

# POCT in the overcrowded emergency department – can it make a difference?

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# Disclosures

- Has been speaker for Abbott Point of care
- Received research funding from Concile gmbH and Abbott point of care
  
- Shareholder in Abbott and Cepheid

# Overcrowding

- Definition: Multiple definitions exist. Essentially overcrowding means that the ED is forced to operate beyond the level of actual (real) and/or staff-experienced capacity. Symptoms are such as shortage of beds, increased waiting times and length of stay at the ED, boarding, feeling of being rushed, ambulance diversion.

# My challenge to you

- Overcrowding is a slow preventable process killing people. Yet, it has become normality in many emergency departments.

# Overcrowding is killing patients

- *Sprivulis, PC, et al.*, The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. *The Medical journal of Australia*, 2006. 184(5): p. 208-12.
- + 30% relative mortality within 7 days if admitted during overcrowding, 60.000 pats
- *Richardson, DB*, Increase in patient mortality at 10 days associated with emergency department overcrowding. *The Medical journal of Australia*, 2006. 184(5): p. 213-6.
- +34% relative mortality at 10 days (34377 vs 32231 pats)
- *Guttman, A, et al.*, Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. *BMJ (Clinical Research Ed.)*, 2011. 342: p. d2983.
- 14 mio pats. Waiting time > 6 h 70% higher rel mortality, 95% (66% low acuity) higher admission probability

# ...and impairing the quality of care

- *Pines, JM, et al.*, The impact of emergency department crowding measures on time to antibiotics for patients with community-acquired pneumonia. *Ann. Emerg. Med.*, 2007. 50(5): p. 510-6.
- Each new pat increases risk of delayed antibiotics by 5%. Overcrowding more than doubles risk for delay
- *Fee, C, et al.*, Effect of emergency department crowding on time to antibiotics in patients admitted with community-acquired pneumonia. *Ann. Emerg. Med.*, 2007. 50(5): p. 501-9, 509 et.
- Same as above. Each new patient increases risk of delayed antibiotics by 5%.
- *Pines, JM and JE Hollander*, Emergency department crowding is associated with poor care for patients with severe pain. *Ann. Emerg. Med.*, 2008. 51(1): p. 1-5.
- Similar as above. Each new patient increases risk for delays in pain medication and room placement.

# ...quality of care.

- *Hwang, U, et al.*, The effect of emergency department crowding on the management of pain in older adults with hip fracture. *J. Am. Geriatr. Soc.*, 2006. 54(2): p. 270-5.
- *Diercks, DB, et al.*, Prolonged emergency department stays of non-ST-segment-elevation myocardial infarction patients are associated with worse adherence to the American College of Cardiology/American Heart Association guidelines for management and increased adverse events. *Ann. Emerg. Med.*, 2007. 50(5): p. 489-96.
- *Liu, SW, et al.*, A pilot study examining undesirable events among emergency department-boarded patients awaiting inpatient beds. *Ann. Emerg. Med.*, 2009. 54(3): p. 381-5.

# Overcrowding is a slow preventable process.....

- - the processes at the ED
- - the pathophysiology of overcrowding
- - POCT and the ED-process

# What is the purpose of the ED?

- Resuscitation of the critically ill
- Diagnosis and treatment of less critically ill
- Decision on further disposition
  - in or out
  - referral
  - Follow up

# Emergency department reality

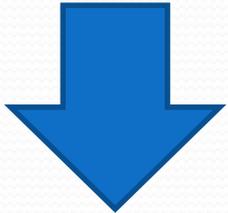
- Patients present with symptoms, not diagnoses
- In Sweden, up to 80% of patients at the ED are not life threatening emergencies, and 40% are no emergencies at all
- 50% of diagnoses at the ED are erroneous
- Overcrowding and shortage of beds are not solvable issues any more, neither are time targets

# Processes at the ED

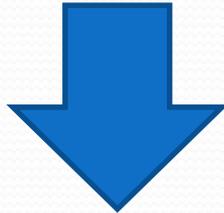
- Inflow
  - Inflow > capacity
  - ambulance diversion
- ED-processing
  - Long process time
  - stacking
  - rushed staff
- Outflow
  - Outflow obstruction
  - boarding
-

