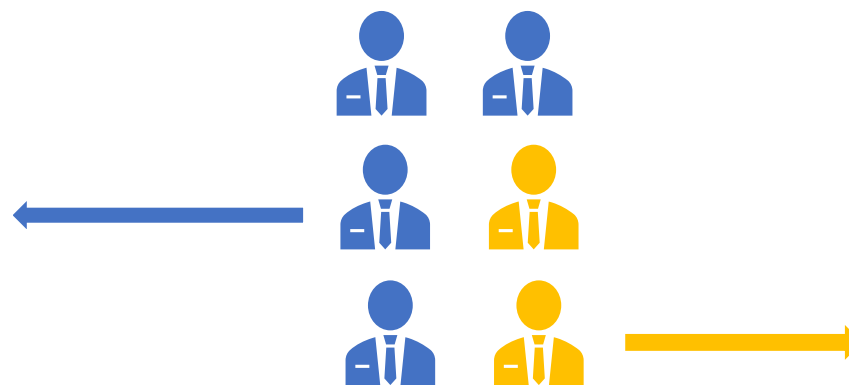
Two RN Staff Educators

One Pharmacist

One Dietician

- Started in 2013
- Referrals are Self, Core Health, Provider

Diabetic Employees with Blessing Health Insurance (Employee Health Plan)

Employees NOT in the BWWD Program

- Receiving usual care from their primary care physician or endocrinologist

BLESSING Health System

Comparison of Cost and Utilization for Be Well With Diabetes (BWWD) Program Participants/Non-BWWD

		N	Rate
Admissions-	BWWD	36	15.7/ 1000 MM
	Usual Care	17	14.7/ 1000 MM
ER Visits-	BWWD	51	22.4/ 1000 MM
	Usual Care	24	20.8/ 1000 MM

	Total spend	PMPM
BWWD $	3.8 mil	$1662
Non BWWD $	1.4 mil	$1200

Where is the $ difference?

-Hospital Diagnostic

-Physician Services for

     Specialty care, largest is:

     -Ophthalmology

     -Anesthesia

     -Cardiology

-DME

Key Take away:
- BWWD and Non-BWWD had similar ER and Inpatient rates in 2020
- BWWD patients have a higher PMPM rate.
- The higher PMPM is in the areas of: Hospital Diagnostics, Physician Specialty Care, and DME

CROSSRIVER
QUALITY HEALTH PARTNERS

BWWD Propensity Score Matching Analysis
Methods and Results

Irshad Siddiqui, MD, MS
EVP, Chief IT & Innovation
Blessing Corporate Services, Blessing Health

Irshad.Siddiqui@blessinghealth.org

Anup Kumar Mishra, PhD
Data Scientist
Dept. of Data Analytics, Blessing Health

AnupKumar.Mishra@blessinghealth.org
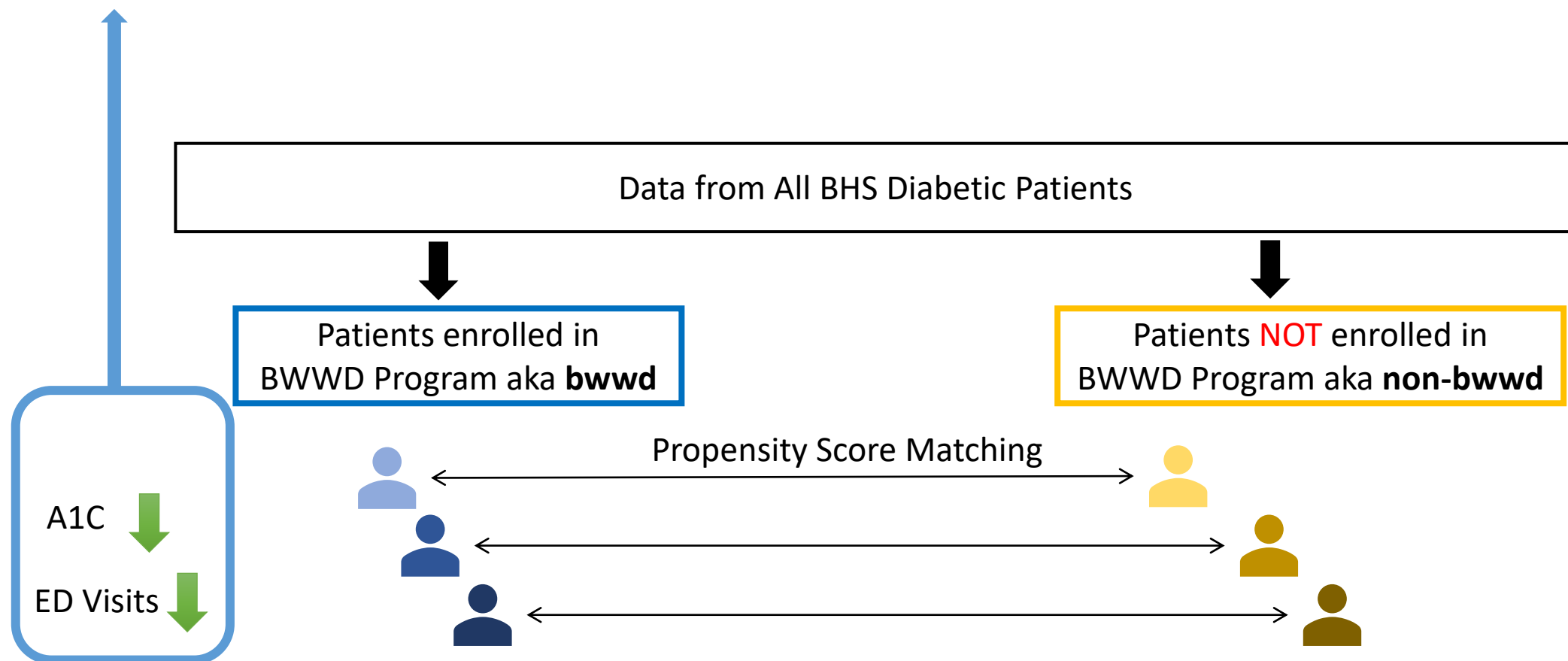
Be Well With Diabetes (BWWD) Analysis

Data:

Total Type 2 Diabetic Patients in Employee Health Plan between 2017-2021 = 310

bwwd, N=146

Non-bwwd, N=164

>= 2 years in the program

Never enrolled in the BWWD program,
>= 2 years with T2D Diagnosis

N=127

N=114

Has HbA1c data

N=126

Has HbA1c data

High compliance with BWWD Program

Propensity Score Matching

N=122

N=82

bwwd (N=122)

Non-bwwd (N=82)
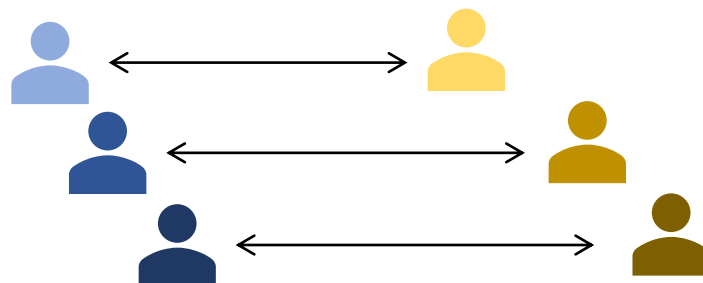
Be Well With Diabetes (BWWD) Analysis

BWWD Compliance Check

BWWD Program Compliance Rules:

- An **A1C of 6.5 or less** allows the participant an option to come **every other quarter**.
- An **A1C of 6.6 - 9.9** requires the participant to come **quarterly**.
- An **A1C of 10.0 or greater** requires the participant to come **monthly**.

