Big Open (IE) Problems in Operating Room Management

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Dept. of Anesthesia's Consulting Center

- Analogy is a statistical consulting center
  - Analyze data for hospitals and groups, and teach them how to do/use on their own
- Professional service, like clinical care
  - Not sponsored program like research
  - Very rarely is research desired – "do it"
- Contract requiring 5 minutes for approval
  - Clients often want agreement that day
- 221 consultations for > 105 corporations

Dept. of Anesthesia's Consulting Center

- www.FranklinDexter.net
  - Comprehensive bibliography of peer reviewed articles in operating room and anesthesia group management
  - Lectures on drug and supply costs, day of surgery decision making, PACU staffing, anesthesia staffing, financial analysis, comparing surgical services among hospitals, and strategic decision making
  - Course information and problem sets
  - Contact information

Dept. of Anesthesia's Consulting Center

- Employment and financial disclosure
  - I am employed by the University of Iowa, in part, to consult and analyze data for hospitals, anesthesia groups, and companies
  - Department of Anesthesia bills for my time
    - I receive no funds other than from the University of Iowa, including no travel reimbursement or honorarium
    - I own no healthcare stocks (other than indirectly through mutual funds)
    - I have tenure with no incentive program

Industrial Perspective on IE Problems in OR Management

- Lack of research in education in OR/ MS/ IE for perioperative medicine
- Use of monitoring, physician order entry, and clinical notes for automatic determination of states for management decision making
- Methods to determine for individual physicians how to increase productivity
  - Corresponding methods to communicate those results to the individuals

Uncommon Non-Preemptive Tasks of Uncertain Durations

Automatic Updating of Times Remaining in Surgical Cases Using Bayesian Analysis of Historical Case Duration Data and "Instant Messaging" Updates from Anesthesia Providers

Franklin Dexter, MD, PhD*

Richard H. Epstein, MD†

John D. Lee, PhD‡

Johannes Ledolter, PhD§

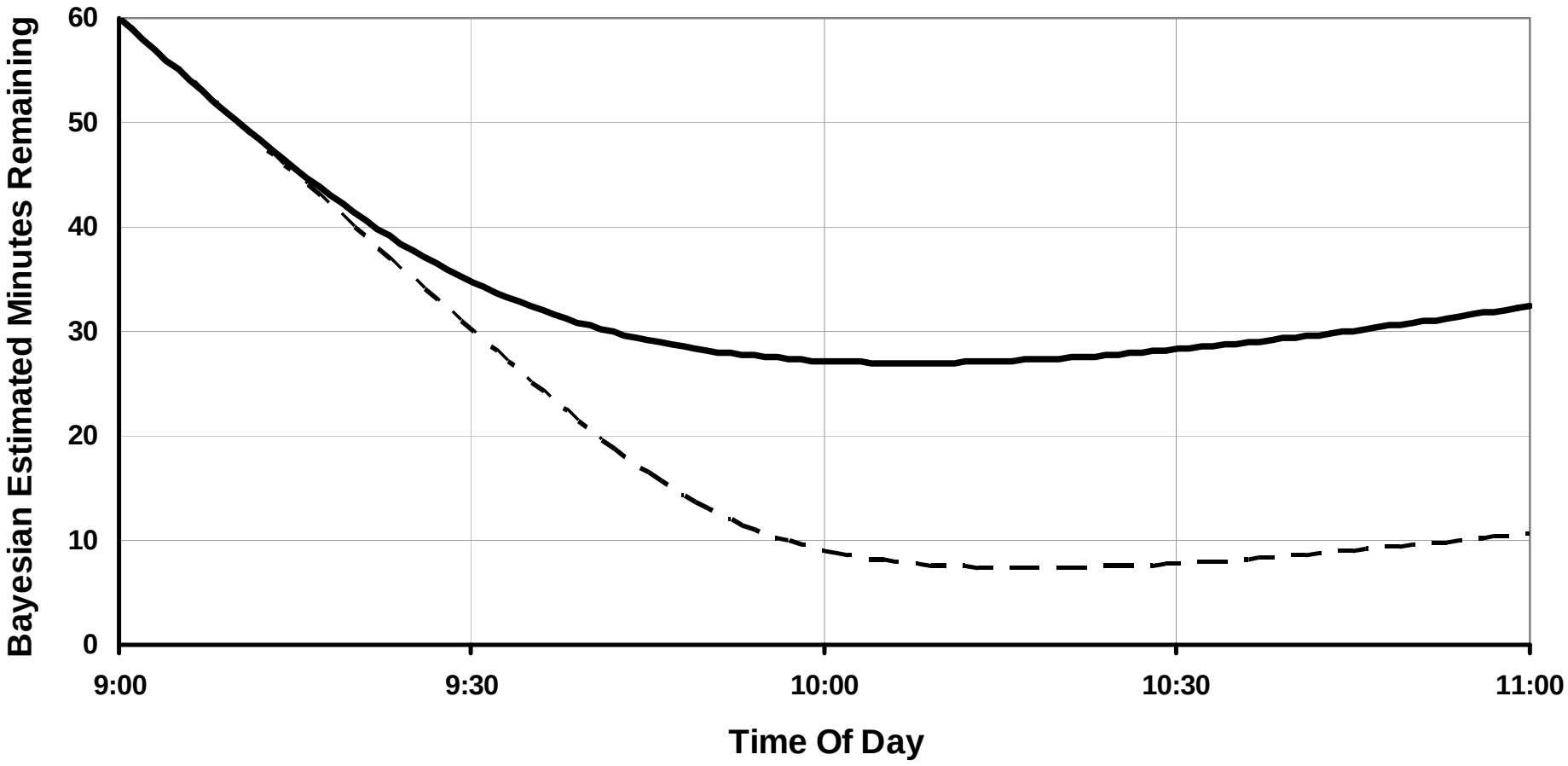
BACKGROUND: Operating room (OR) whiteboards (status displays) communicate times remaining for ongoing cases to perioperative stakeholders (e.g., postanesthesia care unit, anesthesiologists, holding area, and control desks). Usually, scheduled end times are shown for each OR. However, these displays are inaccurate for predicting the time that remains in a case. Once a case scheduled for 2 h has been on-going for 1.5 h, the median time remaining is *not* 0.5 h but longer, and the amount longer differs among procedures.