# Inflow

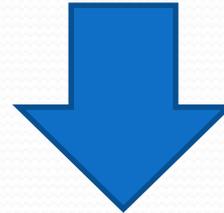
Self referral



GP



Ambulance

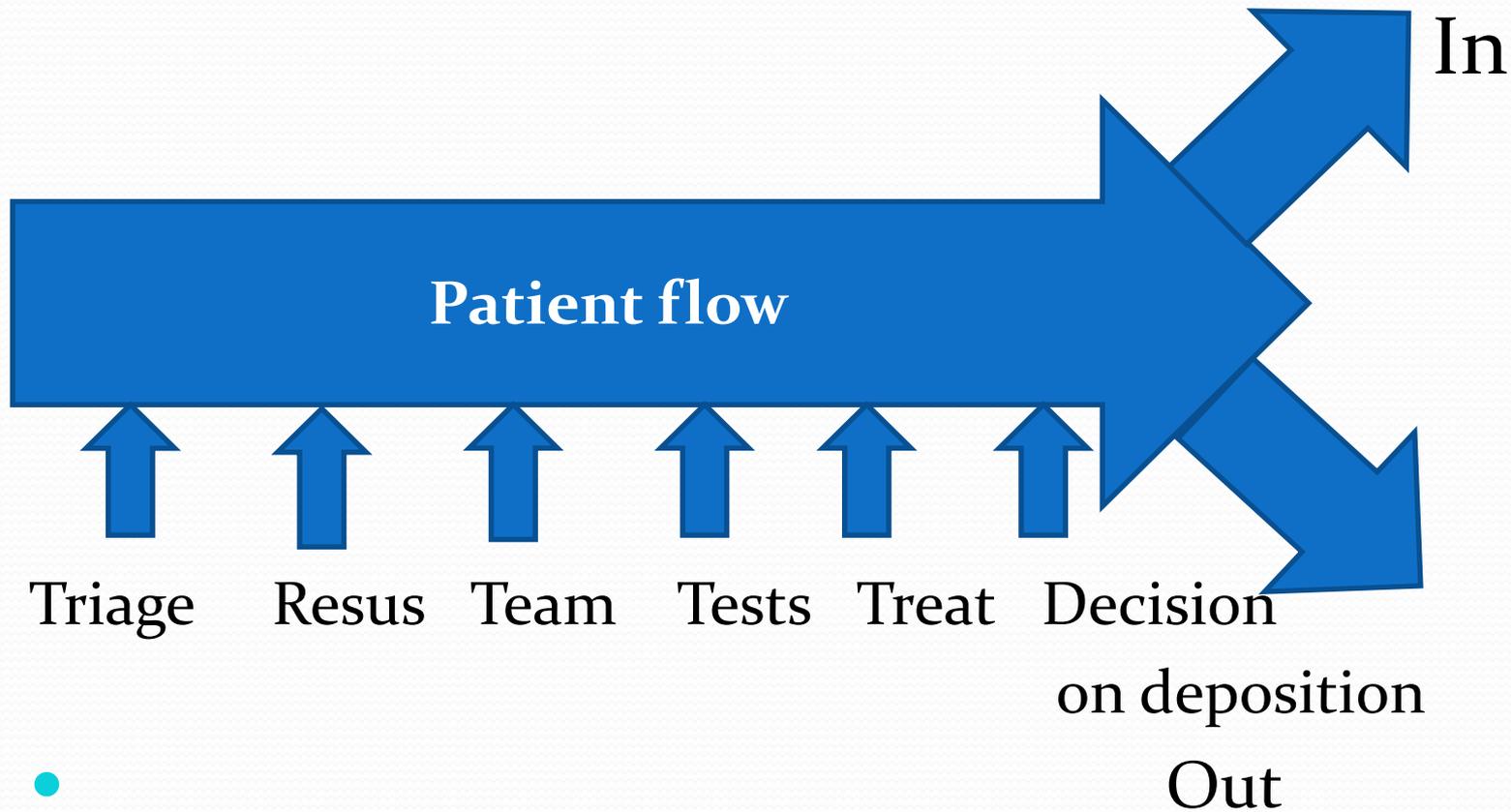


Emergency department

# Factors affecting ED-inflow

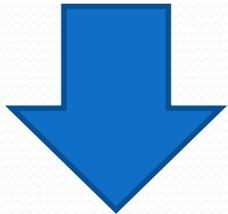
Self referral	Referral	Ambulance
GP-availability	Weekends	Local systems
Costs	Social/community service	Ambulance diversions
Weekends	High inflow in primary care	Major incidents
Self-testing Social/community service	Testing availability at primary healthcare facilities	....