Fuzzy System for BWWD Compliance Test

Histogram of Fuzzy Compliance
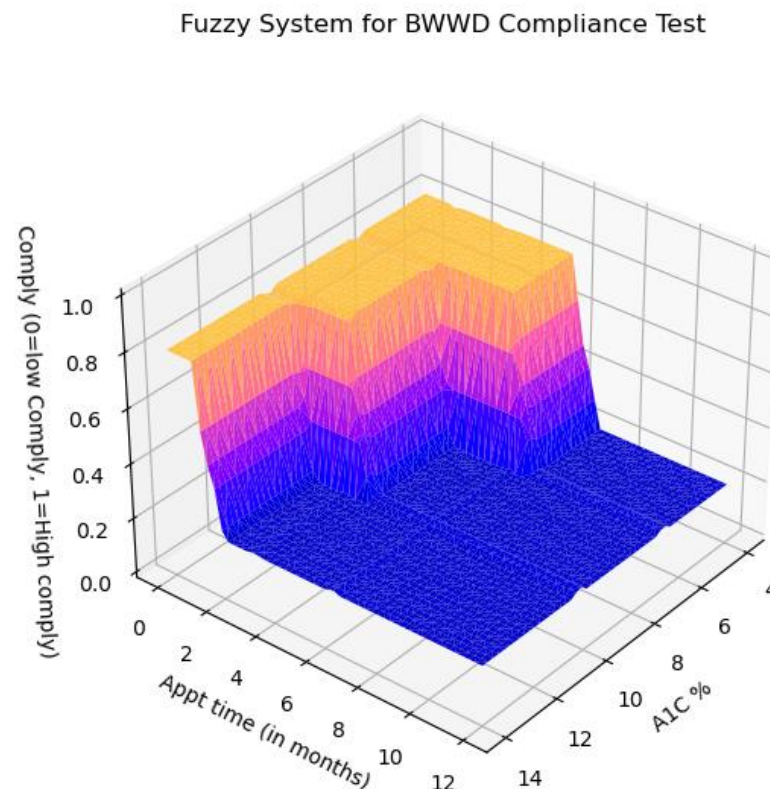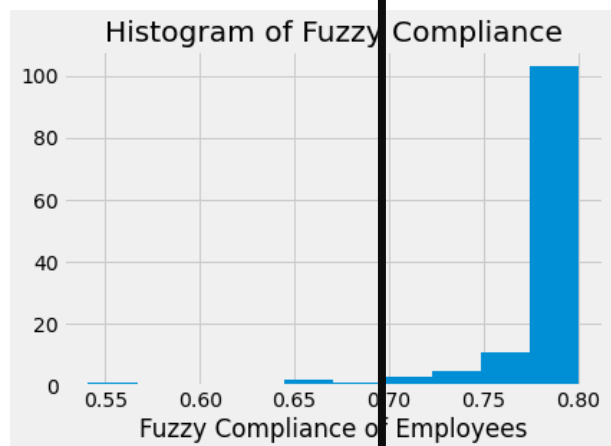
96% (N=122) Patients enrolled in BWWD have Compliance Score > 0.7

Be Well With Diabetes (BWWD) Analysis Matching

bwwd (N=122)

Non-bwwd (N=82)
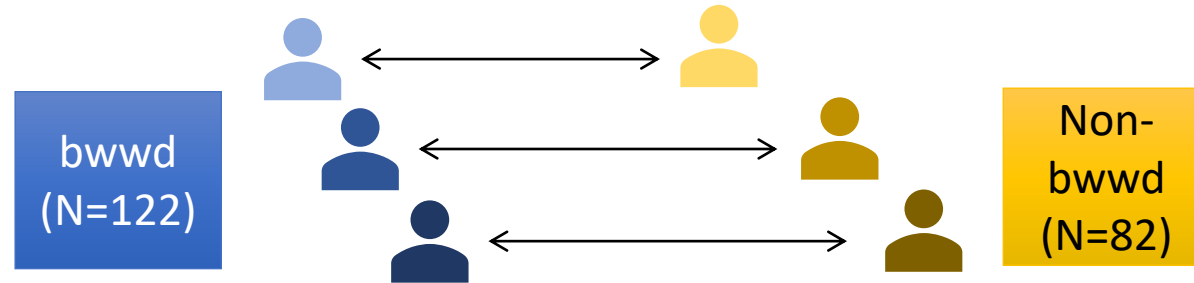
Covariates for Matching:

Demographics: *Age, Gender, Race*

Dx: *Diabetes With Complications, Hypertension, Hyperlipidemia*

Labs: *Base HbA1c*

Other: *# of years with T2D Diagnosis or BWWD enrollment*

Li J, Sun L, Wang Y, Guo L, Li D, Liu C, Sun N, Xu Z, Li S, Jiang Y, Wang Y. A mobile-based intervention for glycemic control in patients with type 2 diabetes: retrospective, propensity score-matched cohort study. JMIR mHealth and uHealth. 2020 Mar 11;8(3):e15390.

Be Well With Diabetes (BWWD) Analysis

Treatment Effect in Matched Population
using Cluster-robust standard errors

Outcome: *Change In HbA1C*: Difference between baseline HbA1c and last measured HbA1c
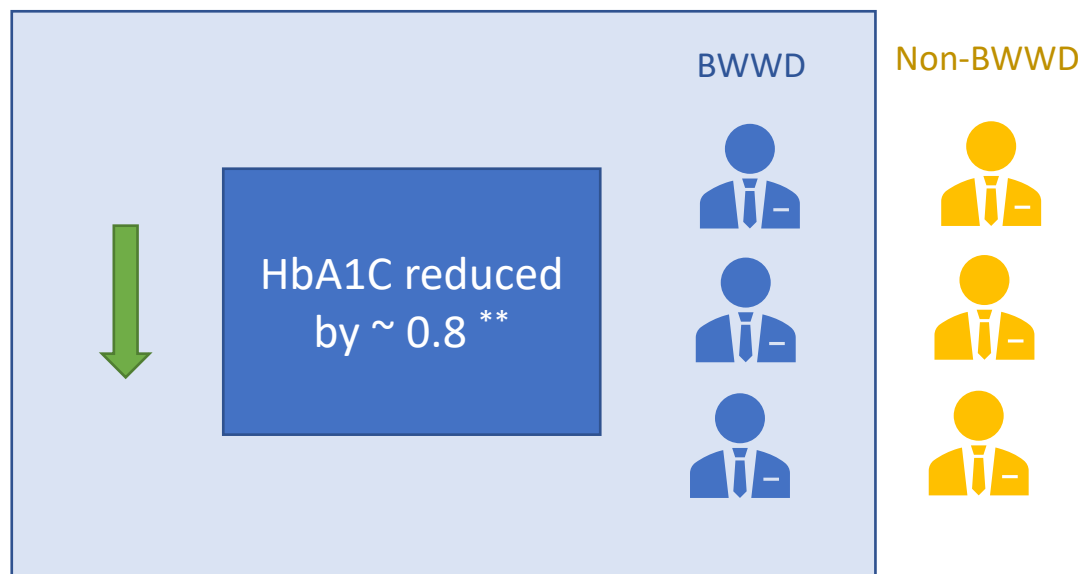
	Estimate	Std. Error	P value
treat	0.78	0.26	0.004**

Mao H, Li L, Greene T. Propensity score weighting analysis and treatment effect discovery. Statistical methods in medical research. 2019 Aug;28(8):2439-54.

Greifer N, Stuart EA. Choosing the Estimand When Matching or Weighting in Observational Studies. arXiv preprint arXiv:2106.10577. 2021

Be Well With Diabetes (BWWD) Analysis

Treatment Effect in Matched Population
using Cluster-robust standard errors

Outcome: *ED Visits*

65% lower odds of ED Visits **

BWWD   Non-BWWD
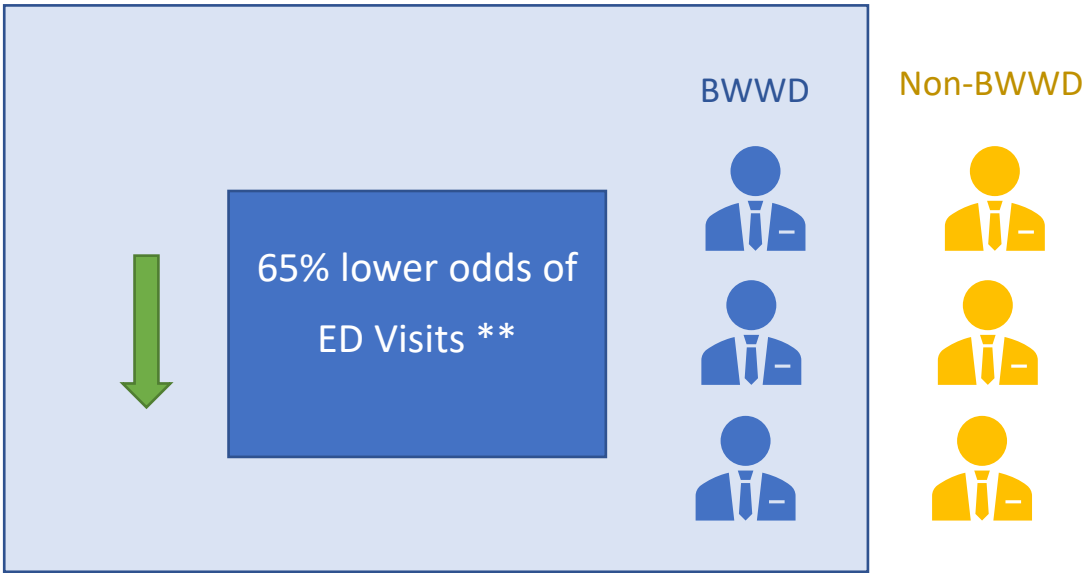
	Estimate	Std. Error	P value
treat	-1.03	0.39	0.008**

Mao H, Li L, Greene T. Propensity score weighting analysis and treatment effect discovery. Statistical methods in medical research. 2019 Aug;28(8):2439-54.