METHODS: We derived the conditional Bayesian lower prediction bound of a case's duration, conditional on the minutes of elapsed OR time. Our derivations make use

Anesthesia & Analgesia 2009

Real-Time Decision Support

Uncommon Non-Preemptive Tasks of Uncertain Durations



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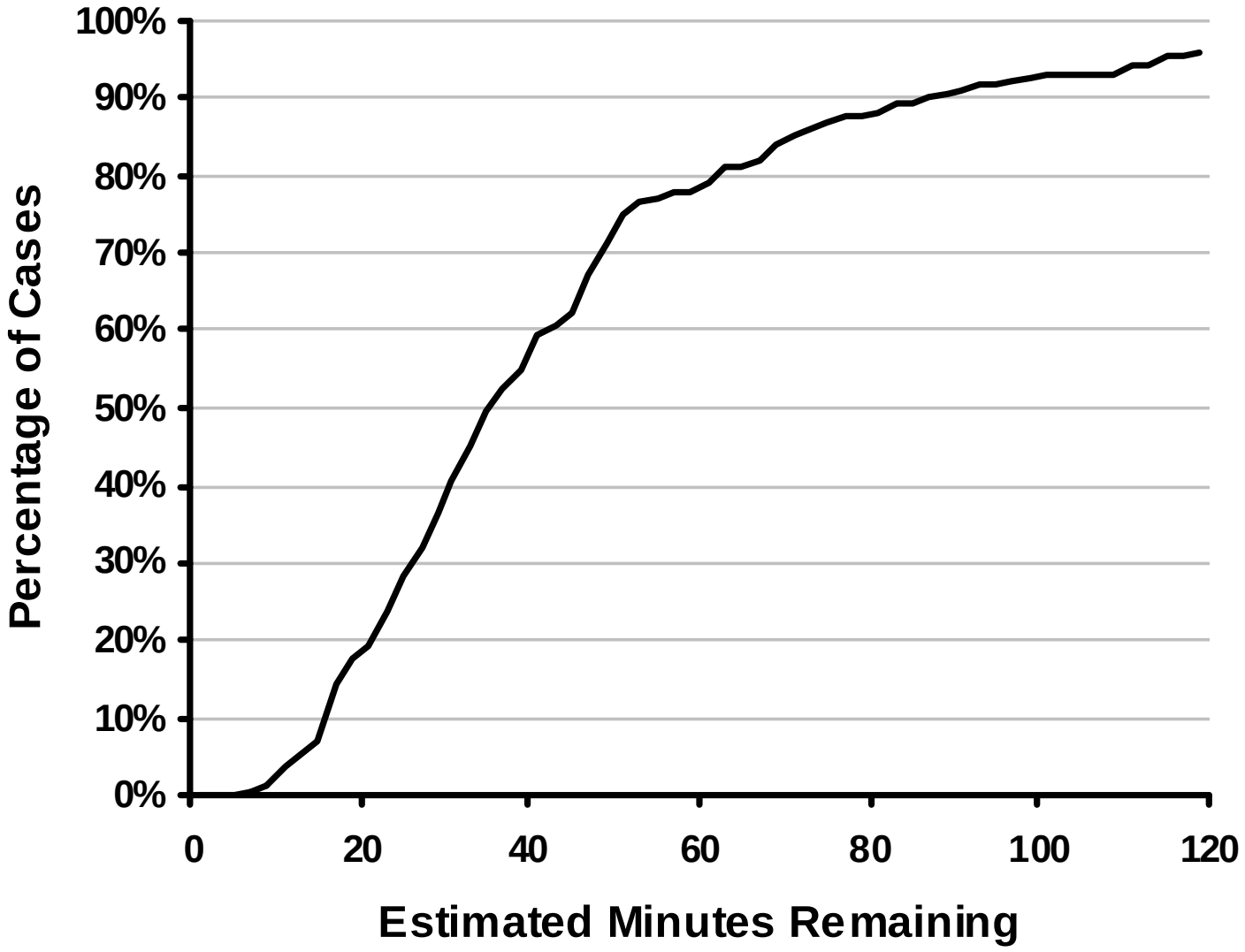

Uncommon Non-Preemptive Tasks of Uncertain Durations

- Most decisions needing improvement rely on either the shortest or longest amounts of time that the first game of the ***pair*** might take
  - Information systems and human behavior revolve around deterministic model
    - Software for resource constraints poor since use deterministic calendars

Uncommon Non-Preemptive Tasks of Uncertain Durations

From Yan Xiao, PhD (Univ. of Maryland)

Uncommon Non-Preemptive Tasks of Uncertain Durations

DocuSys DocuView® Board

OR	Time	Status	Patient	Age	Procedure	MD	MDA
1	07:20		DON.B.HARDON	6 y	JEJUNOSTOMY	L.W.	C.M
3	07:00	Positioning	AMY.LONG	32 y	RADICAL HYSTERECTOMY W/NODE DISSECTION,OIP	S.M	
4	07:00		KAMI.TYGEN	32 y	GLOSSECTOMY-LAPAROSCOPIC CHOLECYSTECTOMY	W.W. A	
5	07:15		JUSTI.Q.HENLEY	24 y	WOUND REPAIR OF NECK	J.W.	C.M
7	08:00		KASIE.R.STRING	22 y	FUSION OF SHOULDER	J.W.	K.D
E 04	07:00	Alert	JOHN.TURNER	64 y	DRAINAGE OF ABDOMEN FOR PANCREATITIS	T.G. A	
OR 06	07:00	In POHA 1	QUINL.TANNER-	58 y	TRIPLE ARTHRODESIS	J.C.	
OR 10	07:00		GUNTE.ASH	83 y	TOTAL HIP BIPOLAR ZIMMER	R.D.	
OR A...	07:00		ASHTO.KOPTAN	22 y	APPENDECTOMY	J.M.	
OR M...	07:00		BRYAN.VAN	71 y	BLADDER AUGMENTATION		C.M
OR O...	13:00		JONNI.COPPER	2 y	ADENOIDECTOMY	J.M.	