# The ED-patient flow

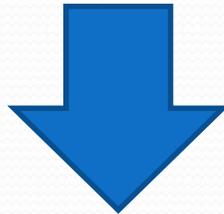


# Outflow

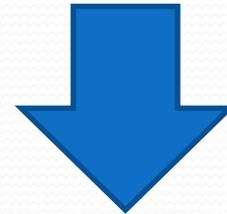
Emergency department



No follow up



Follow  
up/referral

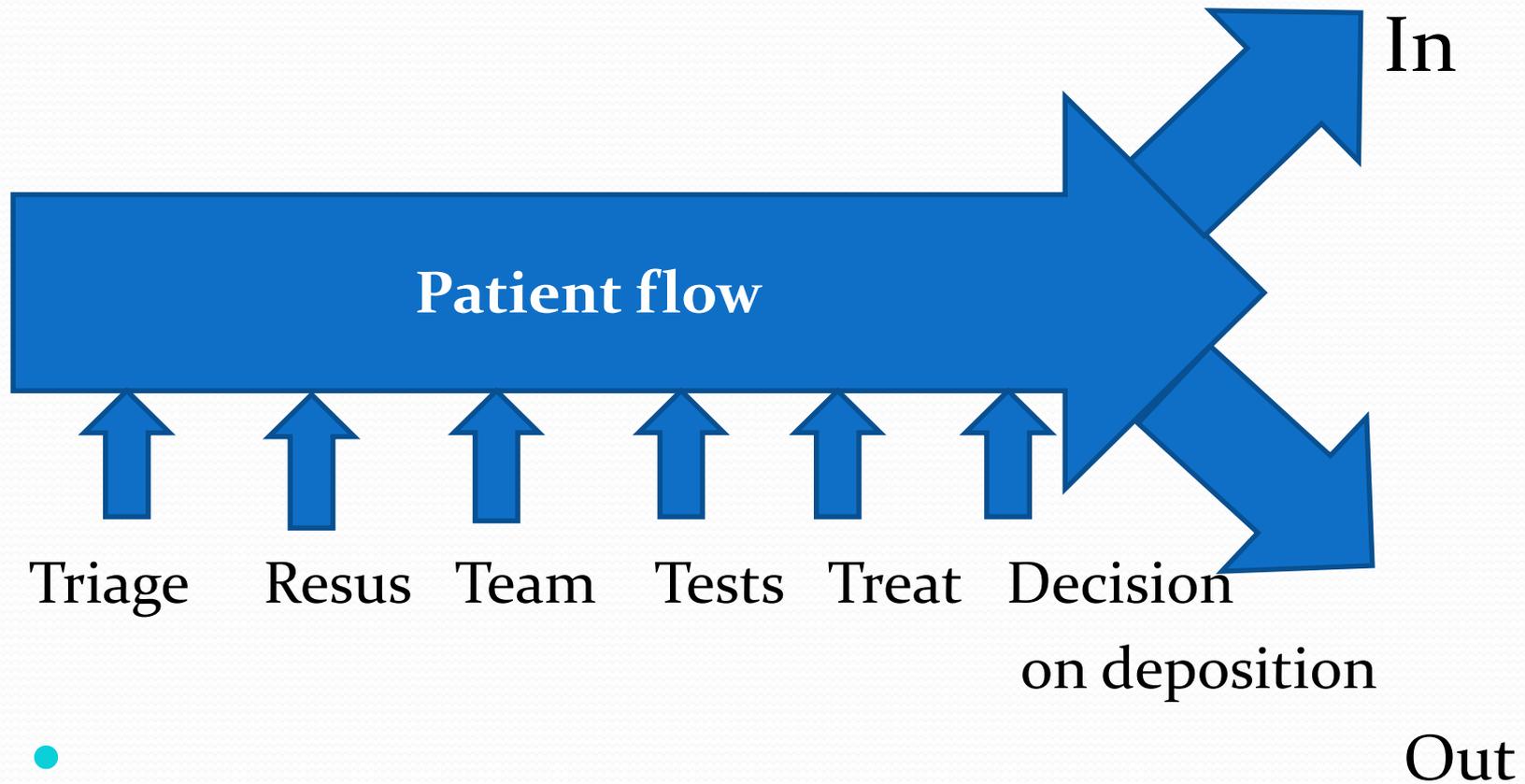


Admission

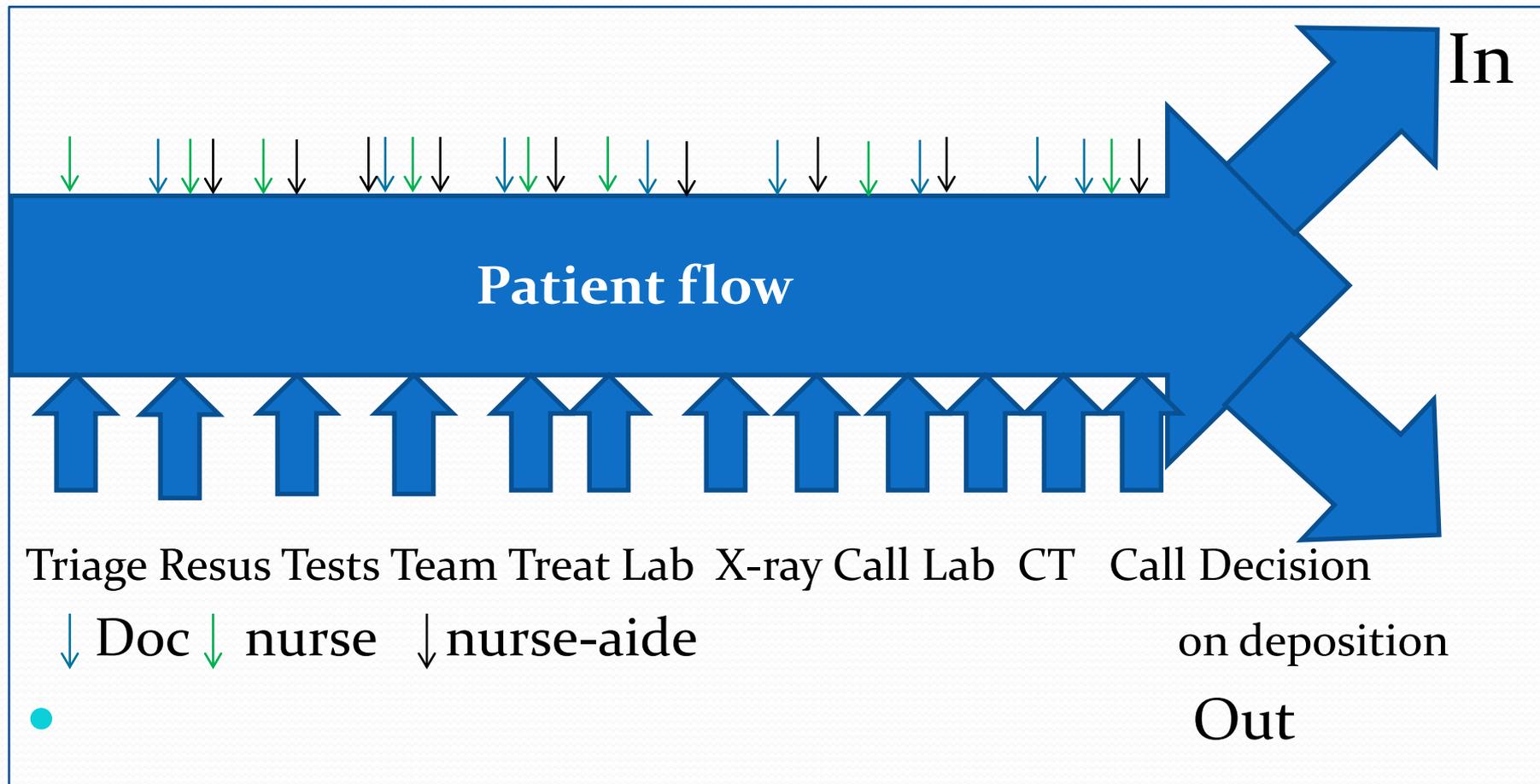
# Factors affecting ED-outflow

No follow up	Follow-up/referral	Admission