Greifer N, Stuart EA. Choosing the Estimand When Matching or Weighting in Observational Studies. arXiv preprint arXiv:2106.10577. 2021

Be Well With Diabetes (BWWD) Analysis

Treatment Effect in Matched Population
using Cluster-robust standard errors

Outcome: *Hospitalization*

44% lower odds of Hospitalization

BWWD   Non-BWWD
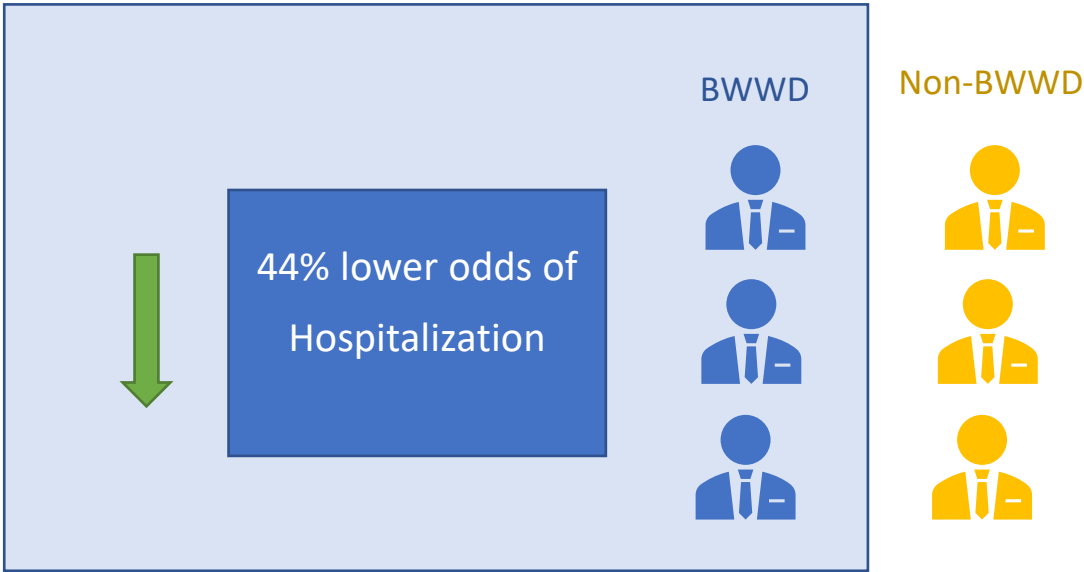
	Estimate	Std. Error	P value
treat	-0.57	0.43	0.18

Mao H, Li L, Greene T. Propensity score weighting analysis and treatment effect discovery. Statistical methods in medical research. 2019 Aug;28(8):2439-54.

Greifer N, Stuart EA. Choosing the Estimand When Matching or Weighting in Observational Studies. arXiv preprint arXiv:2106.10577. 2021

Be Well With Diabetes (BWWD) Analysis

Limitations of the Analysis

- Sample size
- Retrospective nature of the study, we may not have addressed unobserved confounders in propensity matching
- Analysis limited to available clinical medical records data
- Missing data in the non-BWWD population (28% of non-BWWD population had missing HbA1c data)

Be Well With Diabetes (BWWD) Analysis

Conclusion and Future Work

- In the matched population, Employees enrolled in the BWWD program had increased control rates of HbA1c and lower odds of ED Visits

- Future retrospective studies to analyze other Be Well at Work initiatives at Blessing Health

Questions?

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Raw audit logs for the measurement of physician workload, cognitive burden, and burnout

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Disclosures

- Pfizer, Inc; Health IT advisory board (2020-)

- HHS/ONC Technical Expert Panel (TEP) on synthetic data (2019-)

- Elsevier, Inc (Associate Editor, Journal of Biomedical Informatics) (2020-)

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- R01 AG076541-01 (National Institute of Aging)

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- P50 MH122351 (National Institutes of Mental Health)
- R61MH119237 (National Institute of Mental Health)
- R01NR017916 (National Institute of Nursing Research)
- 3UL1TR002345-04S3 (National Center for Advancing Translational Sciences)
- U24TR002306 (National Center for Advancing Translational Sciences)
- R24AG074915 (National Institute of Aging)
- 2UL1TR002345-06 (National Center for Advancing Translational Sciences)

Audit logs are a fingerprint for clinicians' work habits

Mandated for security reasons

Captures whenever patient data is viewed or modified

Tracks **who** performed **what** on **which** patient's chart

Can we use audit logs to measure other work-related behaviors?

| ACCESS_TIME	USER_ID	PAT_ID	ACTION_PERFORMED
12/21 7:20:17	Z		Inpatient Patient Lists list loaded
12/21 7:20:17	Z		Inpatient system list accessed
12/21 7:20:22	Z	A	Results Review accessed
12/21 7:20:32	Z	A	Report with patient data viewed
12/21 7:20:32	Z	A	Report with patient data viewed
12/21 7:20:34	Z	A	Imaging PACS accessed
12/21 7:21:25	Z		Inpatient system list accessed
12/21 7:21:29	Z	B	Storyboard viewed
12/21 7:21:29	Z	B	Visit Navigator template loaded
12/21 7:21:30	Z	B	Orders section accessed
12/21 7:21:30	Z	B	Order sets accessed
12/21 7:22:02	Z	B	Order list changed
12/21 7:22:07	Z	B	Chart Review Notes tab selected
12/21 7:22:09	Z	B	Chart Review Note report viewed
12/21 7:28:44	Z	B	Chart Review Note report viewed

Other uses for audit logs?
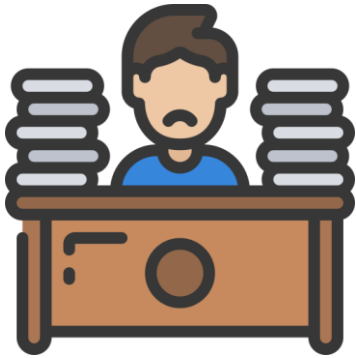
Clinical

Workload

Cognitive

Burden
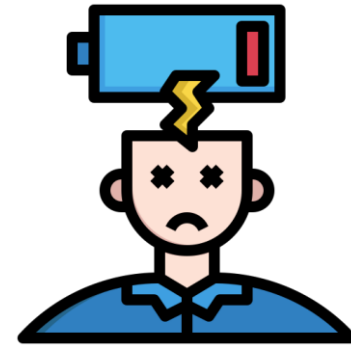
Clinician

Burnout

Vendor platforms to measure clinical workload
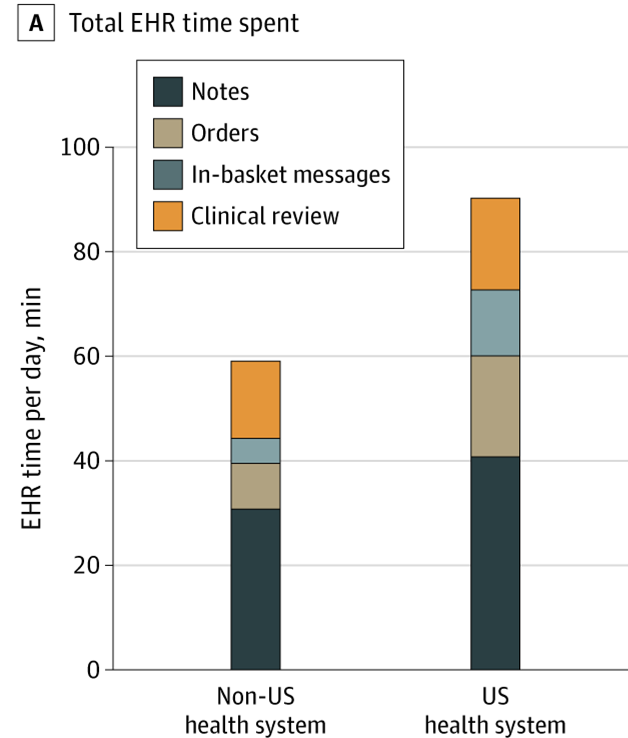
Advantages:

- Widely available

- Easy to use

Limitations:

- Lack of control

- Subject to change

Holmgren (2021) *JAMA IM*

Perspective

Conceptual considerations for using EHR-based activity logs to measure clinician burnout and its effects

Thomas Kannampallil (iD),[1,2] **Joanna Abraham** (iD),[1,2] **Sunny S. Lou,**[2] **and Philip R.O. Payne**[1,3]

[1]Institute for Informatics, Washington University School of Medicine, St Louis, Missouri, USA, [2]Department of Anesthesiology, Washington University School of Medicine, St Louis, Missouri, USA, and [3]Department of Medicine, Washington University School of Medicine, St Louis, Missouri, USA

Corresponding Author: Thomas Kannampallil, PhD, Department of Anesthesiology, Washington University School of Medicine, 660 S. Euclid Avenue, Campus Box 8054, St Louis, MO 63110, USA (thomas.k@wustl.edu)

ICU clinician workload from raw audit logs

4 surgical ICUs (85 beds) in 2019

Staffed by attending physicians, APPs (NP/PA), and residents, who work 12 hour shifts

Collected **14 million audit log** activities (**62,367 hours** of EHR use).

