Decision Fatigue in Physicians

Han Ye,   Junjian Yi,   Songfa Zhong

Department of Economics

National University of Singapore

Questions

- Why Barack Obama in gray or blue suit?
- Why Mark Zuckerberg in gray T-shirt?

Decision Fatigue

- Why Barack Obama in gray or blue suit?
- Why Mark Zuckerberg in gray T-shirt?

Obama: "You'll see I wear only gray or blue suits. I'm trying to pare down decisions. I don't want to make decisions about what I'm eating or wearing. Because I have too many other decisions to make."

Zuckerberg: "I really want to clear my life to make it so that I have to make as few decisions as possible about anything except how to best serve this community."

Literature: Decision Fatigue

Making too many decisions depletes individuals' executive function and mental resources, which may influence their subsequent decisions (Baumeister et al., 1998; Stanovich and West, 2000; Kahneman, 2011; Baumeister and Tierney, 2012).

- Consumer purchasing for custom-made products (Levav et al., 2010)
- Judicial parole decisions (Danziger et al., 2011)
- Voter behavior (Augenblick et al., 2015)
- Financial analysts' forecasts (Hirshleifer et al., 2018)

Excessive Workloads and Decision Fatigue in Physicians

Medical errors are the third leading cause of death in the US, accounting for 250,000 deaths every year.

A large proportion of these errors are caused by physicians' excessive workloads.

- Physicians in the U.S. on average treat 21 patients per day and work 53 hours per week
- Increasing workloads
  - The ageing population and the workforce shortage
  - Pressure from the public to reduce operating costs

One important consequence of excessive workload is decision fatigue

- Excessive workloads compel physicians to make more medical decisions.

Literature: Physician Behavior

Physicians' decisions are affected by a variety of factors irrelevant to patient health.

- Peer effects among doctors and organizational culture (Lee and Mongan, 2009)

- Medical liability (Currie and McLeod, 2008; Frakes, 2013)

- Physician beliefs about treatment (Cutler et al., 2013)

- Physicians' financial incentives (Clemens and Gottlieb, 2014)

- Multiple dimensions of physicians' human capital (Currie and McLeod, 2017)

Decision Fatigue in Physicians

Three research questions

1. Whether and how decision fatigue affects physician behavior?

2. Whether and how decision fatigue of physicians affects patient outcomes?

3. What kind of physicians suffers more from decision fatigue?

Contributions

1. Decision fatigue in a new research domain: healthcare

   Previous studies on physician workload exclusively focus on working hours

2. A quasi-experiment for the causal identification

3. The consequences of decision fatigue of physicians on patient outcomes

4. Physicians' characteristics on their responsiveness to decision fatigue

Patient Flow
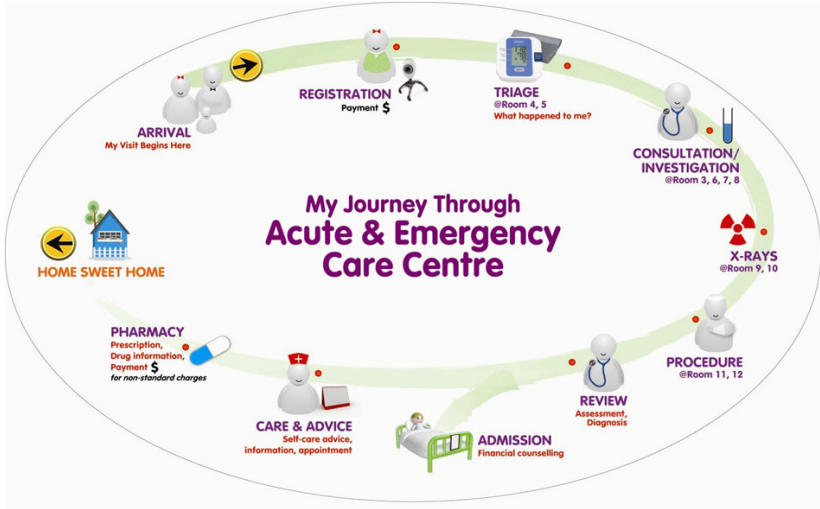
Source: The hospital A&E website

Patient Flow Data

An entire set of Emergency Department (ED) visits in an acute general hospital of SG from January 2011 to December 2012: 264,115 patient cases.