Social problems	Health-care system (GP, community service)	Shortage of beds
Transport problems	Weekends	Operation capacity
Anxiety	Testing	Shortage of staff and transport
....	.....	"Not my patient"/internal policies and structures

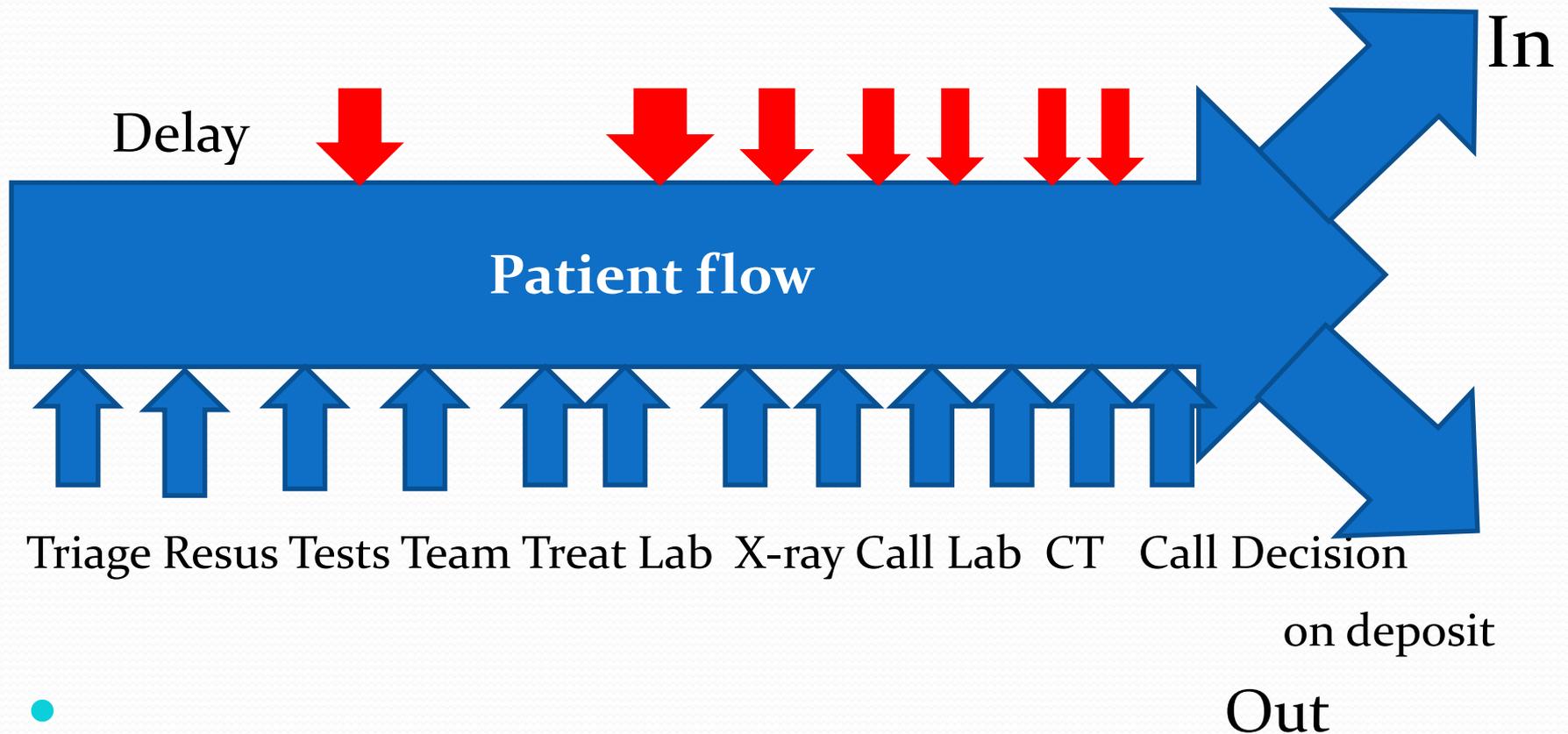
# The ED-patient flow (as it should be)



