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Using TOC to manage patient flow

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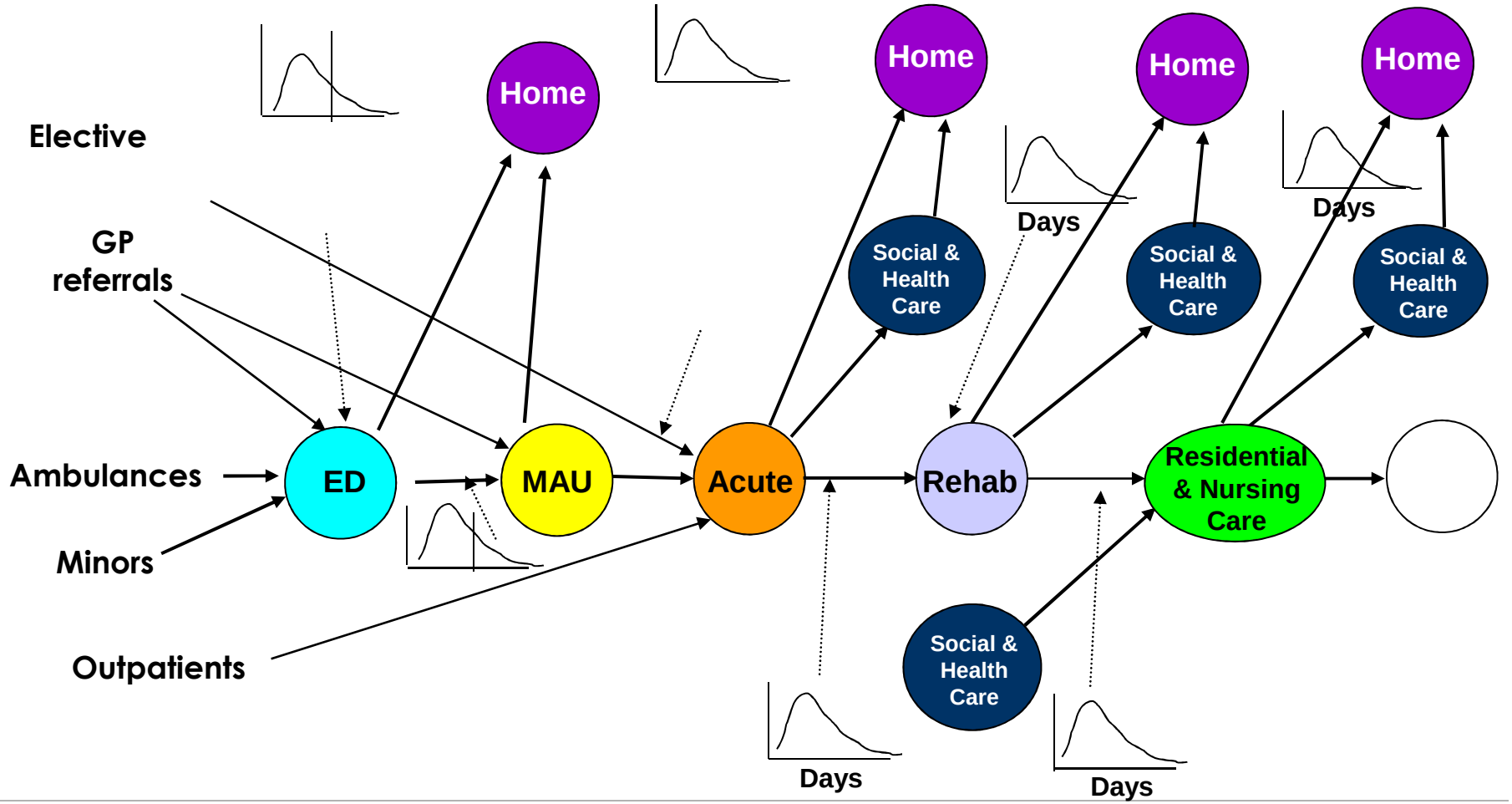
Roy is a chartered Engineeer (MIMech E) and has been awarded a BSc in Mechanical Engineering (Nottingham), an MSc in Manufacturing System Engineering (Warwick), and a PhD in Supply Chain Management (Nottingham Trent).

Using TOC to manage patient flow

- **Structure**
  - Viewing patient flow across health and social care
  - Some limitations in applying 'lean' tools to patient flow
  - Research question and method
  - Buffer Management applied to A&E and planned discharge management
  - The underlying functions of Time Buffer Management (TBM)
  - Theoretically extending Ohno's Kanban concept
  - Conclusion
  - Further research exploring the integration of aggregated capacity buffering with TBM.

Health and social care:a systems perspective



- Emergency Room
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NHS Access targets: ED=4 hrs Elective surgery=18 weeks

Is kaizen Blitz a long term answer?

- Lean kaizen events in healthcare are often not strategically focused as suggested by Dan Jones in his Lean Enterprise (August 08) news letter.
  - *'Improvement is not so easy to sustain… With only loose direction from top management it is difficult to trace the results from these islands of improvement… and no one checks. We recently did an assessment of a hospital that had done 93 kaizen events. The success rate was less than 20% and* ***none of these had impacted the core A&E process that really kept the CEO awake at night'***
  - (Jones, 2008)

Why is Kanban not apparent in lean applications concerning patient flow?