	Attending (N = 24) Median (IQR)	APP (N = 71) Median (IQR)
Total EHR time / day (hrs)	2.4 (1.3-3.5)	4.2 (2.1-6.1)
Afterhours EHR time / day (hrs)	0 (0-0.35)	0.35 (0-2.5)
# of patients viewed / day	20 (17-25)	10 (6-14)
# of actions / day	730 (350-1093)	1073 (546-1617)
# of inbox messages / day	34 (13-56)	1 (0-7)
# of order sessions / day	0 (0-1)	25 (4-50)
Note time / day (hrs)	0.29 (0.08-0.67)	1.64 (0-3.43)
Chart review time / day (hrs)	1.37 (0.57-2.30)	2.27 (1.07-3.31)
# of patients with notes signed / day	5 (1-8)	4 (1-6)

Density of EHR-based activities
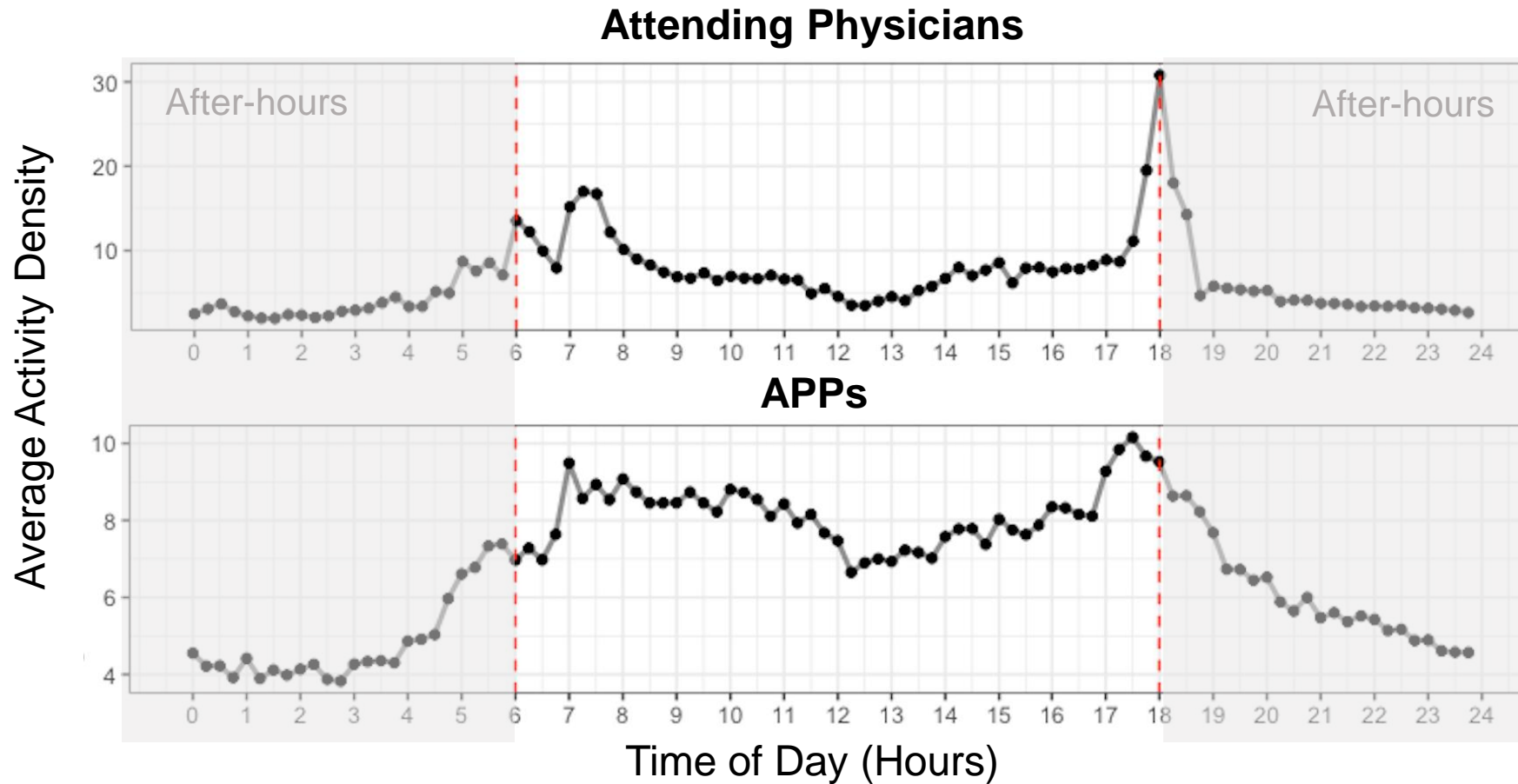
Attention switching (between patients)

Access Date	Access Time	Metric Name	Pat ID	User ID	Report Name
2019-02-19	6:30:49 AM	Report with patient data viewed	A	X	RAD Results Report
2019-02-19	6:30:49 AM	Report with patient data viewed	A	X	BW IMAGING REPORT HYPERLINK - DYNAMIC
2019-02-19	6:30:49 AM	Report viewed for an order	A	X	
2019-02-19	6:30:50 AM	Imaging PACS accessed	A	X	
2019-02-19	6:32:04 AM	Report with patient data viewed	A	X	IP Microbiology Results
2019-02-19	6:32:29 AM	Report with patient data viewed	A	X	IP Radiology Results
2019-02-19	6:32:39 AM	Report with patient data viewed	A	X	IP Pain Management
2019-02-19	6:32:54 AM	Report with patient data viewed	A	X	IP Fever/Antibiotic Dosing
2019-02-19	6:35:10 AM	Order sets accessed	B	X	
2019-02-19	6:36:15 AM	Order list changed	B	X	
2019-02-19	6:45:54 AM	Report with patient data viewed	A	X	IP Radiology Results

Time
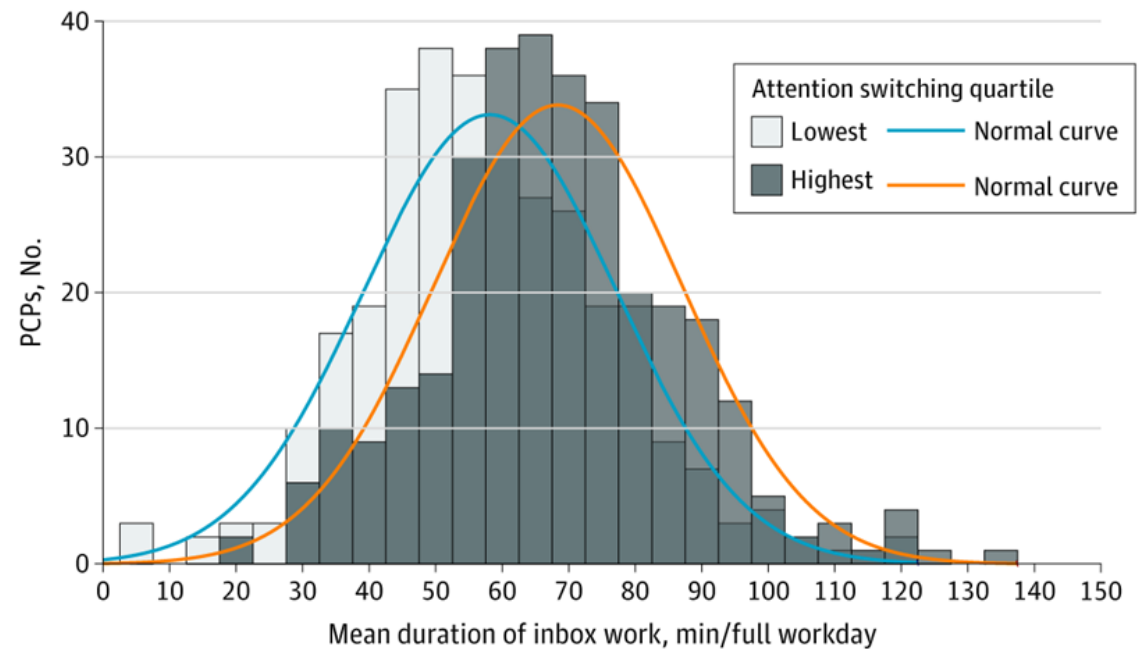
4:21

Attention switch

New Task

1:05

New Session

Potential consequences of work fragmentation

Downstream effects

- Decreased efficiency, longer task completion times

Lieu et al (2021) *JAMA Netw. Open*

Potential consequences of work fragmentation

Downstream effects

- Decreased efficiency, longer task completion times

- Increased risk for errors

Variable	Rate ratio	95% CI	P value
Legal/procedural errors			
Interruptions while prescribing (any vs none)	1.08	0.77 to 1.51	0.66
Multitasking while prescribing (any vs none)	1.86	1.35 to 2.56	<0.001
Clinical errors			
Interruptions while prescribing (any vs none)	2.82	1.23 to 6.49	0.015
Multitasking while prescribing (any vs none)	1.91	0.79 to 4.65	0.154