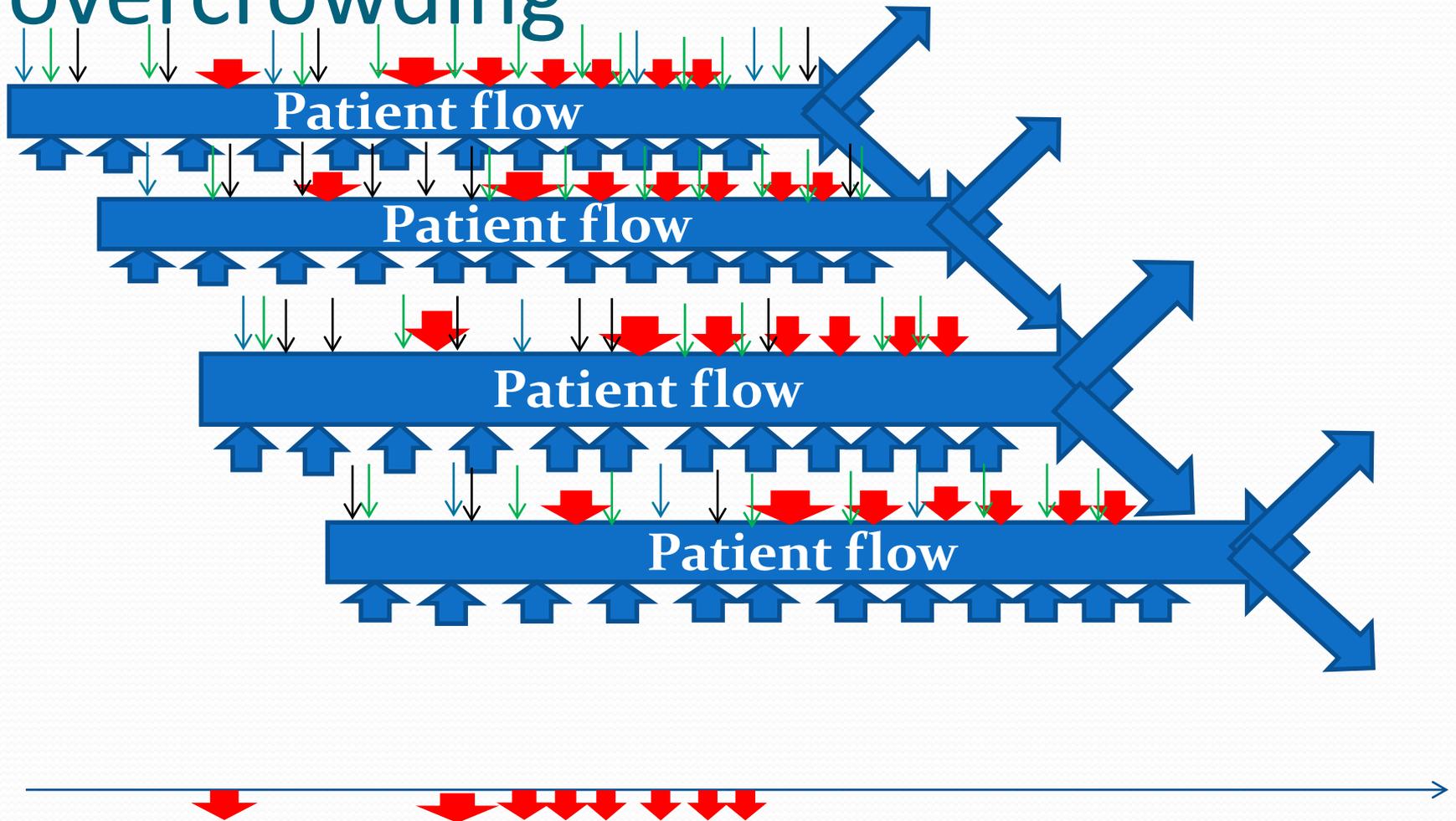
# The ED-patient flow (as it is)