- The traditional means of strategically focusing continual improvement in Ohno's Toyota Production System is through kanban control (Ohno, 1988: 30).
- *'Kanban is a way to achieve just-in-time; its purpose is just-in-time. Based on this, production workers start work by themselves, and make their own decisions concerning overtime.* ***The kanban system also makes clear what must be done by managers and supervisors.*** *This unquestionably promotes improvement in both work and equipment.'* (Ohno, 1988:29)

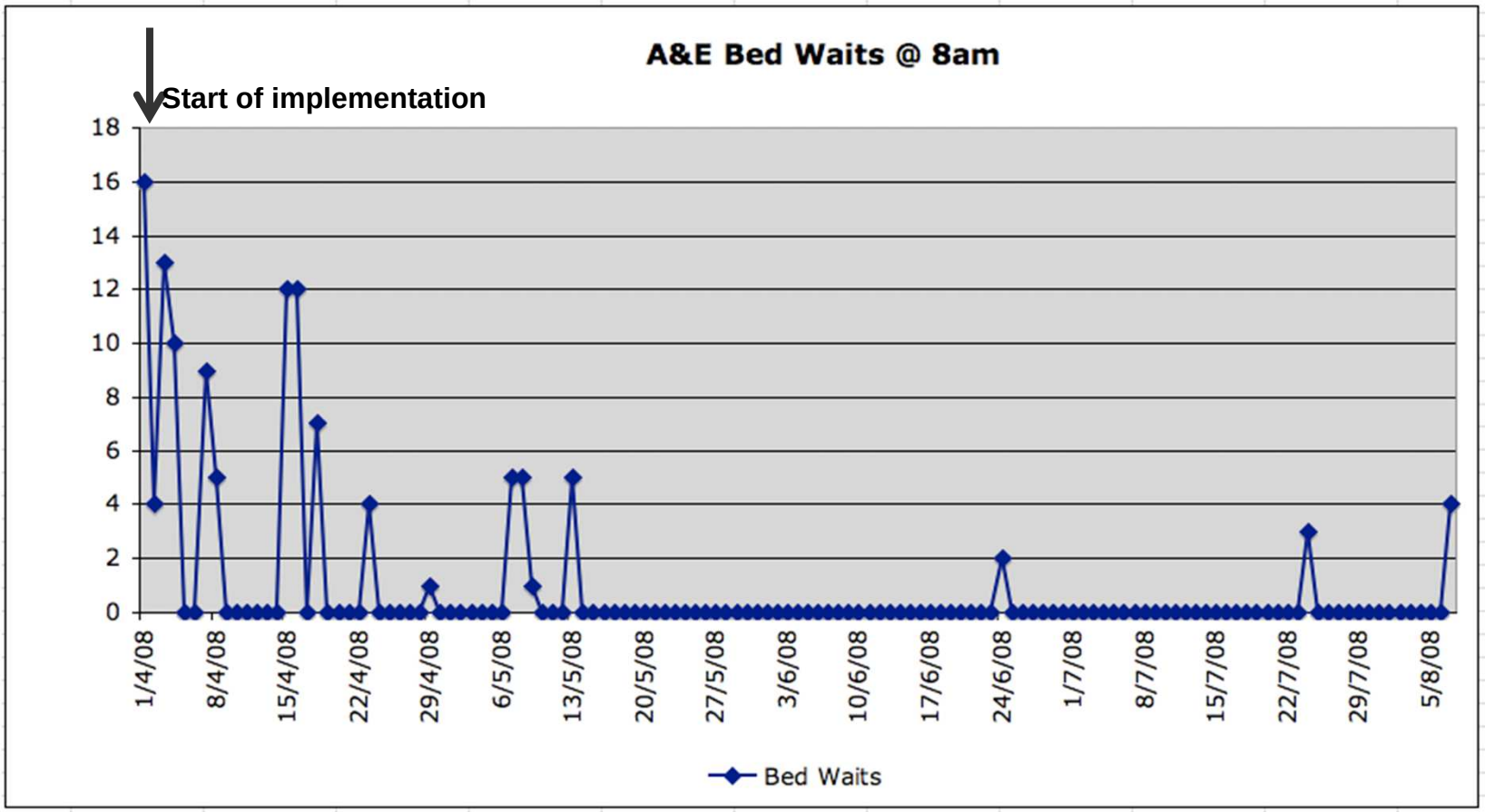
Research Question and method

- ***How and why has time buffer management contributed to improved patient flow?***
- Method
- Two buffer management applications were chosen:
  - Discharge Buffer Management (termed Discharge Jonah)
  - Emergency Department Buffer Management (termed A&E Jonah)
- Case research across four hospitals where the systems were seen in operation, archival data and reports were accessed and semi-structured interviews undertaken.