Westbrook et al (2018) *BMJ Qual Saf*

Potential consequences of attention switching

Downstream effects

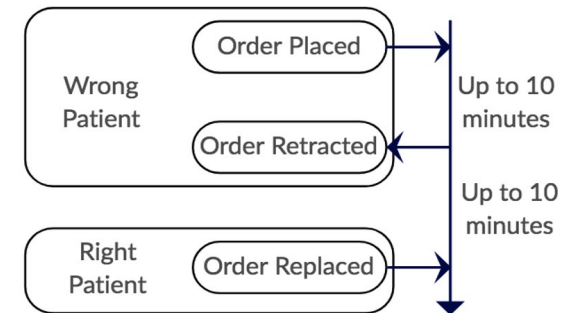- Decreased efficiency, longer task completion times

- Increased risk for errors

Goal: Measure relationship between attention switching, work efficiency, and errors in the ICU

Work Efficiency

- Total EHR Time

Errors

- Wrong patient error

Adelman et al (2013) *JAMIA*

Switching is associated with increased EHR time for APPs

Attending		
Variable	**Parameter Estimate (95% CI)**	**P-value**
Patient Load	0.41 (0.32–0.49)	< 0.001 ***
Switch Rate	0.04 (-0.02–0.10)	0.1562
Gender (=Male)	-1.0 (-2.0–0.1)	0.0781
APP		
Variable	**Parameter Estimate (95% CI)**	**P-value**
Patient Load	2.56 (2.50–2.63)	< 0.001 ***
Switch Rate	0.28 (0.24–0.32)	< 0.001 ***
Gender (=Male)	-0.3 (-0.9–0.3)	0.348

For APPs, an **increased rate of switching** (from once per 25 actions to once per 12 actions) **increased total EHR time by 0.28 hours** (17 minutes, or ~7%)

Linear mixed-effect model for Total EHR Time
Parameter estimates represent the effect size for a 25th to 75th percentile change in each variable.

Switching is associated with wrong-patient errors

Poisson model for number of wrong-patient errors

Rate ratios represent an effect size for a 25th to 75th percentile change in each variable.

APP		
Variable	**Rate Ratio (95% CI)**	**P-value**
Patient Load	1.07 (0.73 – 1.48)	0.7177
Switch Rate per 100 actions	1.28 (1.04 – 1.55)	0.0143 *

Wrong Patient Error
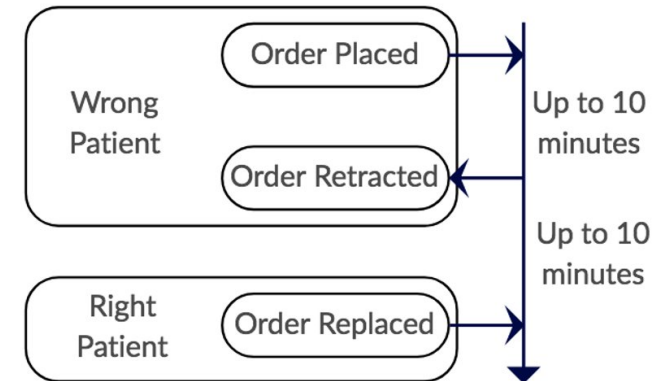
116 RAR events observed

An **increased rate of switching** (from once per 25 actions to once per 12 actions) **increased the wrong-patient error rate by 28%**

Summary, part I

ICU workflow is **highly fragmented**.

Attention switching is associated with **increased EHR time** (decreased efficiency) and **increased wrong-patient errors**.

Limitations

- Audit log derived measures of workload, efficiency, attention switching, and errors are imperfect

- Not all attention switching is captured (i.e., within same pt)

- Cause of attention switching is unknown

BJA

CORRESPONDENCE

Effect of clinician attention switching on workload and wrong-patient errors

Sunny S. Lou[1,2,†], Seunghwan Kim[2,3,†], Derek Harford[1], Benjamin C. Warner[4], Philip R. O. Payne[2,3,4,5], Joanna Abraham[1,2,3] and Thomas Kannampallil[1,2,3,4,*]

[1]Department of Anesthesiology, School of Medicine, Washington University in St Louis, St Louis, MO, USA, [2]Institute for Informatics, School of Medicine, Washington University in St Louis, MO, USA, [3]Division of Biology and Biomedical Sciences, School of Medicine, Washington University in St Louis, St Louis, MO, USA, [4]Department of Computer Science and Engineering, McKelvey School of Engineering, Washington University in St Louis, St Louis, MO, USA and [5]Department of Medicine, School of Medicine, Washington University in St Louis, St Louis, MO, USA

*Corresponding author. E-mail: thomas.k@wustl.edu
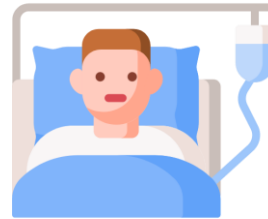
Physician burnout is widespread
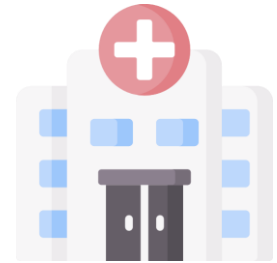
50% of practicing physicians

70% of trainee physicians (residents, fellows)

Physicians

Patients

Healthcare System

Effects of Persistent Exposure to COVID-19 on Mental Health Outcomes Among Trainees: a Longitudinal Survey Study

Charles W. Goss, PhD[1], Jennifer G. Duncan, MD[2], Sunny S. Lou, MD PhD[3], Katherine J. Holzer, PhD[3], Bradley A. Evanoff, MD MPH[4], and Thomas Kannampallil, PhD[3,5] iD

[1]Division of Biostatistics, Washington University School of Medicine, St Louis, MO, USA; [2]Department of Pediatrics, Washington University School of Medicine, St Louis, MO, USA; [3]Department of Anesthesiology, Washington University School of Medicine, St Louis, MO, USA; [4]Department of Medicine, Washington University School of Medicine, St Louis, MO, USA; [5]Institute for Informatics, Washington University School of Medicine, St Louis, MO, USA.

ABSTRACT:

BACKGROUND: The rapid spread of the coronavirus disease 2019 (COVID-19) has created considerable strain on the physical and mental health of healthcare workers around the world. The effects have been acute for physician trainees—a unique group functioning simultaneous-
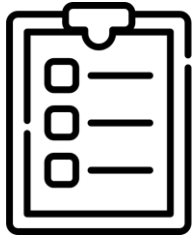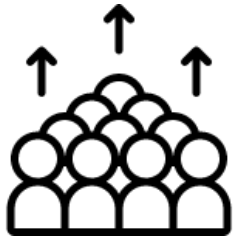
Measurement of burnout is challenging