# The ED-patient flow (as it is)

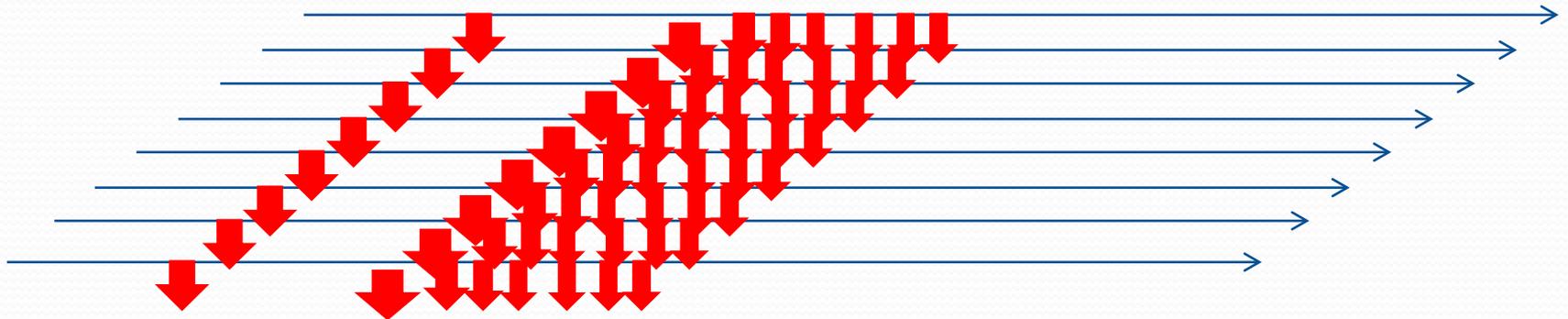


# The pathophysiology of overcrowding



# Pathophysiology continued

- Somewhere in between 6-8 patients/team....



- The delays become critical and impair team performance, thus impeding further flow. To reduce overcrowding, the patient flow has to be optimized.

# POCT, workflow and overcrowding

- So how can we optimize the flow?
- Is there any point for POCT?
- And if so, where is it?

# Inflow optimization

- Reduce inflow
  - Restrict access.
  - Divert ambulances.
  - Does not really work.
- Improve prehospital diagnostics and subsequent processing
  - Primary care enhancement
  - Ambulance diagnostics

# Primary care enhancement

- *Blattner et al.* Changes in clinical practice and patient disposition following the introduction of point-of-care testing in a rural hospital. *Health Policy* 2010 Jun;96(1):7-12.  
POC increases diagnostic certainty, reduced transfer to main hospital (62%) and discharge rate (+480%)  
75% substantial changes of therapy, 22% minor changes
- *Kingma et al.* Multi-faceted implementation strategy to increase use of a clinical guideline for the diagnosis of deep venous thrombosis in primary care. *Fam Pract.* 2016 Jul 28. pii: cmwo66. [Epub ahead of print]  
54% non-referrals (619 patients)
- *Wilcox et al.* Cardiac troponin testing for diagnosis of acute coronary syndromes in primary care. *Med J Aust.* 2015 Oct 19;203(8):336.  
No change in referral patterns but better risk-stratification
- *Nilsson et al.* Cost consequences of point-of-care troponin T testing in a Swedish primary health care setting. *Scand J Prim Health Care.* 2014 Dec;32(4):241-7.  
18% less referrals but missed cases

# Ambulance/prehospital diagnostics

- *Di Serio et al*: Integration between the tele-cardiology unit and the central laboratory: methodological and clinical evaluation of point-of-care testing cardiac marker in the ambulance. *Clin Chem Lab Med* 2006;44(6):768-73.
- *Sorensen et al*: Prehospital troponin T testing in the diagnosis and triage of patients with suspected acute myocardial infarction. *Am J Cardiol* 2011 May 15;107(10):1436-40.  
Testing is feasible. Early start of protocols irrespective ECG enhances diagnostics.
- *Ezekovitz et al*: Providing Rapid Out of Hospital Acute Cardiovascular Treatment 4 (PROACT-4). *J Am Heart Assoc.* 2015 Dec 1;4(12).  
Difference 2 hours in diagnostic time, improved LOS before admission

# Prehospital continued

- *Mikkelsen et al. Scand J Trauma Resusc Emerg Med 2015; 23: 54.* Advanced ABG-analysers are feasible at EMS
- *Schedler et al. Bedside blood gas analysis in airborne rescue operations. Air Med J. 2004 Mar-Apr;23(2):36-9.*  
It might help to control ventilation strategies.
- *Shah et al: Diagnostic accuracy of a single point-of-care prehospital serum lactate for predicting outcomes in pediatric trauma patients. Pediatr Emerg Care 2013 Jun;29(6):715-9.*  
Critical care necessity can be predicted