Uncommon Non-Preemptive Tasks of Uncertain Durations

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➢ We know how to address these problems mathematically and can implement the statistics practically

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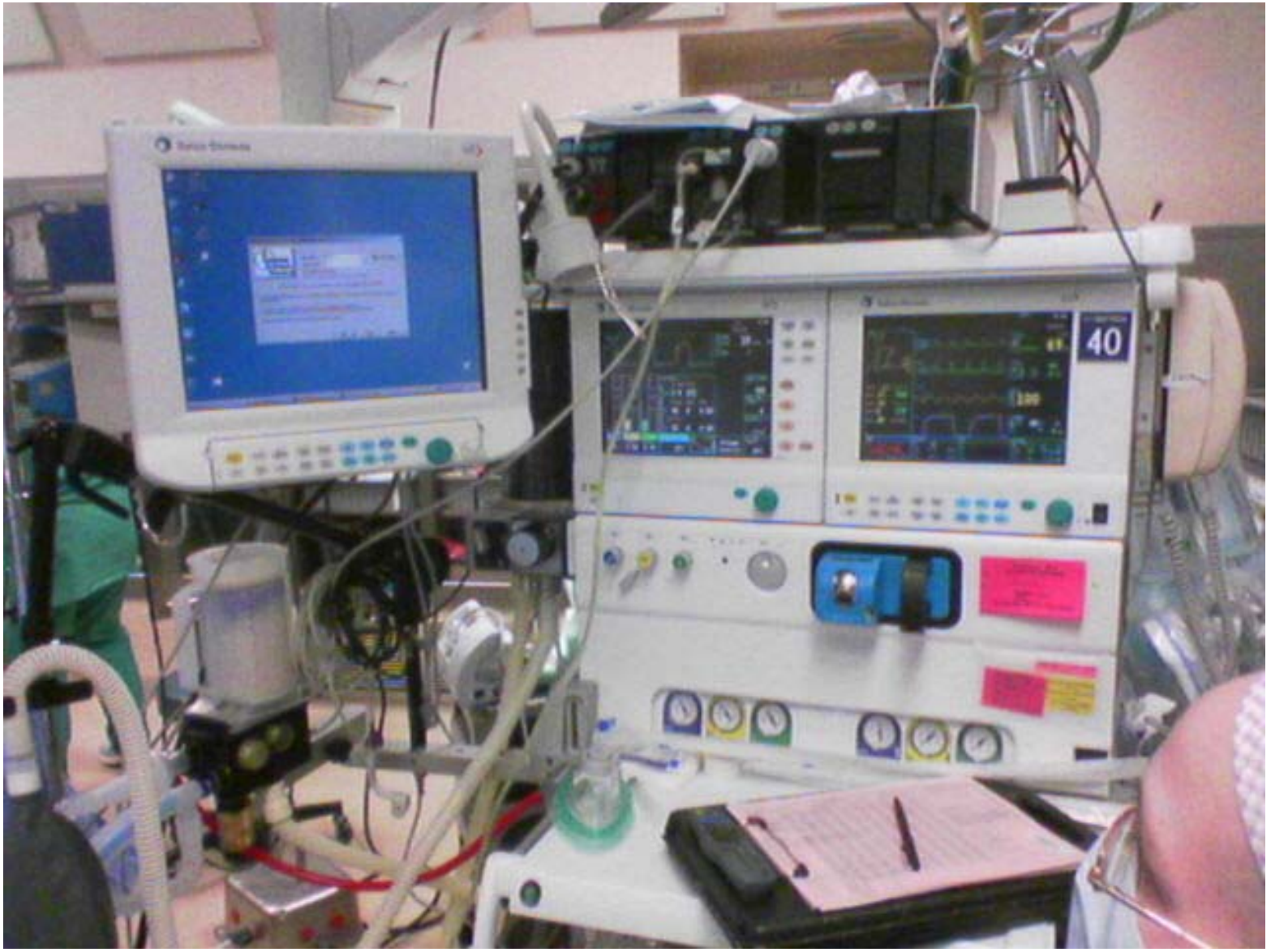

Real-Time *Automatic* Decision Support

Real-Time *Automatic* Decision Support

- Information systems rely on human input even though the humans are supposed to be caring for the patient
- For this and similar problems, we know how to do the statistics and signal processing and can implement the methods practically

