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Indices of ED crowding

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Crowding: items per m²



Why measure crowding?

- Prevent adverse outcomes in real time
 - Adverse outcomes: delays, morbidity, mortality
 - Proxy outcomes:
 - Waiting time
 - Ambulance diversion
 - LWBS rate (Left without being seen)
 - Alarm bell function: call in backup
 - Crowding indices that use realtime ED flow tracking
 - EDWIN: ED work index
 - READI
 - NEDOCS: proprietary system
 - ED work score



NEDOCS
tracking emergency department overcrowding

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We are on a mission to track the National
Emergency Department Overcrowding Score

About NEDOCS
The National Emergency Department Overcrowding Score is an
evidence-based tool that quantifies emergency department and

For Hospitals
Share NEDOCS with each other,
real-time updates and alerts

For Patients
Hospital overcrowding is a rapidly
growing worldwide problem that

Why measure crowding nationally?

- Measure system performance
 - Evaluate temporal trend
 - EDs are “canary in coalmine” for healthcare system
 - Compare EDs (benchmarking)
 - Practice variation = inequity in cost, quality
 - Marketing = product differentiation



Many other potential indices

Ann Emerg Med. 2003;42:824-834

Input Measure	Concept	Operational Definition
1. ED patient		
2. ED patient		
3. ED ambula		
4. ED ambula		
5. Patient sou		
6. Percentag		
7. Percentag		
8. Leave with		
9. Ambulance		
10. Ambulance		
11. Diverted		
12. Average		
13. Patient complexity a		
14. Patient complexity a		
15. Patient complexity a		
*Leave without treatment c		

Throughput Measure	Concept	Operational Definition
1. ED throughput time	ED efficiency	Average time between patient sign-in and departure (separately for ad

Output Measure	Concept	Operational Definition
1. ED boarding time	Hospital efficiency	Mean time from inpatient bed request to physical departure of patients from the ED overall and by bed type within a defined period (shift/day/week)*
2. ED boarding time components	Hospital efficiency	Mean time from inpatient bed request to physical departure of patients from the ED by bed type by component (bed assignment, bed cleaning, transfer arrival) within a defined period*
3. Boarding burden	Hospital efficiency	Mean number of ED patients waiting for an inpatient bed within a defined period ÷ number of staffed ED treatment areas
4. Hospital admission source, standardized and adjusted	Hospital efficiency	Number of requests for admission within a defined period (shift/day) overall and by admission source ÷ annual mean requests for admission during that period and source and adjusted for day of week and season of year [†]
5. ED admission transfer rate	Hospital efficiency	Number of patients transferred from ED to another facility who would normally have been admitted within a defined period ÷ number of ED admissions within this period
6. Hospital discharge potential	Hospital efficiency	Number of inpatients ready for discharge at or within a defined period ÷ number of hospital inpatients at that time
7. Hospital discharge process interval	Hospital efficiency	Mean interval from discharge order to patient departure from a unit in a defined period (shift/day/week/month)
8. Inpatient cycling time	Hospital efficiency	Mean amount of time required to discharge an inpatient and admit a new patient to the same bed within this period
9. Hospital census	Hospital capacity	Mean number of inpatient beds available by bed type at a defined time ÷ number of staffed inpatient beds by bed type*
10. Hospital occupancy rate	Hospital capacity	Number of occupied inpatient beds overall and by bed type ÷ number of staffed inpatient beds overall and by bed type*
11. Hospital supply/demand status forecast	Hospital capacity	Forecast of expected hospital admissions and discharges as reported daily at 6 AM and compared with hospital census
12. Observation unit census	Hospital capacity	Mean number of available ED observation beds at a defined time ÷ number of staffed ED observation beds

ED occupancy rate: As good as the ED work index (EDWIN)

HEALTH POLICY AND CLINICAL PRACTICE/ORIGINAL RESEARCH

The Emergency Department Occupancy Rate: A Simple Measure of Emergency Department Crowding?