For each patient case, we observe **detailed timestamps** (e.g. the start and end times of triage, consultation, and task orders) and **physician identifiers**.

With these data, we construct

- Real-time patient flow volume in the ED
- Patient's entire path through the ED
- Physician's shift schedules
- Sequences of actual patients who are seen by the physician in each shift

Patient Information

- Basic demographics: birthdate, gender, race, address

- Patient triage severity

- Arrival mode: ambulance or walk in

- Disposition type: discharge home, follow-up in primary care, inpatient admission ...

- Diagnostic information

Sample Restrictions

All patient cases whose attending physician

- has at least 10 shifts observed
- is working in a shift with shift length 6-16 hours

Finally, we have **242,761** patient cases, with **124** physicians.

Q1: Whether and how decision fatigue affects physician behavior?

Physician Decisions: Regression Specification

$$Y_{ijt} = PatientCount_{ijt}\alpha + X_i\beta + T_t\gamma + \nu_j + \epsilon_{ijt}$$

Y_{ijt}: decisions for patient i by physician j starting consultation at time t

1. physician discharge decision
   - inpatient admission(dummy variable)
2. number of task orders
3. patient length of stay
   - from the start to the end of consultation

Regression Specification

$$Y_{ijt} = PatientCount_{ijt}\alpha + X_i\beta + T_t\gamma + \nu_j + \epsilon_{ijt}$$

Y_{ijt} – decisions for patient i, treated by physician j starting consultation at time t

$PatientCount_{ijt}$ – number of cases seen by physician j prior to patient i's consultation at time t

X_i – patient characteristics: gender, age, age squared, race, and triage severity

T_t – time fixed effects: hour of day, day of week, and month-year interactions

ν_j – physician fixed effects

Standard errors clustered at the physician level
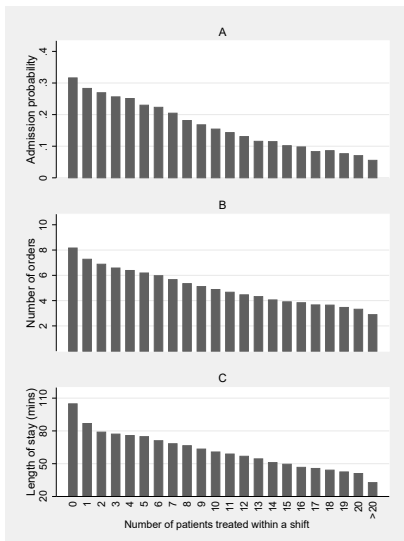
Graphic Evidence

Figure: Physician decisions by the number of patients treated

OLS Results

Table: Decision fatigue on physician decisions

	(1)	(2)	(3)	(4)
	Inpatient admission	Inpatient admission	Number of orders	Log length of stay
	OLS	**Probit**	**OLS**	**OLS**
# Patients treated	-0.0021***	-0.0029***	-0.0655***	-0.0191***
	(0.0002)	(0.0004)	(0.0054)	(0.0018)
R-squared	0.378	0.376	0.515	0.329
Percent effect: #Patients treated +10	11.9	16.5	12.3	19.1
Patient characteristics	YES	YES	YES	YES
Physician FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	242761	242761	204510	242752
Sample mean outcome	0.176	0.176	5.317	3.387

Identification

Is the assignment of patients to physicians random?