Details of and Skills for Implementation

- SQL Server, etc., for Bayesian methods
  - Scientific programming
- Real-time processing of networked vital signs from patients to know activity in each OR
  - Eliciting knowledge from the combinations of the signals relies on clinical context
- Lack of research to know how to train the 1000's of people to roll out these systems

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Likely the Most Common Question that I Cannot Answer

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Experience in Interviewing

- Appropriate job advertisement
- Interviewed > 10 people with scientific programming background – none when given the signals thought of the missing values as being the relevant information
  - Took me 10 yr to learn after medical school
- Interviewed > 10 people with relevant medical informatics background - the few who knew “linear programming” all thought it was fitting a straight line

Likely Most Common Question that I Cannot Answer

- How train OR/ MS/ IE students in perioperative medicine, even though only need 1 at each of 1000 anesthesia groups?

Likely Most Common Question that I Cannot Answer

- How train OR/ MS/ IE students in perioperative medicine, even though only need 1 at each of 1000 anesthesia groups?
  - Not opinion, solid educational research

Industrial Perspective on IE Problems in OR Management

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Another Example of Clinical Data for Management

- Patient leaves operating room and goes to the recovery room (“post-anesthesia care unit”)
- Stochastic programming to match PACU staff scheduling to forecasted workload
  - Relies on knowing nurse : patient ratios from historical data, but adjusted dynamically
- Inference from electronic medical record data
  - Scores of potential signals (AIMS, CPOE, EMR)
  - Must infer local factors specific to each PACU and that change over months

Another Example of Clinical Data for Management

- Restaurant analogy
  - Know when every door is opened
  - Know whenever every appliance is opened and closed
  - Know when every order is taken and completed
- However, to extend the clinical analogy,
  - Every restaurant is unique to some extent
  - Not chains

Another Example of Clinical Data for Management

- Use real-time electronic medical records ("anesthesia information management systems") for managerial purposes
  - Seemingly unlimited and overwhelming amount of work to learn how to use the signals
    - Not engineered systems
    - Results scalable to 10,000 different PACU
    - We do not know how to hire and train people to do this type of work successfully

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Another Example of Clinical Data for Management

- Same principles in increasing surgeon and anesthesiologist productivity
  - Capital cannot be the bottleneck since used for so many hours per week
  - Nursing staff 1/3rd the years of education
  - Specialization of surgeons results in productivity highly sensitive to Poisson OR workload with small daily means

Another Example of Clinical Data for Management

- Same principles in increasing surgeon and anesthesiologist productivity
  - Change physician schedule pattern
  - Change patient scheduling
  - Change patient flow
  - Hire additional clerks
  - Hire additional clinical assistants
  - Hire additional nurses
  - Hire additional advanced practice nurses

Another Example of Clinical Data for Management

- Same principles in increasing surgeon and anesthesiologist productivity
  - Analogous to providing automatic recommendations to every faculty member in a College of Engineering about how to increase their productivity
    - Difference is that far more data available for the physicians if you use the clinical documentation for managerial purposes

Further Interpreting Clinical Data for Management

- With perfect knowledge of surgeons'
  - Calendar
  - Telecommunications use
  - Clinical notes
- How provide advice to that individual and his/her group to increase productivity?
  - How adjust with realistic information?
  - How adjust based on different objectives?
  - How communicate the recommendations?
    - Recommendations, video, or status displays

Communicating Results

- Suppose use discrete event simulation to show impact for the physician on productivity
  - Does animation change implementation?
- If perform analysis for 45 anesthesiologists simultaneously, produce 45 four-page reports with graphs or tables?
  - Does presentation change implementation?
- Sociological (organizational) factors had no influence relative to psychological biases
  - Education had no effect

Example from Chuck Hogue, Anesthesiologist at JHU

- At societal level, ICU should be bottleneck
- Large uncertainty in ICU length of stay
  - Incorporate into surgeon “block” schedule
  - Rely on “pull” system day to day
    - Optimization nicely developed (see Adan I et al. Health Care Management Science 2009)
- How best show to one surgeon the impact of block changes on all aspects of her work?
- How implement communication and calendaring of physicians for “pull” system?

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