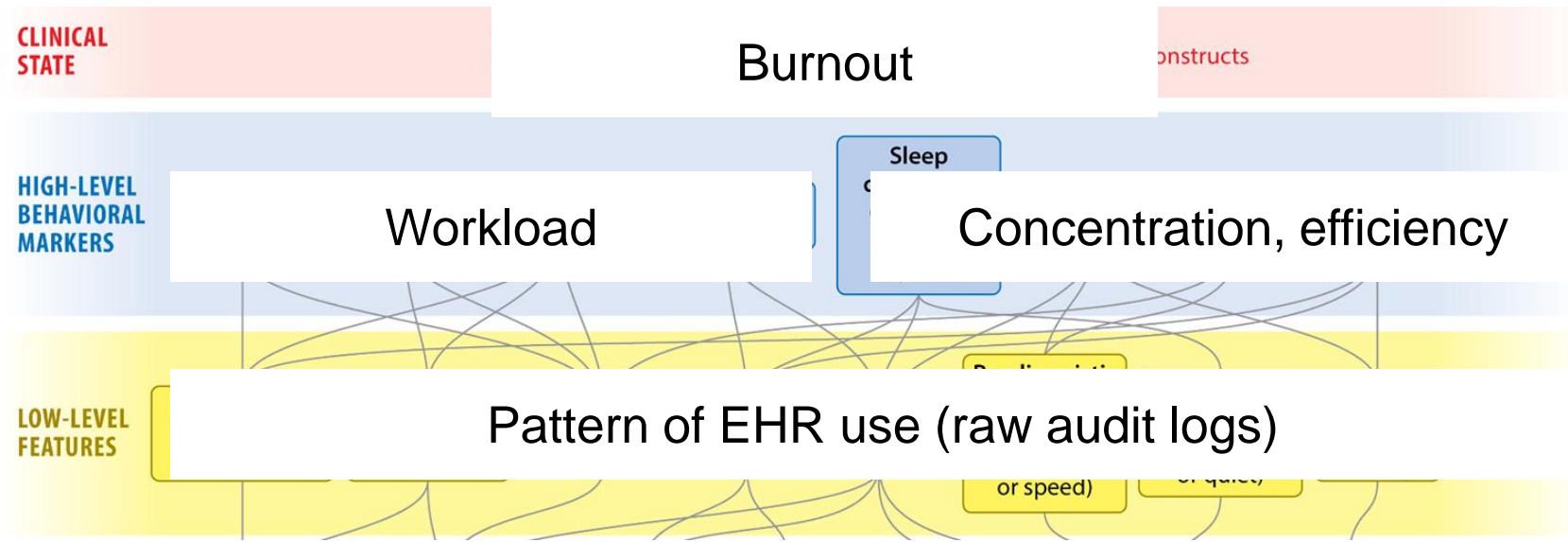**Current status**

Survey data

Cross-sectional

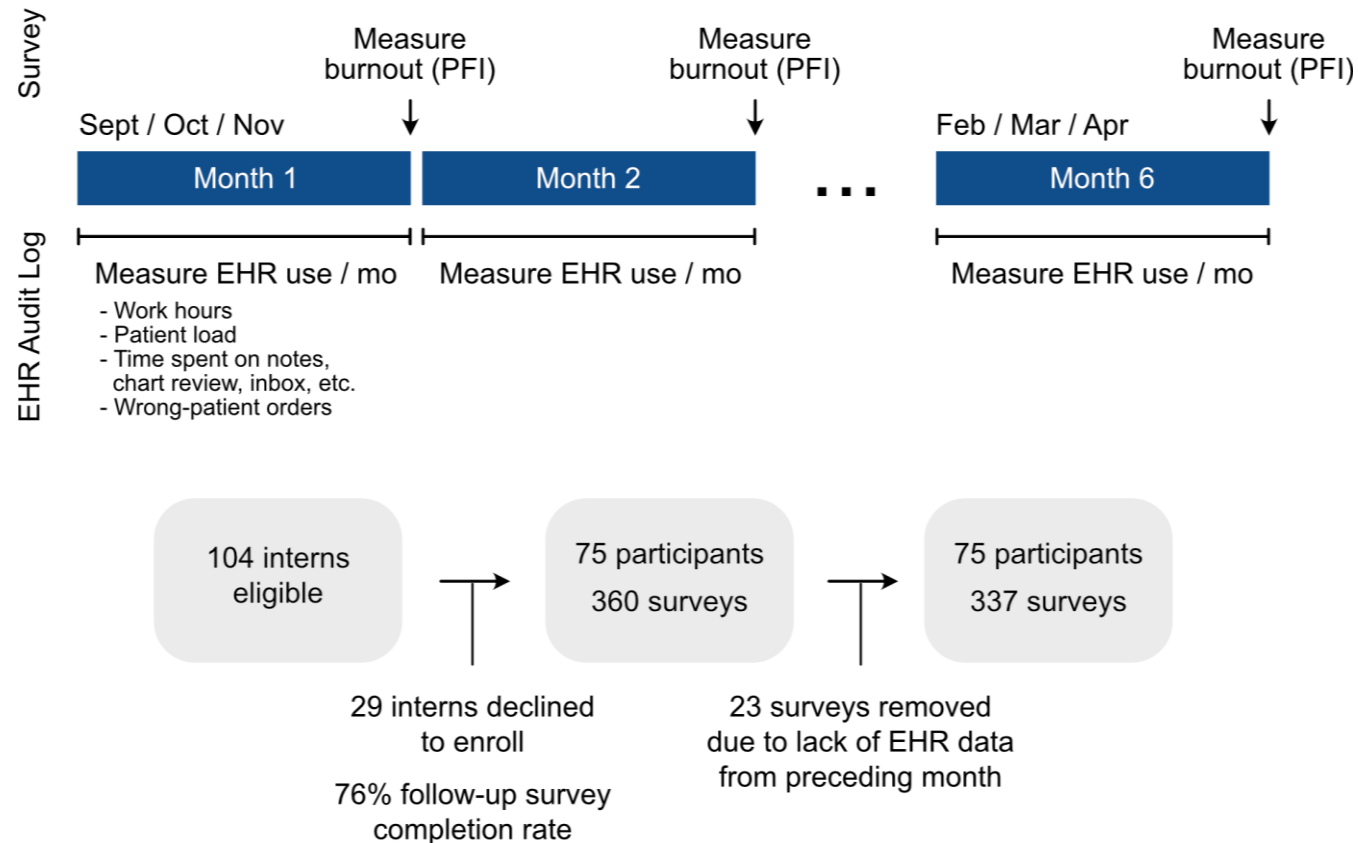

What if we could screen for burnout using audit logs?

Digital phenotyping for burnout

Mohr et al (2017) *Ann. Rev. Clin. Psych.*

Digital phenotyping for burnout

CLINICAL STATE

Burnout

...onstructs

HIGH-LEVEL BEHAVIORAL MARKERS

Workload

Sleep

Concentration, efficiency

LOW-LEVEL FEATURES

Workload features
- Patient load
- Total EHR time
- After-hours time
- Inbox time
- Chart review time
- Note time
- Order volume

Temporal features
Statistical features (i.e., mean, min, max, skew, kurtosis, energy, entropy, autocorrelation, slope):
- Temporal pattern of EHR click activities
- Temporal pattern of attention switching

Study design and data collection

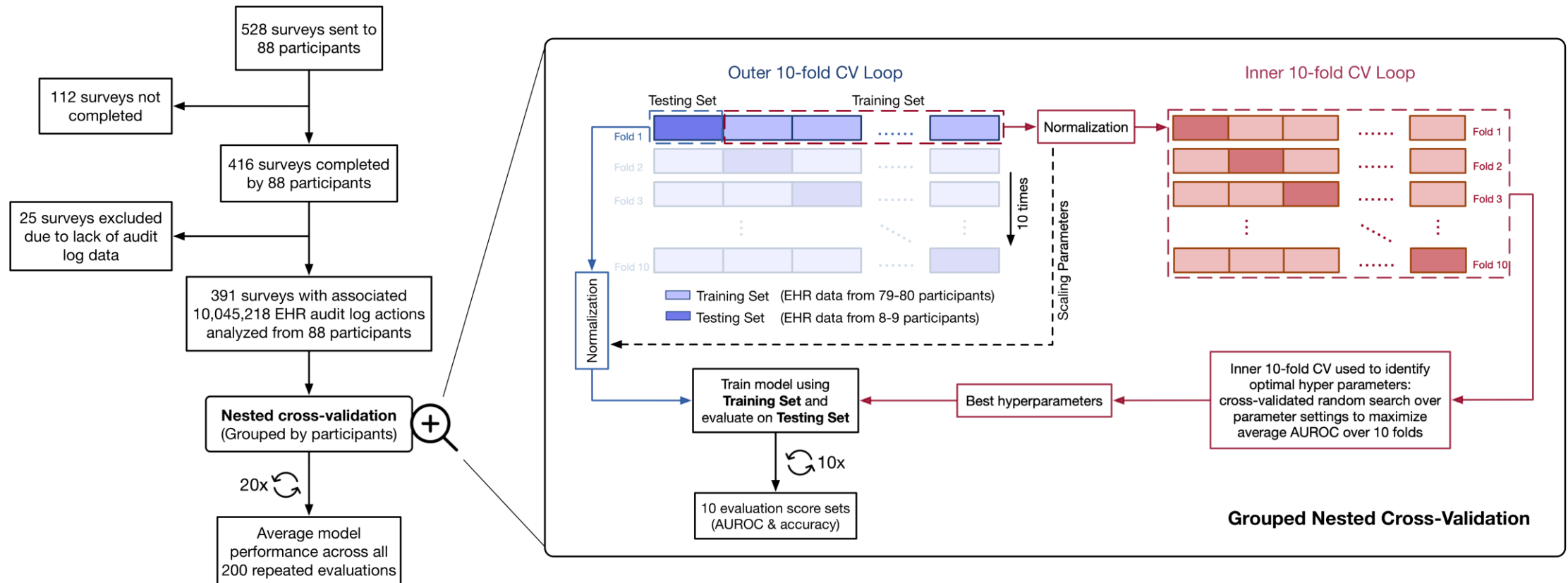Lou et al. (accepted) *J. Gen. Intern. Med.*