- patient side
- physician side
- hospital administrators

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IV: number of total patients arrived at the ED by ambulance from the starting time of the shift to the starting time of consulting patient i for physician j

- an important determinant for the physician's workload
- exogenous to physician characteristics and patient conditions

IV Results

	(1)	(2)	(3)
	Inpatient admission	Number of orders	Log length of stay
Panel A: First-stage results			
# Ambulance arrivals	0.5573***	0.5415***	0.5573***
	(0.0230)	(0.0222)	(0.0230)
R-squared	0.641	0.636	0.641
Panel B: IV estimates			
# Patients treated	-0.0034***	-0.1014***	-0.0230***
	(0.0004)	(0.0082)	(0.0022)
R-squared	0.377	0.513	0.329
Percent effect: #Patients treated +10	19.3	19.1	23.0
P value of Hausman test	<0.001	<0.001	<0.001
Patient characteristics	YES	YES	YES
Physician FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	242761	204510	242752
Sample mean outcome	0.176	5.317	3.387

OLS vs. IV Estimates

The magnitude of IV estimates is larger than that of the OLS estimates in terms of absolute values.

The result implies that the hospital has realized the problem of decision fatigue among physicians by allocating more serious patients to less tired physicians. But the hospital haven't completely solved the problem.
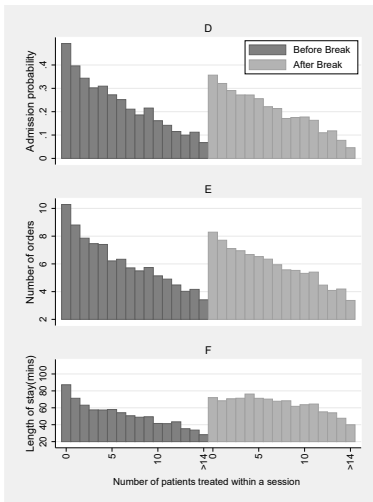
Break within the Shift

Mental resources might be replenished by a short rest which increases glucose and leads to a positive mood (Danziger et al., 2011).

Restricted sample of visits:

- the physician is in a shift with an at-least-one-hour break (not in charge of any patient case)
- break up a shift into two distinct sessions (before and after break)

Graphic Evidence

Figure: Physician decisions by the number of patients treated within a session

Regression Analysis

We extract three groups of patient visits from the analytic sample:

- *Group*1: the last fourth to sixth cases before the break
- *Group*2: the last three cases before the break (omitted category)
- *Group*3: the first three cases after the break

$$Y_{ijt} = \alpha_1 Group1_{ijt} + \alpha_2 Group3_{ijt} + X_i\beta + T_t\gamma + \nu_j + \epsilon_{ijt}$$

- $-\alpha_1$: the effect on physician decisions when the number of previously treated patients increases by three in the same session
- α_2: the combined effect of treating three more patients and taking a break
- $\alpha_1 + \alpha_2$: the effect of a break

Table: Break within the shift

	(1) Inpatient admission	(2) Number of orders	(3) Log length of stay
Group 1 ($\alpha 1$)	0.0118	0.2887*	0.1582***
	(0.0134)	(0.1538)	(0.0352)
Group 3 ($\alpha 2$)	0.0260*	1.1302***	0.2235***
	(0.0139)	(0.1958)	(0.0461)
$\alpha 1 + \alpha 2$	0.0378	1.4189	0.3817
P value of Wald test	0.0937	0.0000	0.0000
Patient characteristics	YES	YES	YES
Physician FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	7, 285	6,458	7, 285
R-squared	0.387	0.504	0.426
Sample mean outcome	0.279	7.026	3.367

Robustness Checks

- Decision fatigue vs physical fatigue
- End-of-shift effect
- ED crowding
- Physicians' multitasking
- Patient diagnostics
- Further restrictions on physician shift length

Table: Robustness Analyses

	(1) Inpatient admission	(2) Number of orders	(3) Log length of stay
Panel A: control for cumulative time elapsed in the shift			
# Patients treated	-0.0010***	-0.0342***	-0.0127***
	(0.0002)	(0.0049)	(0.0021)
Panel B: exclude the last three visits in each shift			
# Patients treated	-0.0023***	-0.0607***	-0.0150***
	(0.0003)	(0.0059)	(0.0019)
Panel C: control for ED patients-in-waiting			
# Patients treated	-0.0021***	-0.0647***	-0.0192***
	(0.0002)	(0.0053)	(0.0018)
Panel D: control for ED system load			
# Patients treated	-0.0021***	-0.0643***	-0.0195***
	(0.0002)	(0.0053)	(0.0019)
Panel E: control for physician multitasking			
# Patients treated	-0.0021***	-0.0643***	-0.0182***
	(0.0002)	(0.0059)	(0.0018)