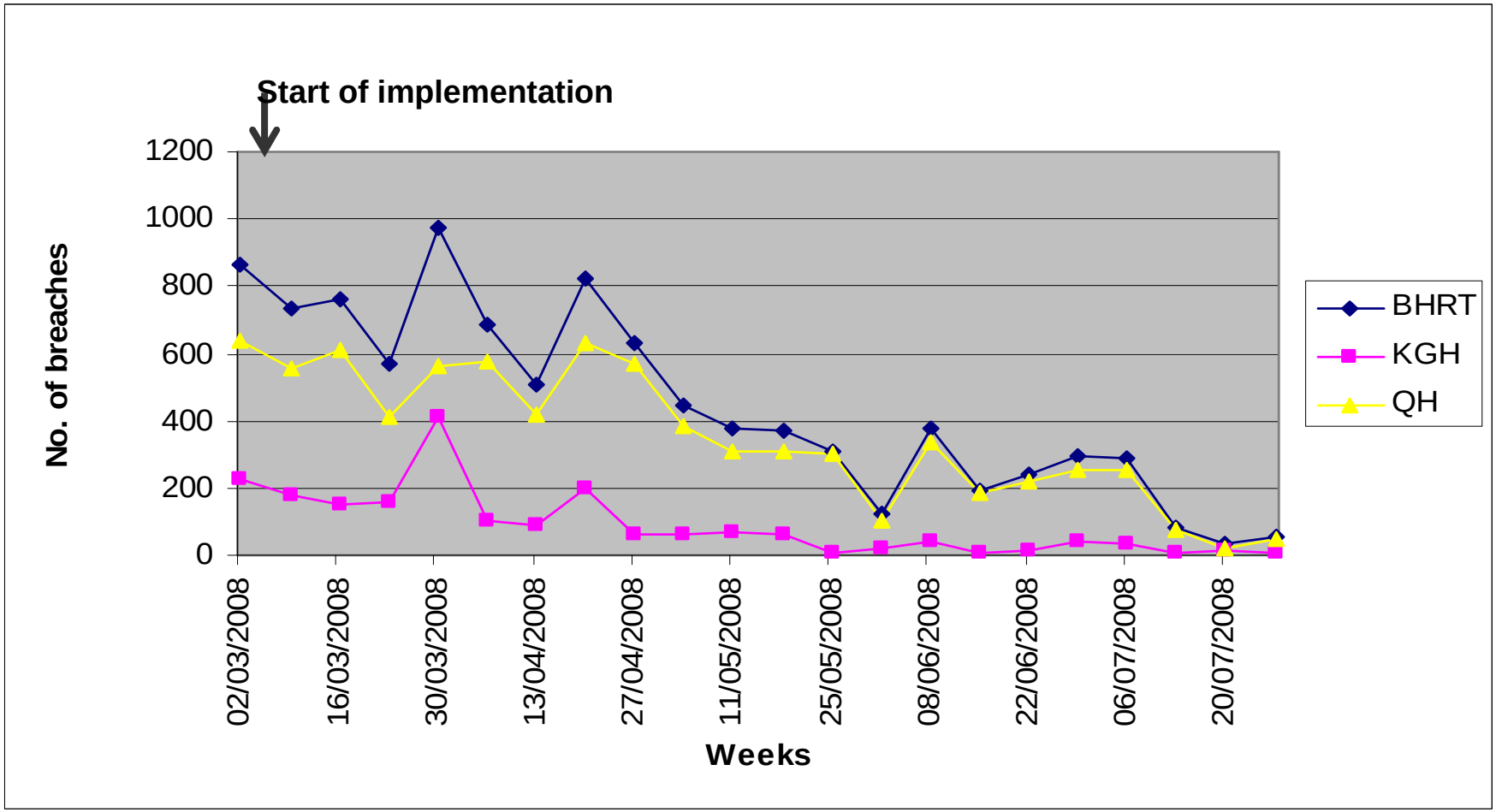
TOC Buffer Management headline benefits

- *'With the help of Theory of Constraint we have been able to move Barnet & Chase Farm Hospitals NHS Trust from one of the worst performing trusts in England to one of the top performing. In* ***Q4 (2007-2008) we were the top performing trust in London for the 4 hour target and 6th across England****. Also, by applying the Theory of Constraints to our discharge process we have been able to reduce our* ***length of stay by 27%*** *and we know we can improve further on this.'* CEO
- *'The application of TOC has helped us to* ***reduce our length of stay by up to 23%*** *in one of our hospitals, but the real benefits from QFI Jonah are around improving how we deliver care to our patients through better planning and co-ordination of their care - ultimately it's about recognising that patients should go home as quickly and safely as possible.'* CEO
- *'TOC has been applied to* ***improved patient flow in A&E, Assessment Units, and discharge planning****. This has resulted in a sustained reduction in medical* ***length of stay from 8.6 to 6.3 days (>25%).*** *Released bed capacity supported the achievement of the 18 week GP referral to treatment target, a year ahead of schedule.'* Director of Governance and Nursing.