# Prehospital continued

- *Walter S, et al.* Diagnosis and Treatment of Patients with Stroke in a Mobile Stroke Unit Versus in Hospital: A Randomised Controlled Trial. *Lancet Neurol.* 2012;11:397-404.
- *Weber et al:* Prehospital thrombolysis in acute stroke: results of the PHANTOM-S pilot study. *Neurology* 2013 Jan 8;80(2):163-8. Prehospital stroke thrombolysis is feasible and 36 min earlier than in standard care (152 pats, 50% control, 50% of study group thrombolysis). Follow up study on 6200 pats: 25 min earlier (metropolitan area).
- *Mattila et al:* Ultra-acute diagnostics for stroke: Large-scale implementation of prehospital biomarker sampling. *Acta Neurol Scand* 2016 Sep 18. doi: 10.1111/ane.12687  
No clinical impact but blood is available 31 min earlier.

# ED-process optimization

- Triage
- Team work
- Testing
- Symptom-driven protocols
  
- Downstream/inhouse optimization

# First you have to identify the critically ill.... - Triage

- *Soremekun et al. Am J Emerg Med 2013 Feb 31(2):291-6*
- Setting: urban ED, 60000 visits annually. Triage nurse, protocolled panel testing according to complaint. 300 patients.
- Selection criteria: CP or SOB, infection/SIRS, age>65 (no trauma).
- POCT panel testing on triage is helpful in 56% of ED patients. Increased level of concern: 16%. 4% were upgraded, 10% downgraded. Management changed in total 13.7% reclassified compared to triage alone 6% (i.e. 4 + 2) were brought back to the physician earlier.
- Upgrade: Elderly (5.7%). Downgrade: CP (12.4%), others 8%

# Second, you need relevant test- results in a timely matter - TAT and needle to brain time

- Testing: TAT and ED workflow
- Symptom driven protocols
- - guidelines, scoring systems and biomarkers
- Panel testing

# TAT – somewhere around -45 min

- **Walter S, et al: Point-of-care laboratory halves door-to-therapy-decision time in acute stroke.** *Ann Neurol* 2011, 69(3):581-586.
- **Asha SE, et al: Impact from point-of-care devices on emergency department patient processing times compared with central laboratory testing of blood samples: a randomized controlled trial and cost-effectiveness analysis.** *Emerg Med J* 2014; 31(9):714-9
- **Goodacre S, et al: The RATPAC (Randomised Assessment of Treatment using Panel Assay of Cardiac markers) trial: a randomised controlled trial of point-of-care cardiac markers in the emergency department.** *Health Technol Assess* 2011, 15(23):iii-xi, 1-102.
- **Singer AJ, et al: Point-of-care testing reduces length of stay in emergency department chest pain patients.** *Ann Emerg Med* 2005, 45(6):587-591.

# Overall results

- *Parvin et al. Clin Chem 1996*  
1722 vs 2918. Electrolytes. No difference LOS.
- *Murray et al. JEM 1999*  
93 vs 87. Electrolytes, Hc, CO<sub>2</sub>, glucose, cardiacs. Overall LOS -54 min by POCT (3.28 vs 4.22 h). No difference in patients to be admitted, though.
- *Lee-Lewandrowski et al. Arch Path Lab Med 2003*  
369 pts totally. BG, urine, preg, cardiacs. TAT -87%, LOS - 41 min.
- *Singer et al. Acad Emerg Med 2008*  
4500 vs 4500. Electrolytes, cardiacs, bloods, urine and pregnancy panel. LOS - 64 min for admitted patients, -30 discharged. LOS decreased for non-tested patients (discharged - 13, admitted -30).

# Outflow optimization

- Downstream optimization
- Little data to be found about the role of POCT in downstream optimization
- Mostly screening and long-term follow up in diabetes, lipids, blood and INR
- Theoretically, POCT could prove beneficial in care of the elderly and follow up in primary health care (similar to in-flow optimization)

# When does POCT make a difference?

- Critically ill patient – differential diagnosis
- Critically ill patient – timely appropriate therapy
- Critically ill patient – if staffing is a problem
- In logistic nightmares – ED
- In primary care
- Small hospitals without laboratory 24/7
- Remote areas

# POCT and the critically ill

- Huge evidence exists that POCT can make a difference in the critically ill
  - Glucose
  - Capnometry
  - Blood gases
  - Electrolyte disorders
  - Coagulation
  - Infectious disease/sepsis
  - .....