Heterogeneous Analysis:Nonlinear Fatigue Effects

$$Y_{ijt} = \sum_m \alpha_m D_{ijm} + X_i\beta + T_t\gamma + \nu_j + \epsilon_{ijt}$$

D_{ijm} - dummy indicator: number of cases seen by physician j before patient i's arrival falls into group m

- D_1: number of previous cases is between 0 to 2
- D_2: number of previous cases is between 3 to 5
- D_3: number of previous cases is between 6 to 8
- D_4: number of previous cases is between 9 to 11
- D_5: number of previous cases is between 12 to 14
- D_6: number of previous cases is between 15 to 17
- D_7: number of previous cases is between 18 to 20
- reference category: number of previous cases is larger than 20
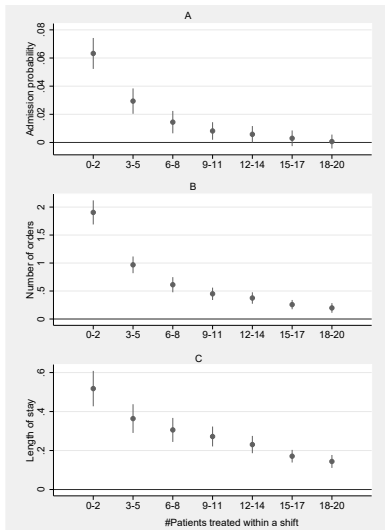
Nonlinear Fatigue Effects

Figure: Parameter estimates with 95% CI

Other Heterogeneous Analyses

- Severity of previous cases

- Patient-physician race and gender concordance

- Severe vs. non-severe current cases

	(1)	(2)	(3)
	Inpatient admission	Number of orders	Log length of stay
Panel A: number of severe cases previously treated			
#Patients treated	-0.0019***	-0.0581***	-0.0187***
	(0.0002)	(0.0056)	(0.0016)
#Severe cases treated	-0.0036***	-0.1082***	-0.0077
	(0.0009)	(0.0204)	(0.0079)
Panel B: patient-physician race and gender concordance			
#Patients treated	-0.0023***	-0.0746***	-0.0183***
	(0.0003)	(0.0064)	(0.0029)
#Patients treated*Race-Concordance	-0.0001	0.0110***	0.0004
	(0.0001)	(0.0029)	(0.0013)
#Patients treated*Gender-Concordance	0.0006**	0.0083***	-0.0020
	(0.0003)	(0.0028)	(0.0026)
Panel C: current severe visits only			
# Patients treated	-0.0029***	-0.1264***	-0.0159**
	(0.0006)	(0.0215)	(0.0062)
percent effect: #Patients treated +10	5.8	12.7	15.9
Panel D: current non-severe visits only			
# Patients treated	-0.0022***	-0.0581***	-0.0207***
	(0.0002)	(0.0050)	(0.0016)
percent effect: #Patients treated +10	41.3	18.7	20.7

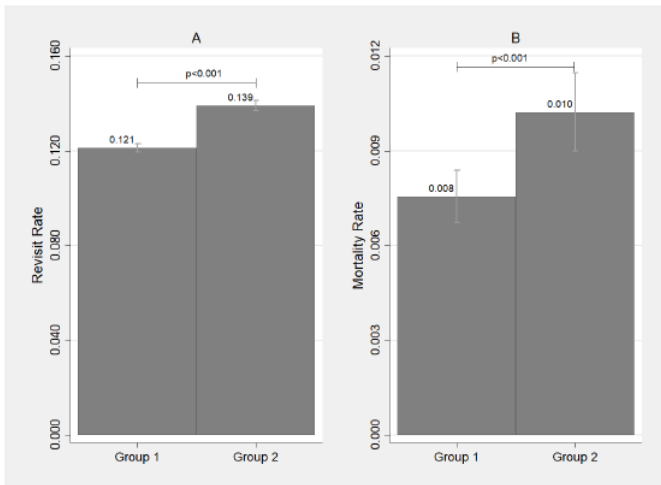Q2: Whether and how decision fatigue of physicians affects patient outcomes?