EHR-based workload is associated with burnout
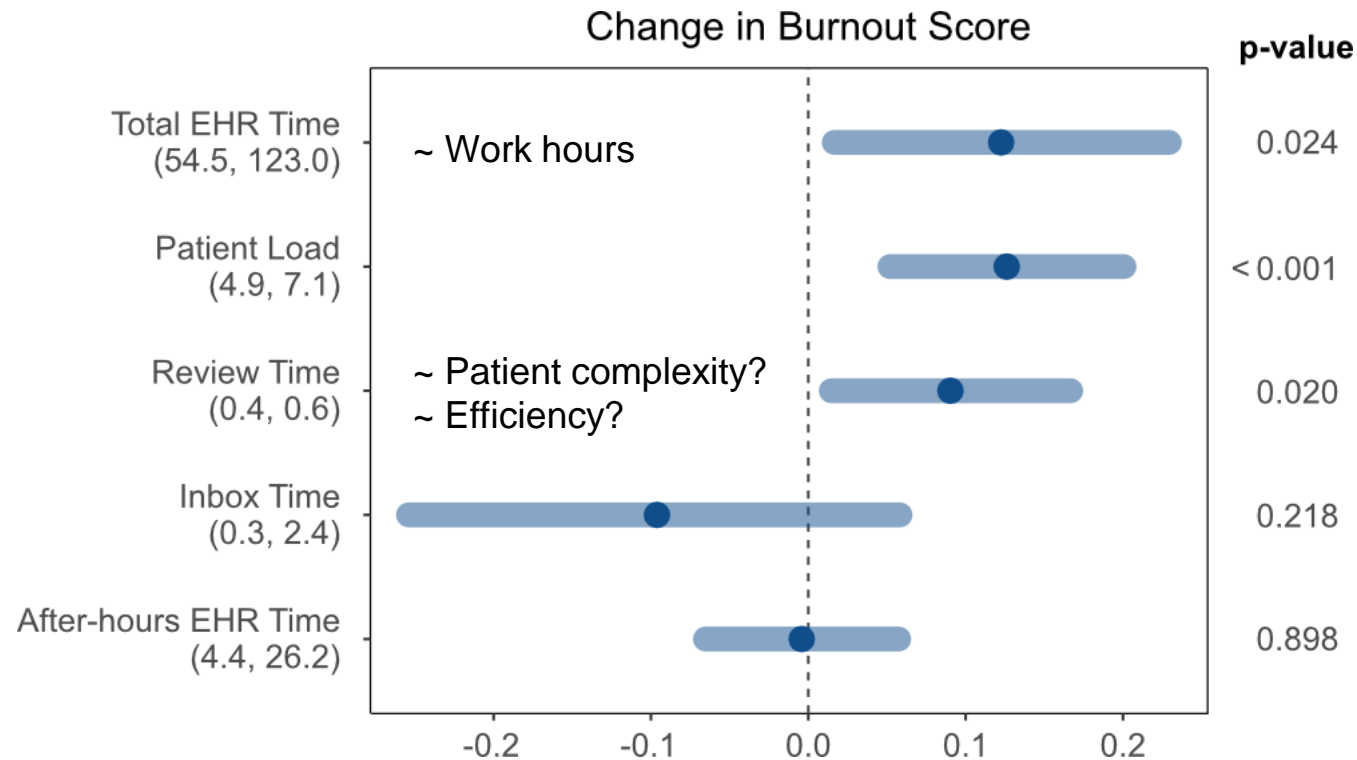
Multivariable mixed-effect model with random intercept per participant, and fixed effects controlling for specialty and gender. Dot shows the estimated effect of a 25th to 75th percentile change in each variable (with shaded area showing 95% CI)

Lou et al. (accepted) *J. Gen. Intern. Med.*

Predicting burnout (from audit logs)

Lou et al. (2022) *Journal of Biomedical Informatics.*

Workload and temporal features weakly predict burnout

Feature Set	Best Model	Mean Absolute Error	AUROC	Accuracy
Workload	Random Forest	0.602 (0.412, 0.826)	0.595 (0.355, 0.808)	0.567 (0.393, 0.742)
Temporal	Support Vector Machine	0.596 (0.391, 0.826)	0.581 (0.343, 0.790)	0.556 (0.318, 0.756)
Workload + Temporal	Gradient Boosting Machine	0.619 (0.438, 0.844)	0.583 (0.270, 0.831)	0.559 (0.386, 0.780)

Median PFI burnout score: 1.2 (IQR 0.7-1.7)

PFI score > 1.33 used to indicate burnout

Lou et al. (2022) *Journal of Biomedical Informatics.*

Baseline burnout is highly predictive of future burnout

Feature Set	Best Model	Mean Absolute Error	AUROC	Accuracy
Workload	Random Forest	0.602 (0.412, 0.826)	0.595 (0.355, 0.808)	0.567 (0.393, 0.742)
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Workload + Temporal	Gradient Boosting Machine	0.619 (0.438, 0.844)	0.583 (0.270, 0.831)	0.559 (0.386, 0.780)

Feature Set	Best Model	Mean Absolute Error	AUROC	Accuracy
First Survey Score + Workload	Neural Network	0.423 (0.293, 0.567)	0.829 (0.607, 0.996)	0.781 (0.587, 0.936)
First Survey Score	Neural Network	0.432 (0.304, 0.570)	0.819 (0.551, 0.999)	0.765 (0.547, 0.952)

Lou et al. (2022) *Journal of Biomedical Informatics.*
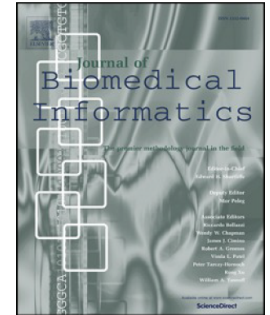
Predicting physician burnout using clinical activity logs: Model performance and lessons learned

Sunny S. Lou [a], Hanyang Liu [b], Benjamin C. Warner [b], Derek Harford [a], Chenyang Lu [b], Thomas Kannampallil [a, c, *]