Major London Hospital: ED Bed waits: 8am



Number of breaches against 4 hour target

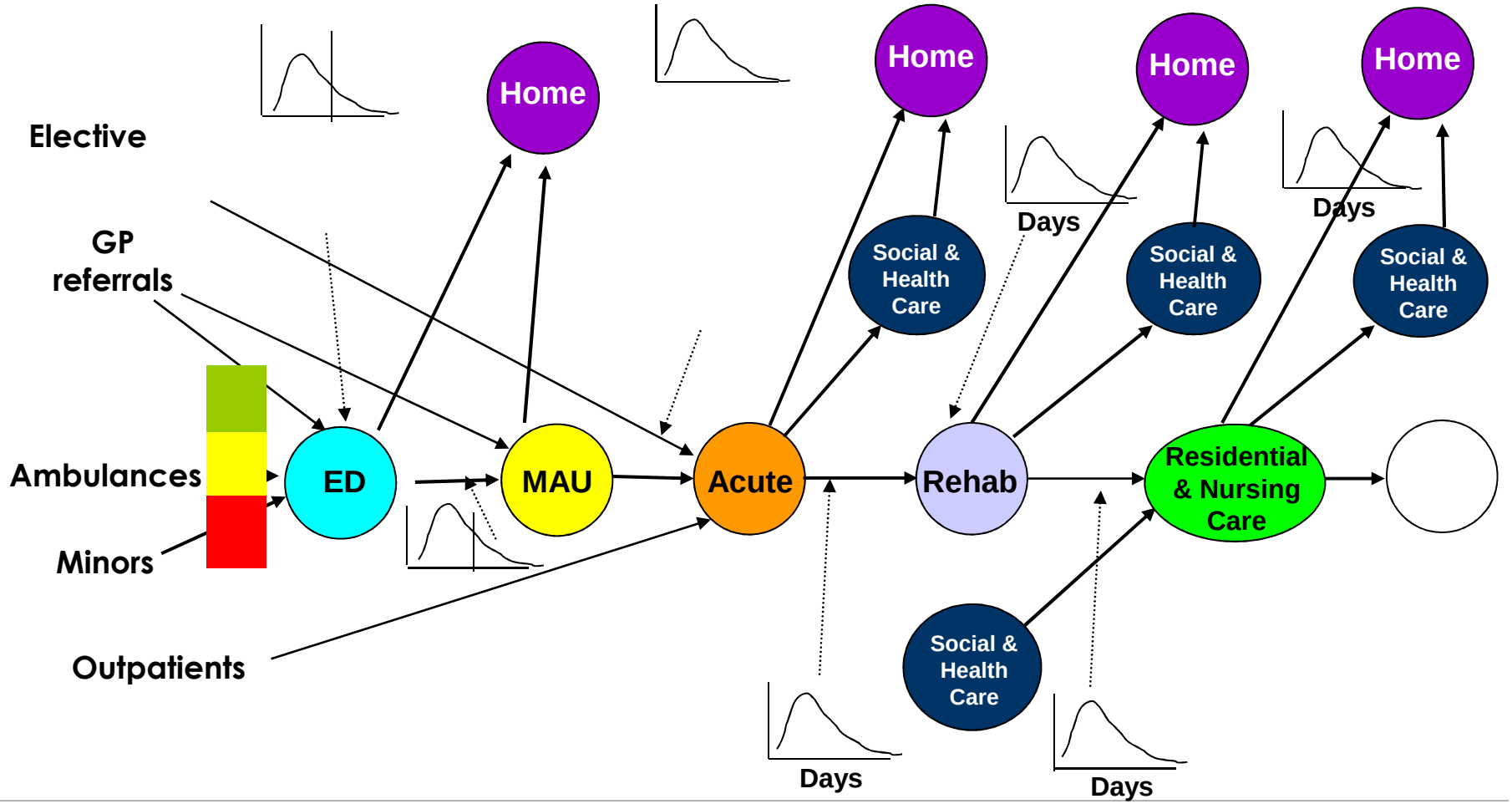


Utilising TOC Time Buffer Management (TBM) in managing patient flow

Origins of the approach

- Simplified Drum Buffer Rope (Manufacturing)
  - Buffer: Planned process time 'touch time' is insignificant (or unknown).
- Critical Chain Project Management buffer (project)
  - Buffer: Planned processing time 'touch time' is significant and known.