Patient Outcomes: Regression Specification

$$Y_{ijt} = PatientCount_{ijt}\alpha + X_i\beta + T_t\gamma + \nu_j + \epsilon_{ijt}$$

Y_{ijt}: Patient outcomes (dummies)

1. return visits to the ED within 14 days
2. death in the ED

Physician Decision Fatigue and Patient Outcomes

Group 1 comprises patients who are among the first 10 to visit the physician, and Group 2 the remaining patients.

Table: Physician decision fatigue on patient outcomes

	(1)	(2)
	14-day revisit to the ED	Death in the ED
# Patients treated	0.00046***	0.00003*
	(0.00013)	(0.00002)
percent effect: #Patients treated +10	3.58	12.71
Patient characteristics	YES	YES
Physician FE	YES	YES
Time FE	YES	YES
Observations	242,761	242,761
R-squared	0.020	0.059
Sample mean outcome	0.1286	0.0024

Q3: What kind of physicians suffers more from decision fatigue?

Who Are More Responsive to Fatigue?

$$\alpha_{Yj} = f(exp_j, X_j) + \epsilon_j$$

α_{Yj}: IV estimate of individual-specific decision-fatigue effect on decision Y for physician j

exp_j: years of experience

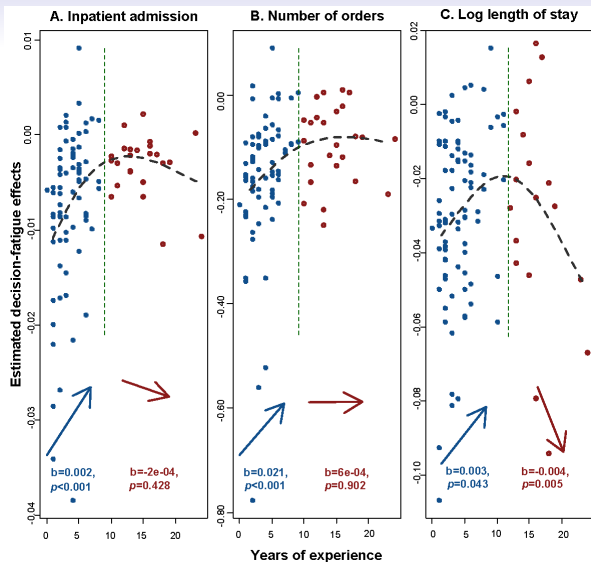X_j: gender, graduation school location and postgraduate study

Figure: Predicted effects of decision fatigue by medical experience.

Summary

Three research questions

- Whether and how decision fatigue affects physician behavior?

- Whether and how decision fatigue of physicians affects patient outcomes?

- Whether and how professional experience affects physicians' responsiveness to decision fatigue?

Answers to Three Research Questions

Decision fatigue: Physicians show a tendency to

- lower inpatient admission
- reduce task orders
- shorten patient length of stay

Patient outcomes: ED mortality and return visits ↑

Professional experience mitigates decision-fatigue effects for young physicians, while this effect fades as the physician ages

Implications

Our results contribute to the literature that takes a behavioral science approach to understand health care.

In order to reduce decision fatigue among physicians, hospitals may

- introduce more breaks and shorter shifts
- allocate serious cases to less fatigued physicians
- delegate certain decisions to decision support systems and subordinates

Implications

Our results have important implications for healthcare policies

- If policymakers are to reduce healthcare costs by increasing the workload of physicians, it may lead to suboptimal care and paradoxically increase healthcare costs.

- Policymakers may re-evaluate restrictions on the supply of healthcare professionals.

Thank you for your comments!