[a] *Department of Anesthesiology, School of Medicine, Washington University in St Louis, St Louis, MO, United States*
[b] *Department of Computer Science, McKelvey School of Engineering, Washington University in St Louis, St Louis, MO, United States*
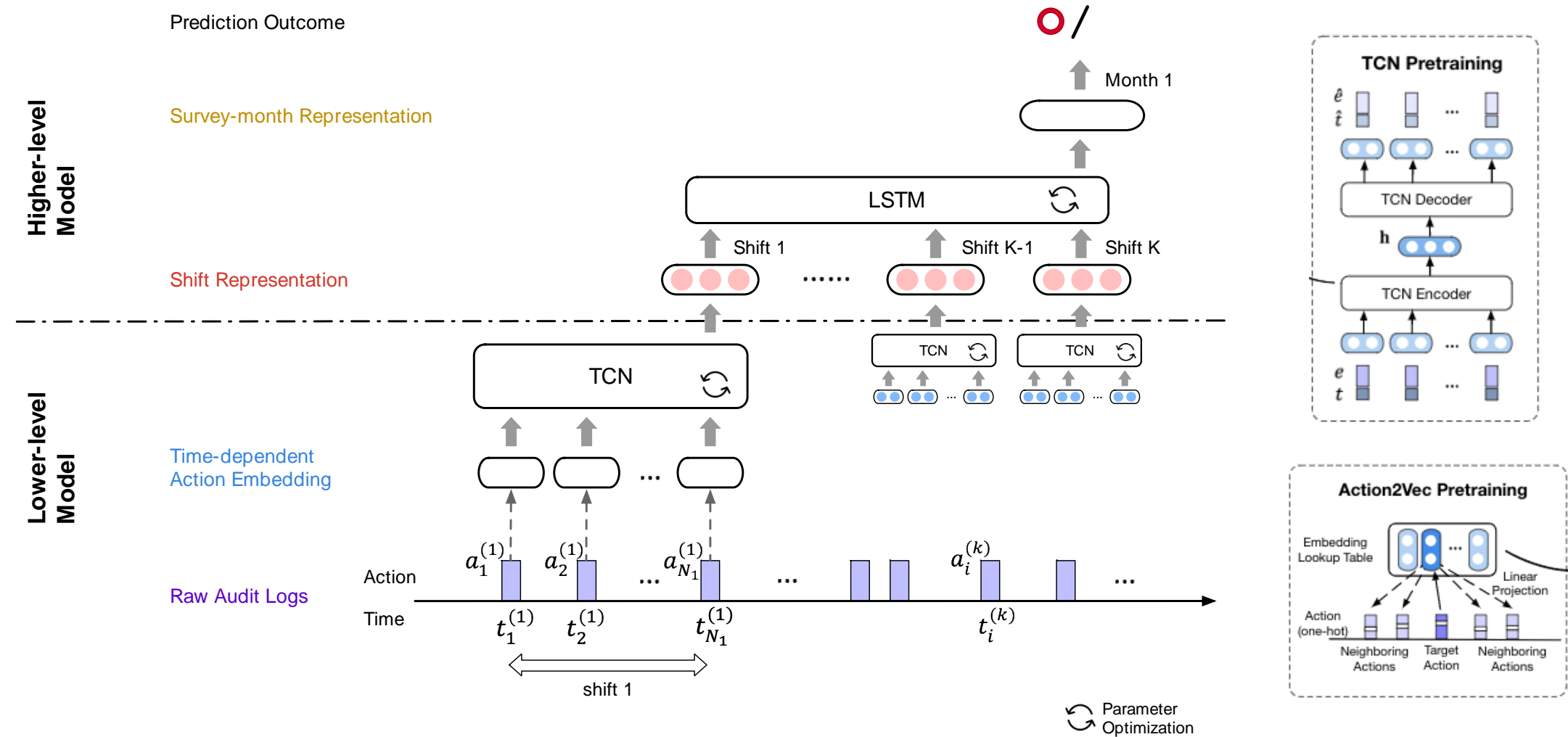[c] *Institute for Informatics, School of Medicine, Washington University in St Louis, St Louis, MO, United States*
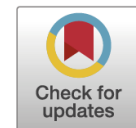
Deep learning for audit log data
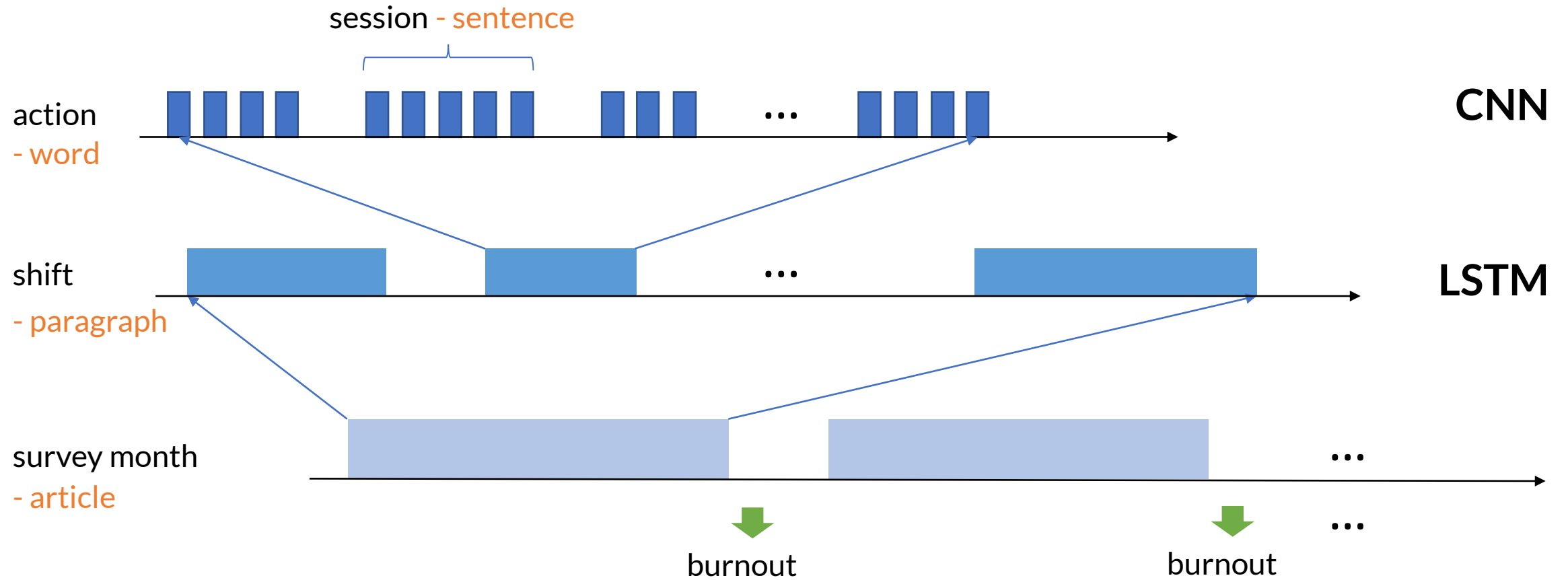
Hierarchical Temporal Convolutional Network

Deep learning model performance

METHOD	AUROC	AUPRC	ACCURACY
XGBoost	.5597 (.0214)	.4646 (.0676)	.5717 (.0361)
SVM	.5793 (.0290)	.4683 (.0513)	.5545 (.0326)
Random Forest	.5645 (.0243)	.4647 (.0606)	.5611 (.0355)
DilatedNet [17]	.5724 (.0313)	.4794 (.0373)	.5835 (.0288)
ResTCN [2]	.6171 (.0258)	.5284 (.0602)	.6150 (.0232)
H-RNN [44]	.5935 (.3780)	.4774 (.0621)	.6012 (.0323)
HiGRU	.5871 (.0155)	.4740 (.0457)	.6117 (.0277)
HiTCN-1	.6197 (.0284)	.5441 (.0537)	.6379 (.0305)
HiTCN-2	**.6244 (.0295)**	**.5611 (.0691)**	**.6390 (.0064)**
Semi-ResTCN	.6185 (.0199)	.5454 (.0378)	.6170 (.0205)
Semi-HiTCN-1	**.6339 (.0309)**	.5476 (.0459)	.6233 (.0160)
Semi-HiTCN-2	.6312 (.0299)	**.5536 (.0479)**	**.6450 (.0270)**
Improvement	2.7 %	4.8 %	4.9 %

Shallow model baselines

Deep learning baselines

Hierarchical TCN

Hierarchical TCN w/ pre-training

HiPAL: A Deep Framework for Physician Burnout Prediction Using Activity Logs in Electronic Health Records

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ABSTRACT

Burnout is a significant public health concern affecting nearly half of the healthcare workforce. This paper presents the first end-to-end deep learning framework for predicting physician burnout based on clinician activity logs – digital traces of their work activities –

1 INTRODUCTION

Lessons Learned (part II)

Resident physicians may not be the right population to develop a stable model – not "steady state"

Digital phenotyping for burnout from EHR logs is hard

- Inter-individual variability in response to workload

- Inability to capture non-EHR work, personal, environmental factors that also contribute to burnout

Effect of Telemedicine on EHR work

- Assessing the effect of telemedicine on physician EHR work, cognition, and process outcomes
  - Two sites (WashU/BJC & UCSF)
- Utilize raw audit logs to assess work-related behaviors (e.g., depth and breadth of search, documentation), cognitive load (e.g., activity switching) and outcomes (e.g., wrong-patient errors)
- Funded by the National Library of Medicine

Other on-going projects

- SecureChat usage: Characterize patterns of SecureChat usage from audit logs (funded by AMA)

- Developing metrics from raw audit logs; creating standardized metrics

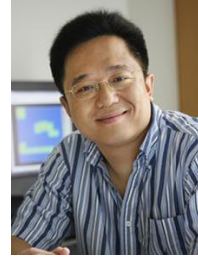- Predicting errors (wrong-patient errors) from audit log events

Team
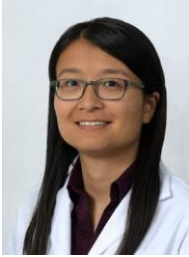
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Using AI to adjust to the "new normal"

Robert Budman, MD MBA

Disclaimer: Nuance Healthcare, a Microsoft company

Premise

What AI platforms and technologies are out there to improve efficiency and derive value. Define value from various perspectives. Reducing physician workload, improving revenue, demonstrating better quality measures, driving physician and patient satisfaction, transforming the mechanics of healthcare to the new normal for example tossing aside the keyboard and the mouse! I'll present various technologies, AI-based solutions, and real-world examples of organizational adjustments to tackle some of healthcare's current challenges.

New normal?

- Is there a "new normal?"
- Let's face it, many of us have been doing this full time for 15+ years!
- Is AI normal? Not even close
  - EHR and delivery struggles are still the norm

Value

- It isn't always $$$$

- Regard for something you hold as important
  - Quality, pt. experience, outcomes, and…satisfaction

- Who isn't tired of ROI forecasting?

Challenges

- Depends who and what you believe

- It changes in terms of focus
  - Implementation, adoption, then pophealth, analytics, Watson, and now "consumerism"
  - By the way how quickly did telehealth video visits boom and dive? But, Zoom persists
  - Blockchain hahahaha!

- Yet, on the frontlines we are dealing with burnout, staffing shortages, kludginess, and the same if not more regulation, coding/billing, compliance

- "Optimize the EHR" LOL
  - No 2 healthcare org's are the same, and within a system no 2 hospitals are the same!

Workload and AI

- Voice/STT

- Ambient

- Virtual assistant

- Imaging reads

Challenge: The ever present documentation devil

Value play? Automate for speed and efficiency, and eliminate clicks

Satisfaction

- Face to face healthcare

- Workday finished earlier

- Admin tasks reduced (sadly not eliminated)
  - John Lee's post on prior auths, query time, risk factoring HCC's

- Pts. navigate and solve tasks easier
  - Chat Bots w/interactive voice response (IVR), virtual assistants, online scheduling, and the ever present "physician reviews"

Value play? Automate for speed and efficiency, and eliminate clicks

Closing thoughts

- The computer isn't going away, but…

- Eliminate the keyboard

- Minimize the EHR shortcomings

- Maximize automation (for both providers and patients) and data mining

Value play? Star Trek isn't coming, it is here! (Machine learning was never mentioned!)