Health and social care:a systems perspective



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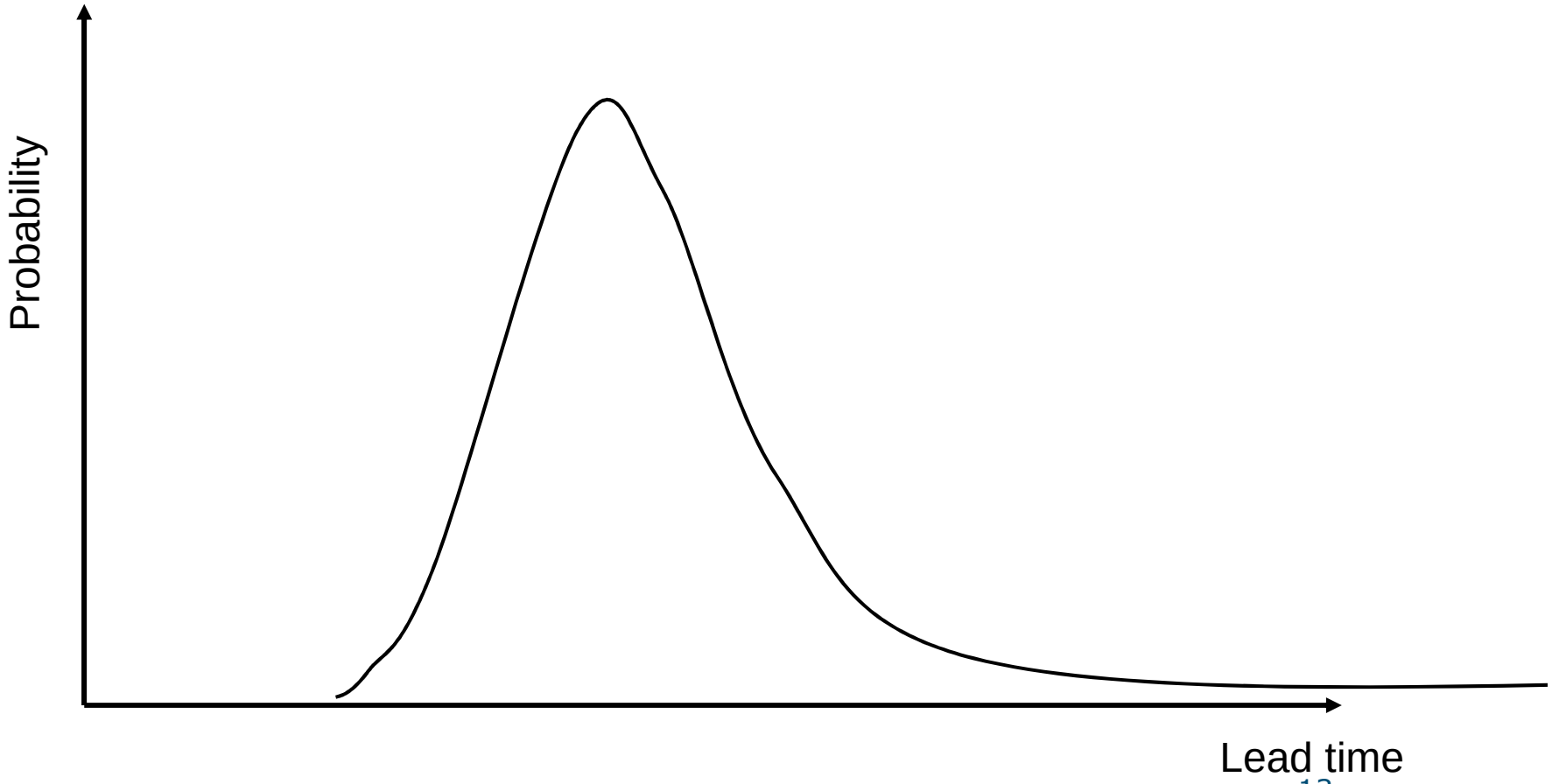
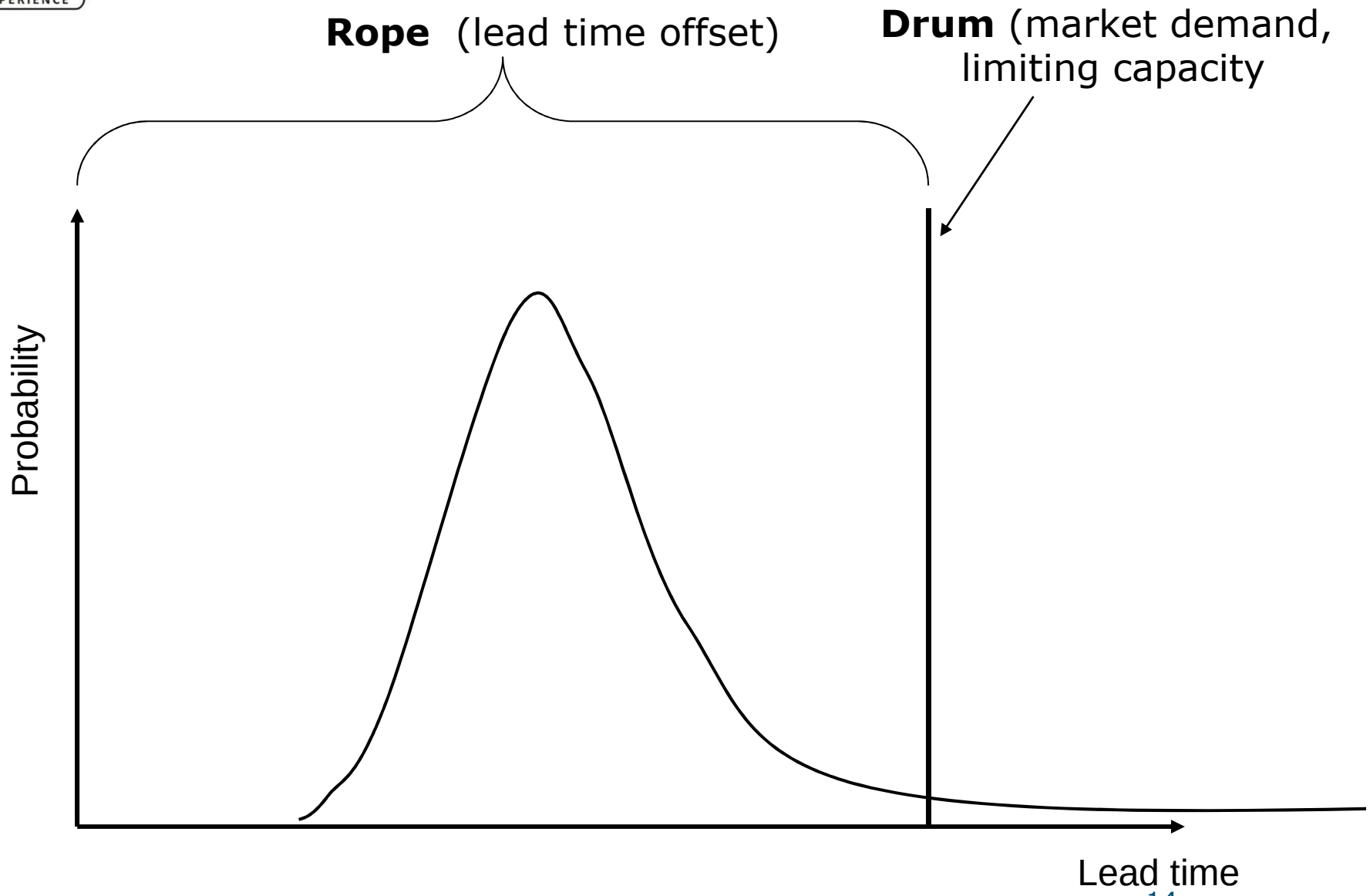
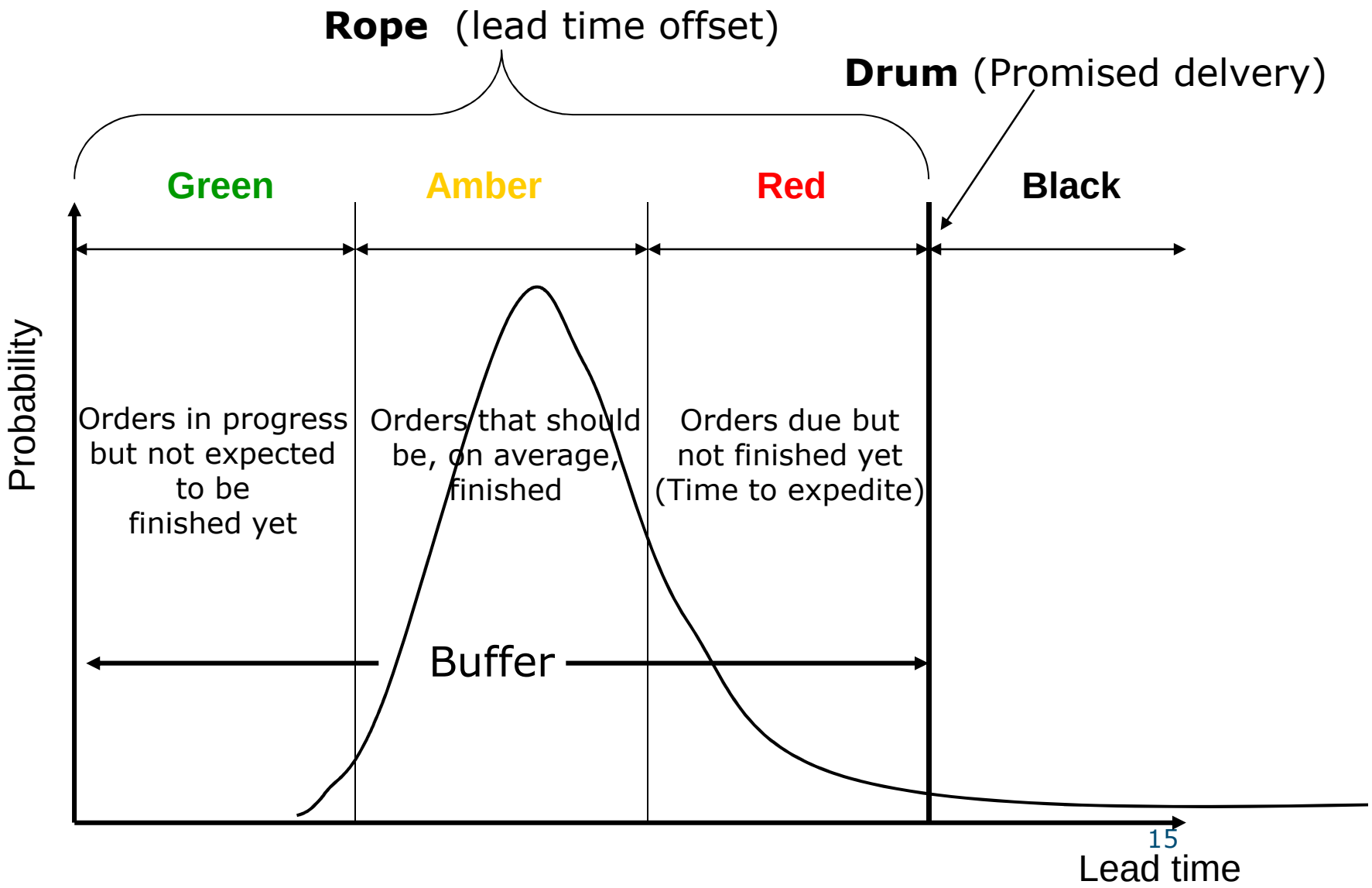