Melissa L. McCarthy, MS, ScD

Dominik Aronsky, MD, PhD

Ian D. Jones, MD

James R. Miner, MD

Roger A. Band, MD

Jill M. Baren, MD, MS

Jeffrey S. Desmond, MD

Kevin M. Baumlin, MD

Ru Ding, MS

Robert Shesser, MD, MPH

From the Department of Emergency Medicine, Johns Hopkins University School of Medicine, Baltimore, MD (McCarthy, Ding); the Department of Biomedical Informatics (Aronsky) and Department of Emergency Medicine (Jones), Vanderbilt University Medical Center, Nashville, TN; the Department of Emergency Medicine, University of Minnesota, Minneapolis, MN (Miner); the Department of Emergency Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA (Band, Baren); the Department of Emergency Medicine, University of Michigan, Ann Arbor, MI (Desmond); the Department of Emergency Medicine, Mount Sinai School of Medicine, New York, NY (Baumlin); and the Department of Emergency Medicine, George Washington University School of Medicine, Washington, DC (Shesser).

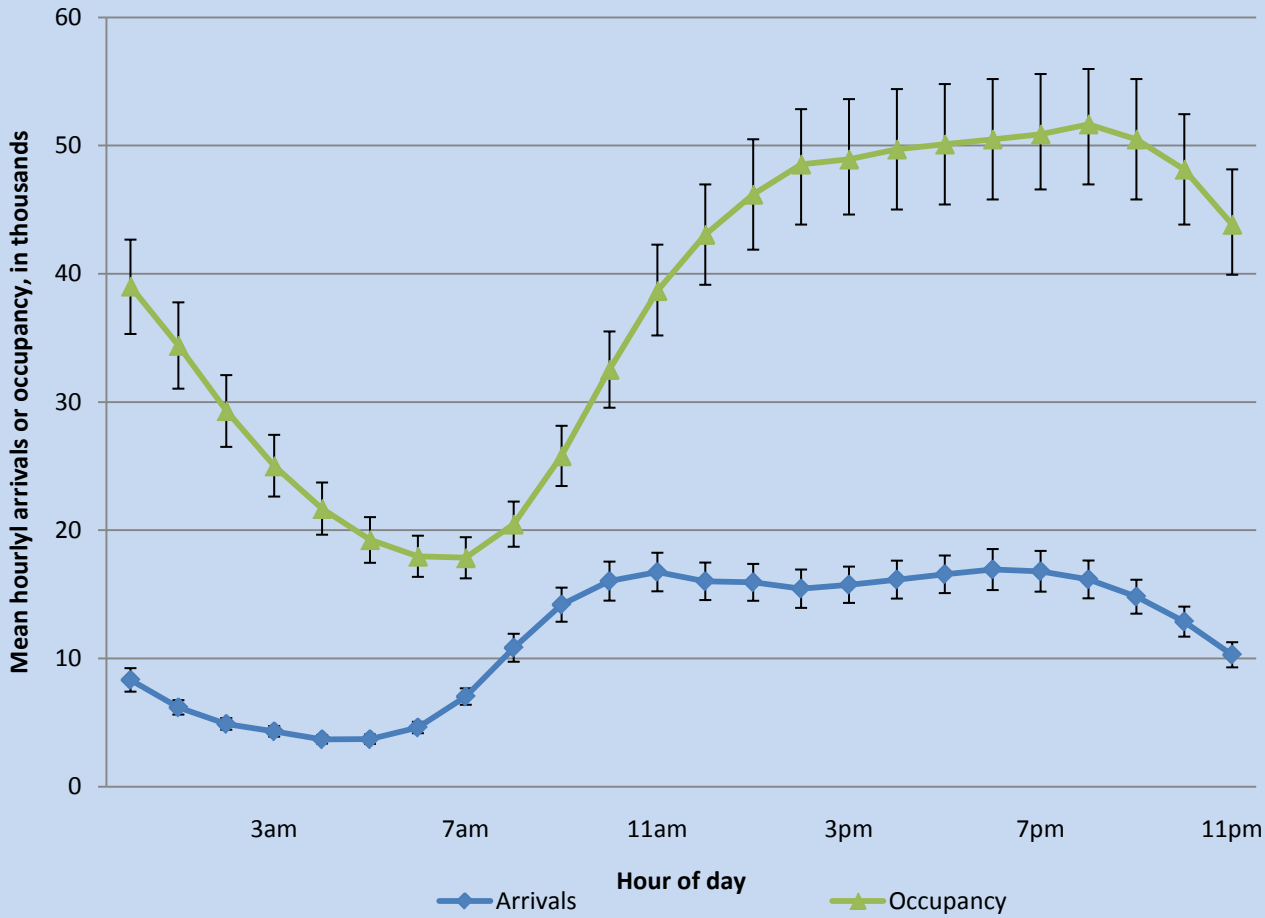
Conclusion: The ED occupancy rate and the EDWIN classified leaving without being seen and ambulance diversion hours with moderate accuracy. Although the ED occupancy rate is not ideal, its simplicity makes real-time assessment of crowding feasible for more EDs nationwide. [Ann Emerg Med. 2008;51:15-24.]