# Case 1

- 75 yr old male
- Strong intermittent cramp-alike epigastric pain with irradiation in both flanks
- 4 days of reduced appetite. Constant nausea, general malaise
- Constipation

# Past medical history

- Hypertension (betablockers)
- Atrial fibrillation (warfarine)
- IDDM. Chronic renal insufficiency
- Small cellular pulmonary adenocarcinoma with cerebral metastasis. Stable on experimental therapie. Chronic opioid-therapy
- o-alcohol, o-abdominal operations, chronic constipation since start of opioides
- Currently asymptomatic

# Presentation

- Elder gentleman in good general condition and subjective well-being
- SpO<sub>2</sub> 93%, RR 16/min. Right lower lungfield dry crepitations on in-and expiration in radiated field
- BP 160/90 mmHg, HF 100 arrhythm, cap refill 3 sec
- Pulse bilat normal (irreg), no oedema, no leg-swelling. ECG AF with signs of left side hypertrophy. NO signs of ischemia.
- Neurol: NAD
- T 36.2°C

# Abdominal status

- Abdomen: Discrete periumbilical pain on palpation. Generally reduced bowel sounds, hearable peristaltic.
- Discomfort on left-sided palpation of descendens and sigma.
- Per rectum: Ampulla filled with hard feces. Prostate generally enlarged without clear identifiable tumours.



??????

# Differentials

- Constipation.
- Gastritis.
- Hepatitis.
- Pancreatitis.
- Diverticulitis.
- Urinary retention.
- Gallstone.
- Hypercalcemia.
- DKA.
- Diabetes gastropathy
- Intestinal ischemia.
- Intestinal hernia.
- Myocardial infarction
- Hepatic venous thrombosis

# Diagnostic proceeding

- ABG
  - Electrolytes + glucose
  - Liver enzymes
  - INR
  - WBC, CRP, PCT
  - Bladderscan
  - Urinary dipstick
  - CT?
- 
- Therapeutic test: Laxation (Enema)

ABG		Electrolytes		Further		Further
pH	7.30	Na	135	CRP	32	Bladderscan no retention
pCO <sub>2</sub>	6.8kPa	K	6.8	PCT	<0.1	
pO <sub>2</sub>	8.9kPa	CL	95	WBC	6.8*10 <sup>6</sup>	Urinary dipstick NAD
HCO <sub>3</sub> <sup>-</sup>	20	Ion Ca	1.37	Hb	8.8	
BE	-4	Glu	8.5	Hc	36%	
Lactate	8	BUN	8.5	INR	2.8	
		Crea	205	ASAT	2.8	
				ALAT	2.6	
				LD, Amylase, bilirubin normal		

# Results

- After enema and defecation subjective wellbeing. CT (no contrast due to known renal insufficiency) after effective defecation
- Interpretation: Normal, probably constipation
- Active feedback of the surgeon: “ Who was the moron ordering the samples? And the CT?”

# Disposition

- Diagnose constipation. Discharge home. No follow up.
- Representation 2 days later by ambulance. Septic peritonitis. Repeated CT: Intestinal ischemia with complete superior mesenteric arterial infarction. On re-reading of the first CT-scan signs of infarction could be detected on the earlier scan.
- Clinical management: Palliation.

# What did we miss?

- Lactate 8 mmol/L ??????????
- In a stable patient with subjective well-being???
- Ischemia!

# Case 2

- 42 year old female
- Bipolar disorder, treated with lithium
  
- Found comatous in the kitchen
- Chaotic living room
- Empty ice-cream-packs all over the place

# ABCDE – clinical picture

- Airway free
- RF 12/min, SpO<sub>2</sub> 95% (air)
- Pulse bilat 100 reg, BP 100/40 mmHg
- GCS 3, no lateralizing signs
- T: 36.5°C
- No signs of trauma
- No obvious seizures
- No rashes
- No neck-stiffness



● ????

# Differentials

- Hypoxia
- Uremia
- Stroke/Bleeding
- Wernicke-Korsakoff
- Status epilepticus
- Hypo-/Hyperglycemia
- Meningitis
- Encephalitis
- Intoxication
- Trauma
- Hyperosmol coma
- Psychogen coma
- Tumor
- Cerebral oedema
- CO<sub>2</sub>-narcosis
- .....

# Tests

- Rationale on coma: 70% metabolic, 30% structural
- Glucose (3 min)
- ABG (CO<sub>2</sub>, HCO<sub>3</sub><sup>-</sup>, BE, aniongap, O<sub>2</sub>) (3 min)
- Elektrolytes (Na, K, ionCa, Krea, Urea, Chlorid) (3 min)
- CT, EEG, LP

# At 3 minutes

- Glucose – normal
- ABG: slight metabolic acidosis, aniongap normal
- Na 105 mmol/L, K 3,4 mmol/L, ionCa, Urea and Crea normal
- **DIAGNOSE:** Suspicion of ADDISSON-CRISIS
- **DD:** Lithium-intoxication (should give a reduced aniongap), SIADH, overdose.....

# Further management

- Secure blood (for cortisol)
- Give cortisol
- Fluids
- Tube and ICU
- Close monitoring

# So back to the challenge....

- Remember?
- Overcrowding is a slow preventable process killing people.
- Can you agree?

# Conclusion

- POCT can make a difference in the overcrowded emergency department. It can contribute to alleviate the effects of overcrowding if not help to prevent it.
- POCT can make this difference on all steps of the ED-process, i.e. on the prehospital level, at the ED and might so at the post-ED level, however, very limited evidence for the latter is to be found.



Any questions?



- **THANK YOU!**