Probability
Lead time

Simplified Drum Buffer Rope (SDBR)

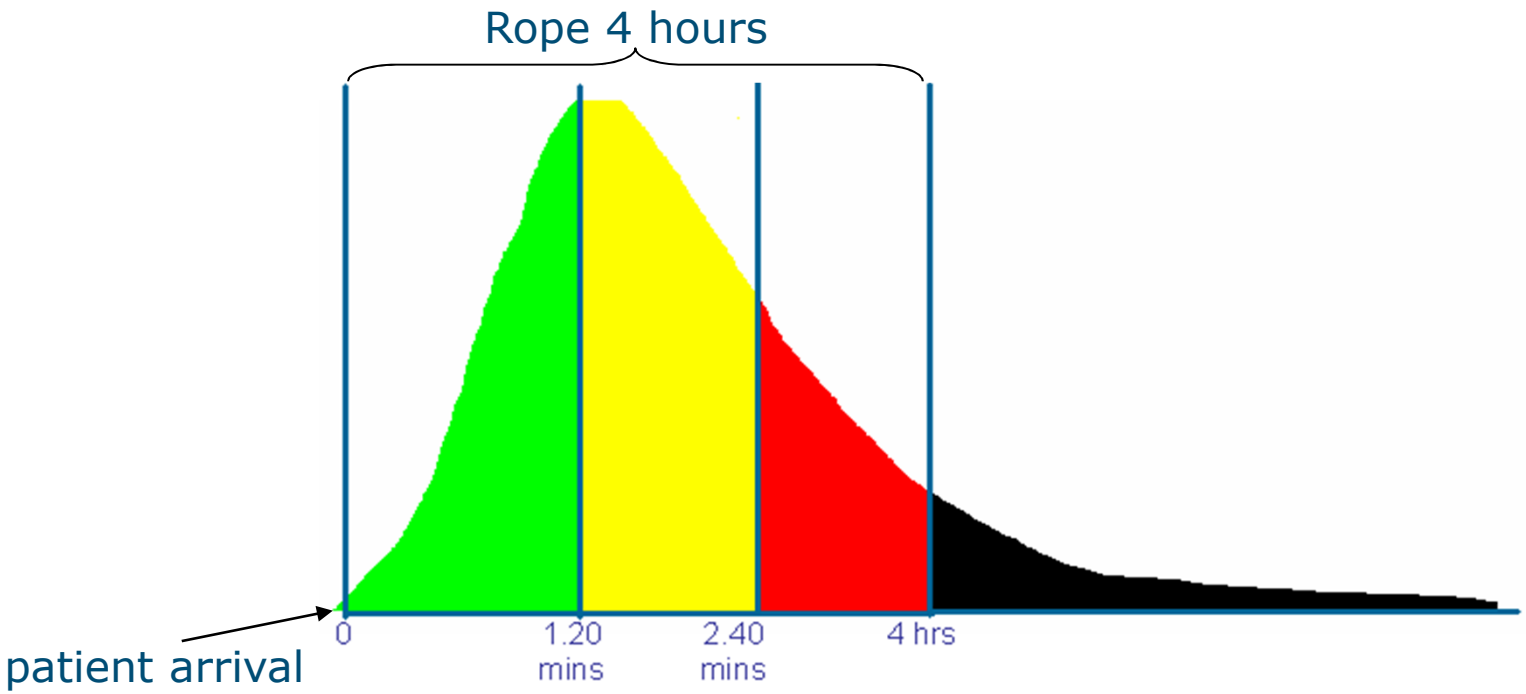


Simplified Drum Buffer Rope (SDBR)