Calculating occupancy in NHAMCS-ED public use data

- Not available:
 - Staffing levels
 - ED bed availability
 - Hospital bed availability
 - Date of visit (only month, day of week)
- Available since 2001:
 - Time of arrival
 - Length of visit in minutes

National ED arrivals vs. occupancy

(2001-2007 NHAMCS-ED surveys combined)



Error bars are 95% confidence intervals

Advanced Statistics: Developing a Formal Model of Emergency Department Census and Defining Operational Efficiency

Thomas J. Flottemesch, PhD, Bradley D. Gordon, MD, Spencer S. Jones, MStat

occupancy

ACADEMIC EMERGENCY MEDICINE 2007; 14:799-809

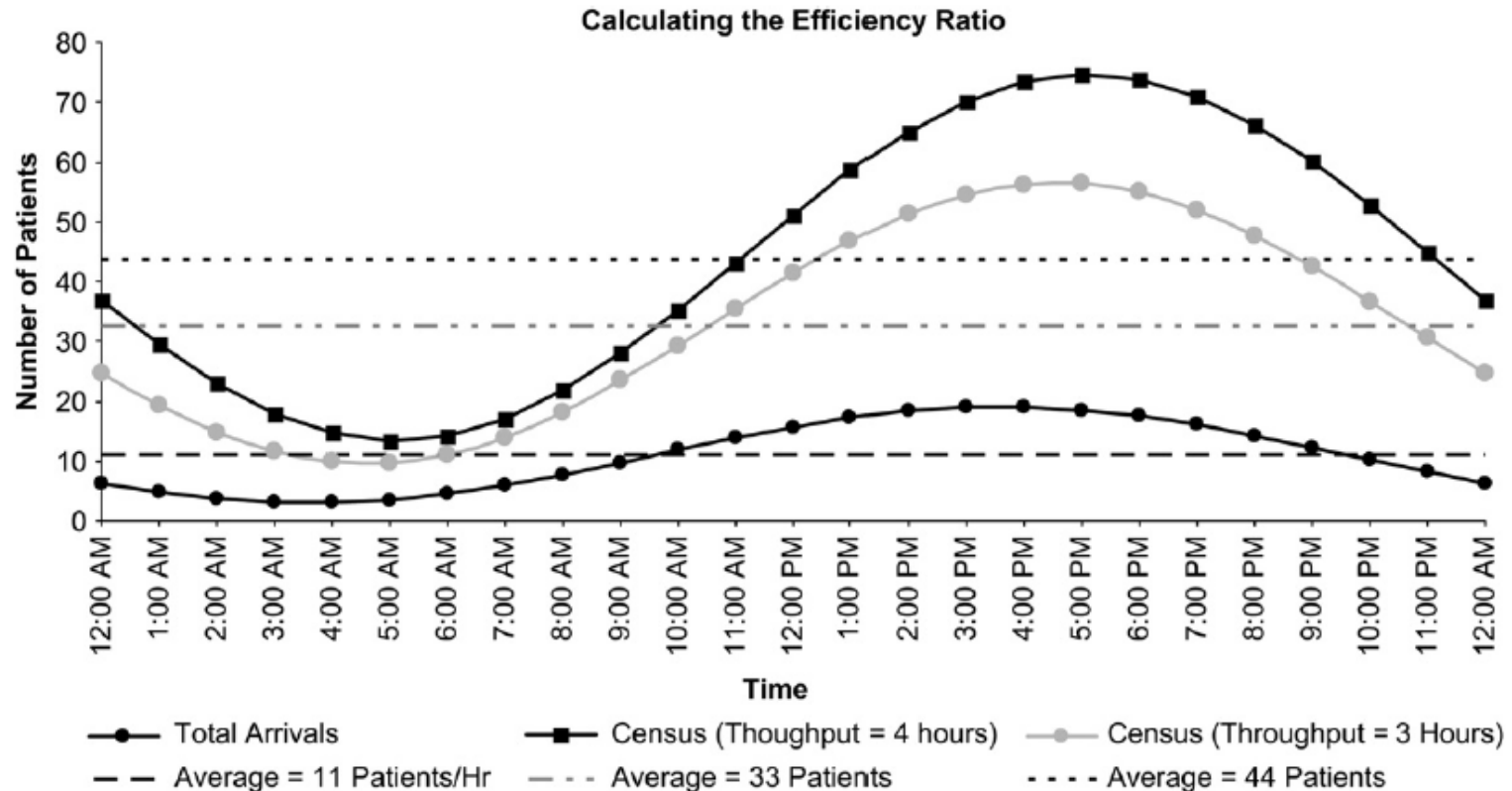
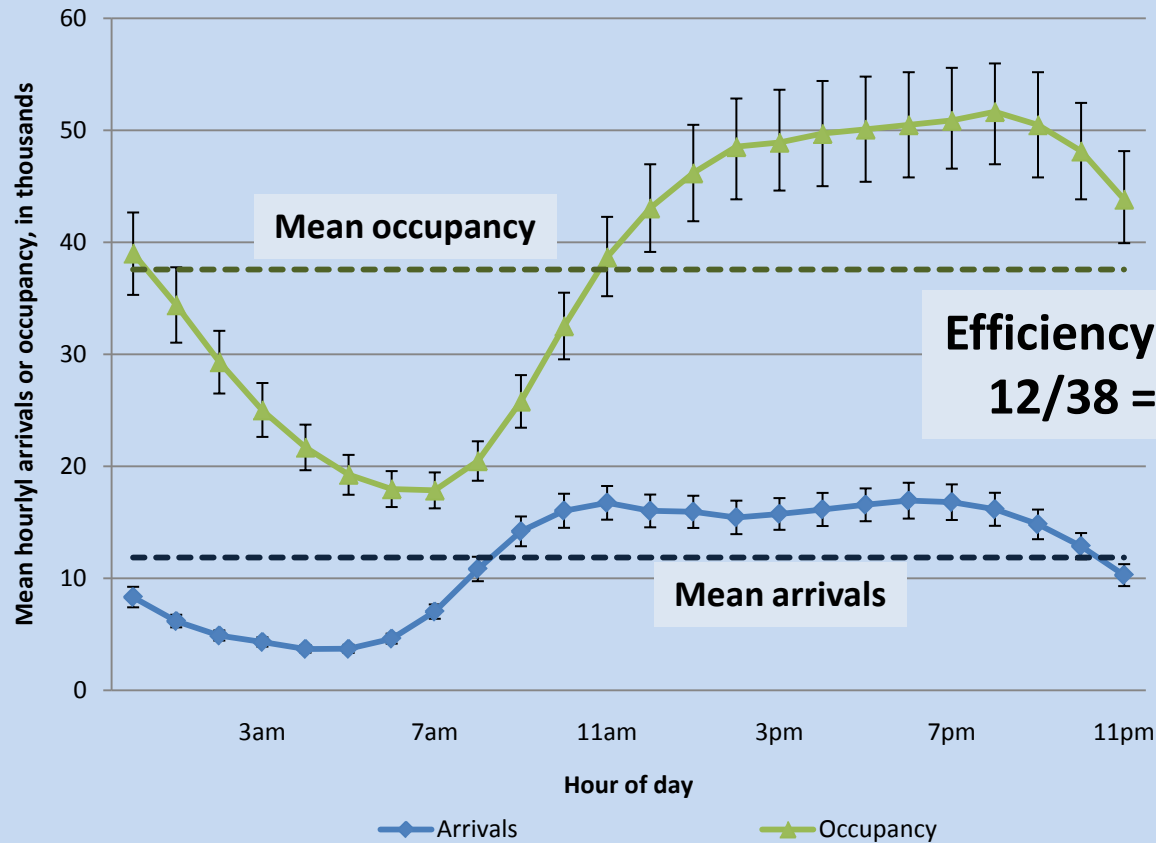


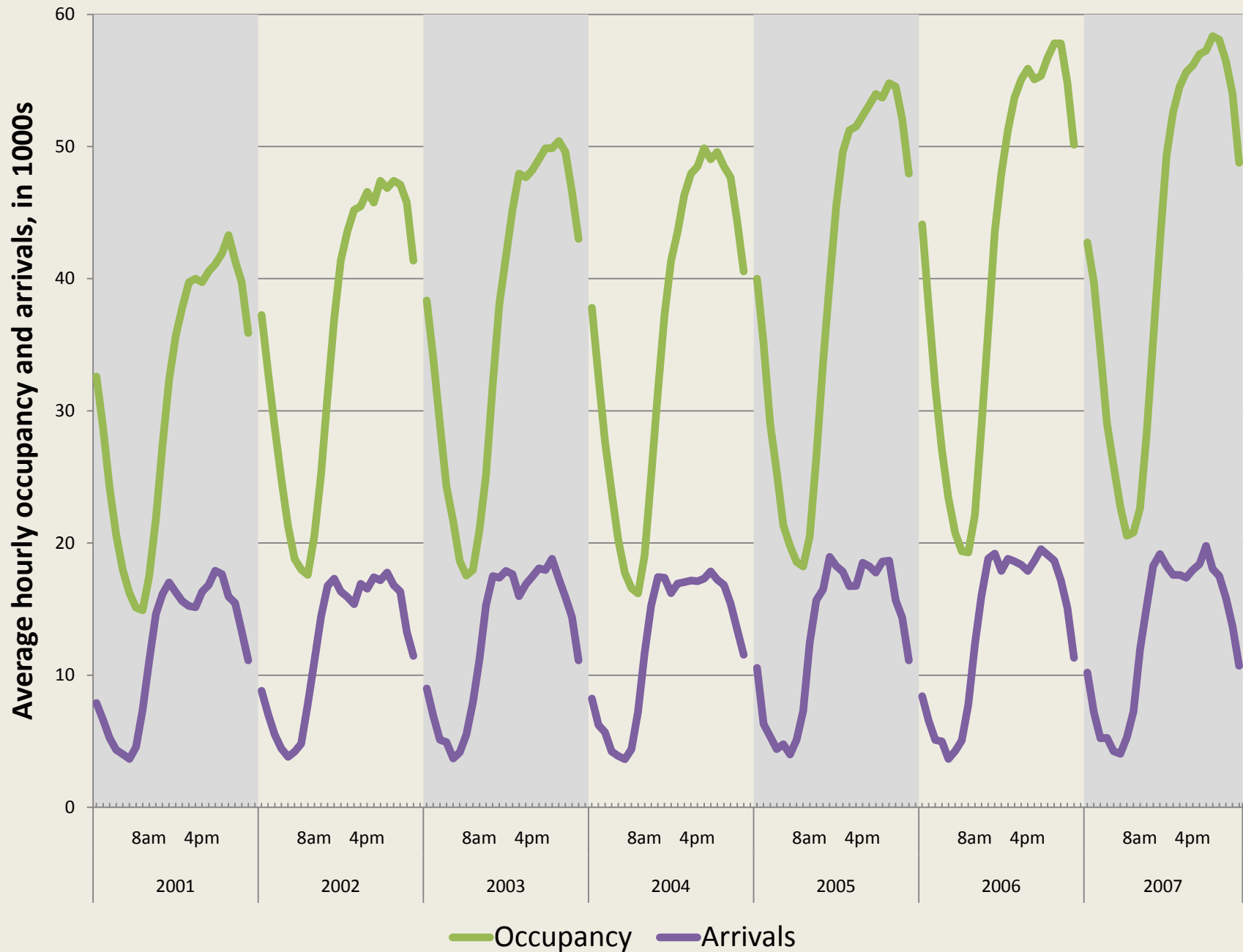
Figure 2. Although both of the modeled EDs have identical arrival patterns, they have significantly different census patterns. This difference is caused by their different average throughput times (four hours vs. three hours). It is possible to express the percentage difference in throughput times between the two EDs by taking the ratio of average census (44 or 33 patients) to average arrivals (11 patients per hour). This ratio is termed the efficiency ratio and expresses the operational efficiency of an ED.

National ED arrivals vs. occupancy

(2001-2007 NHAMCS-ED surveys combined)



Error bars are 95% confidence intervals



Problems with occupancy

- No national denominator (# of treatment spaces)
 - # of spaces probably decreased nationally 2001-2007
 - Underestimates crowding trend
- Time of discharge = problematic item
 - Actual ED departure harder to get than time of admission
 - Underestimates boarding, crowding
- Occupancy is an ED-level characteristic
 - NHAMCS-ED surveys 350+ EDs
 - ED identity and characteristics are masked
 - Avg 100 surveys per ED annually
 - Too few for ED-specific occupancy/efficiency estimate
- Solution: proxy for crowding = length of visit
 - Patient-level analysis