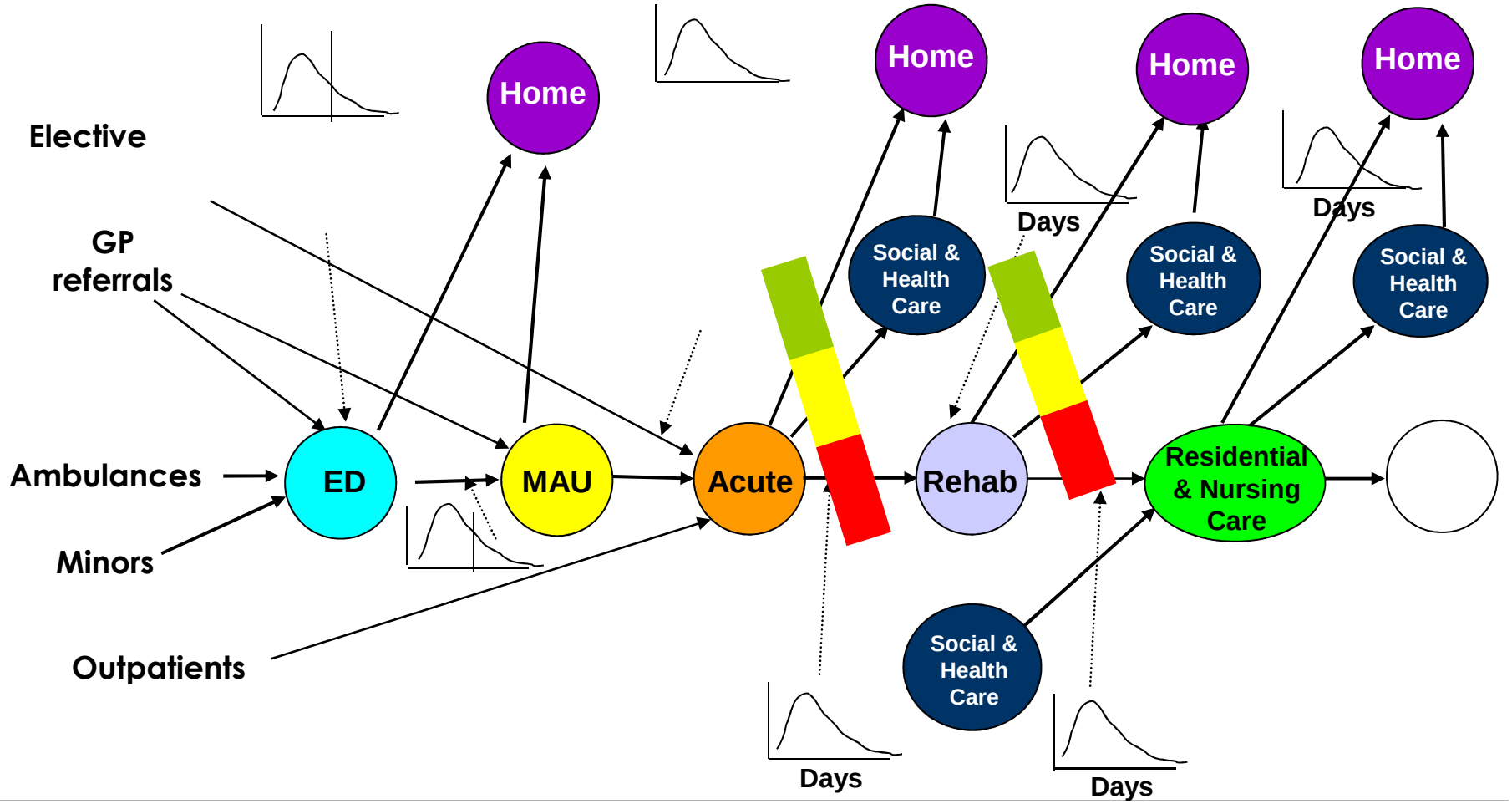
Time Buffer management simplification in emergency care

Split the 4 hour process into 3 zones: green, yellow and red.



Prioritise patients; Expedite in red zone; Signal instability; target causes of delay.

Health and social care:a systems perspective



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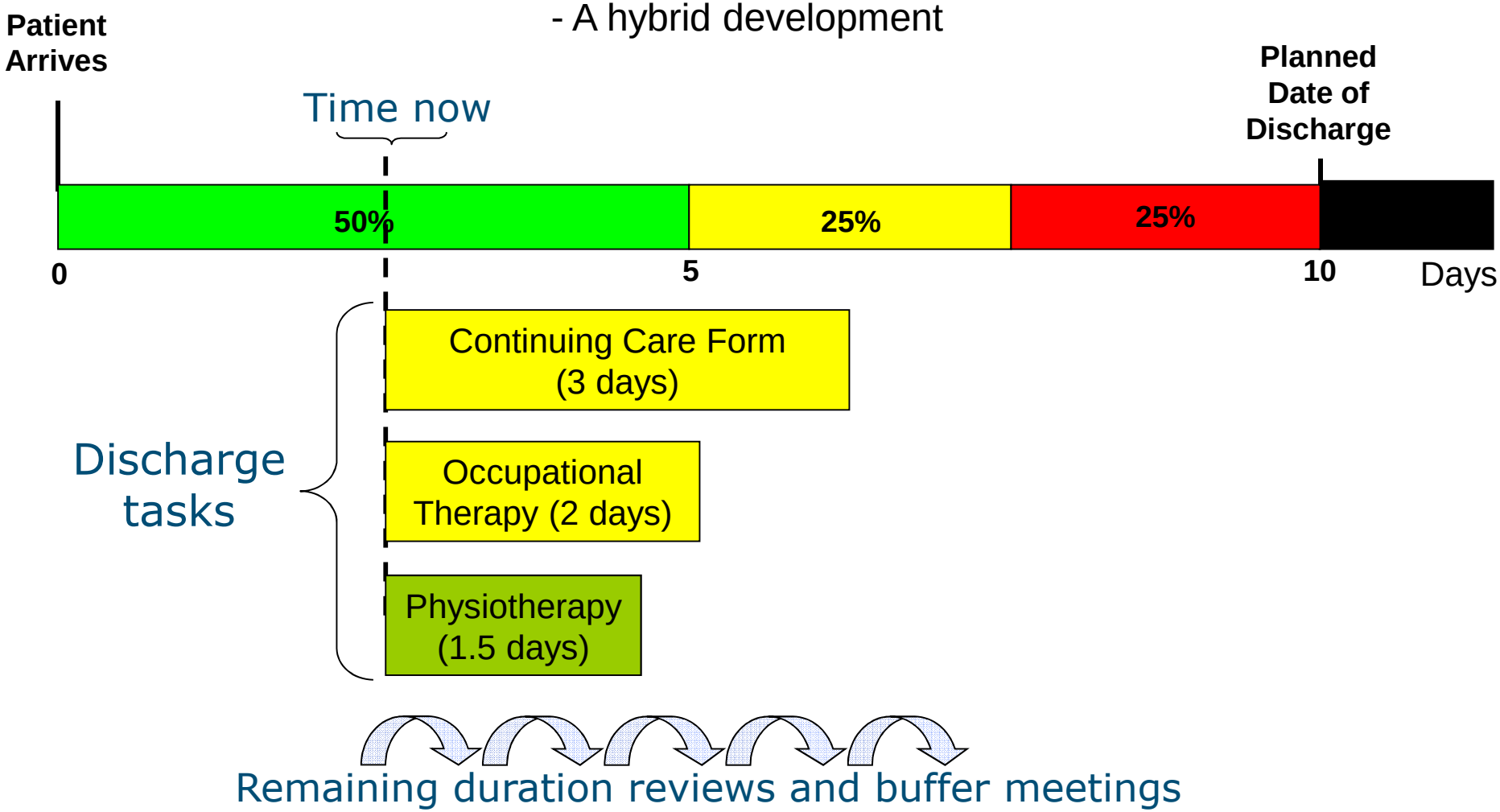
Healthcare Discharge Buffer Management

- A hybrid development



Healthcare Discharge Buffer Management

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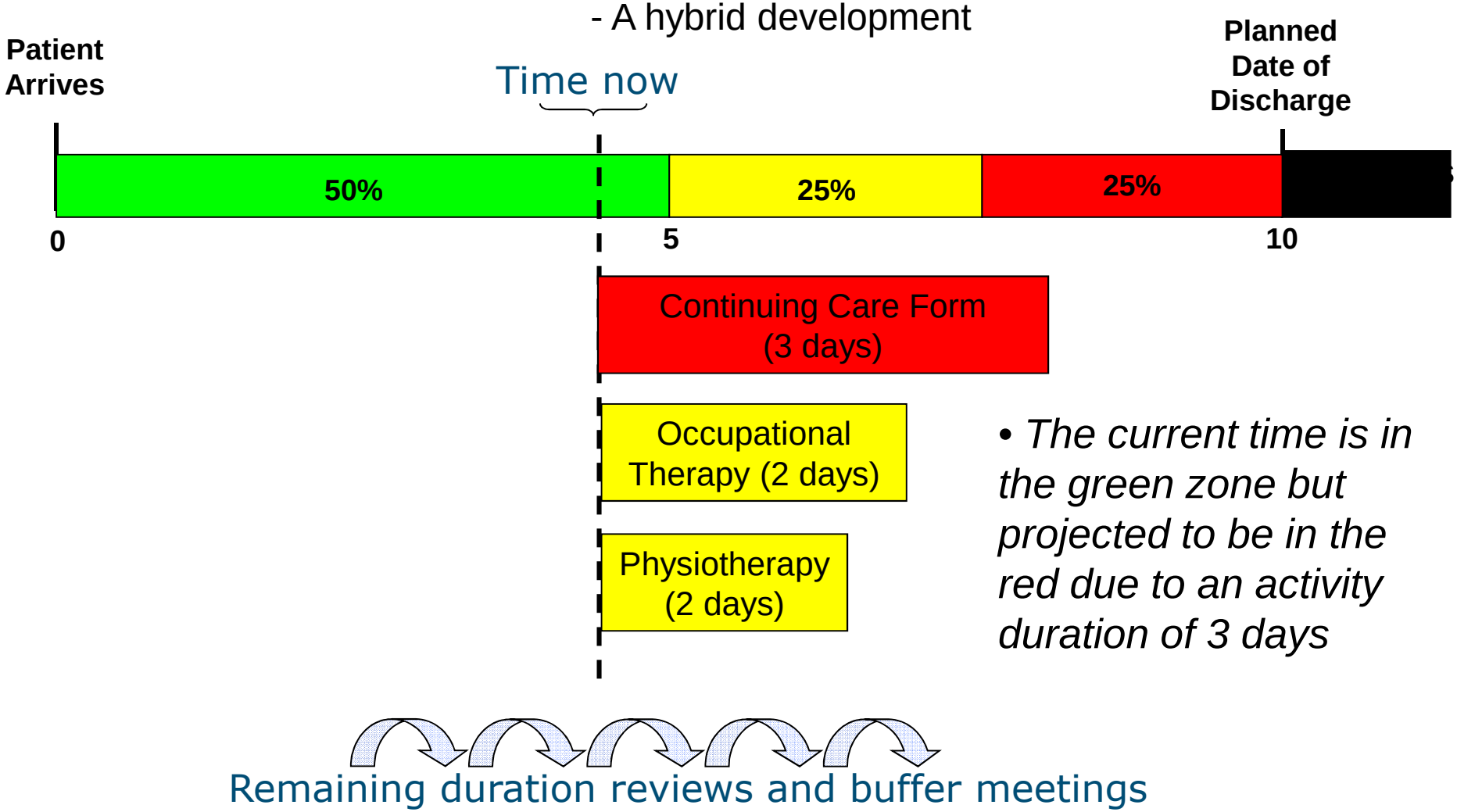
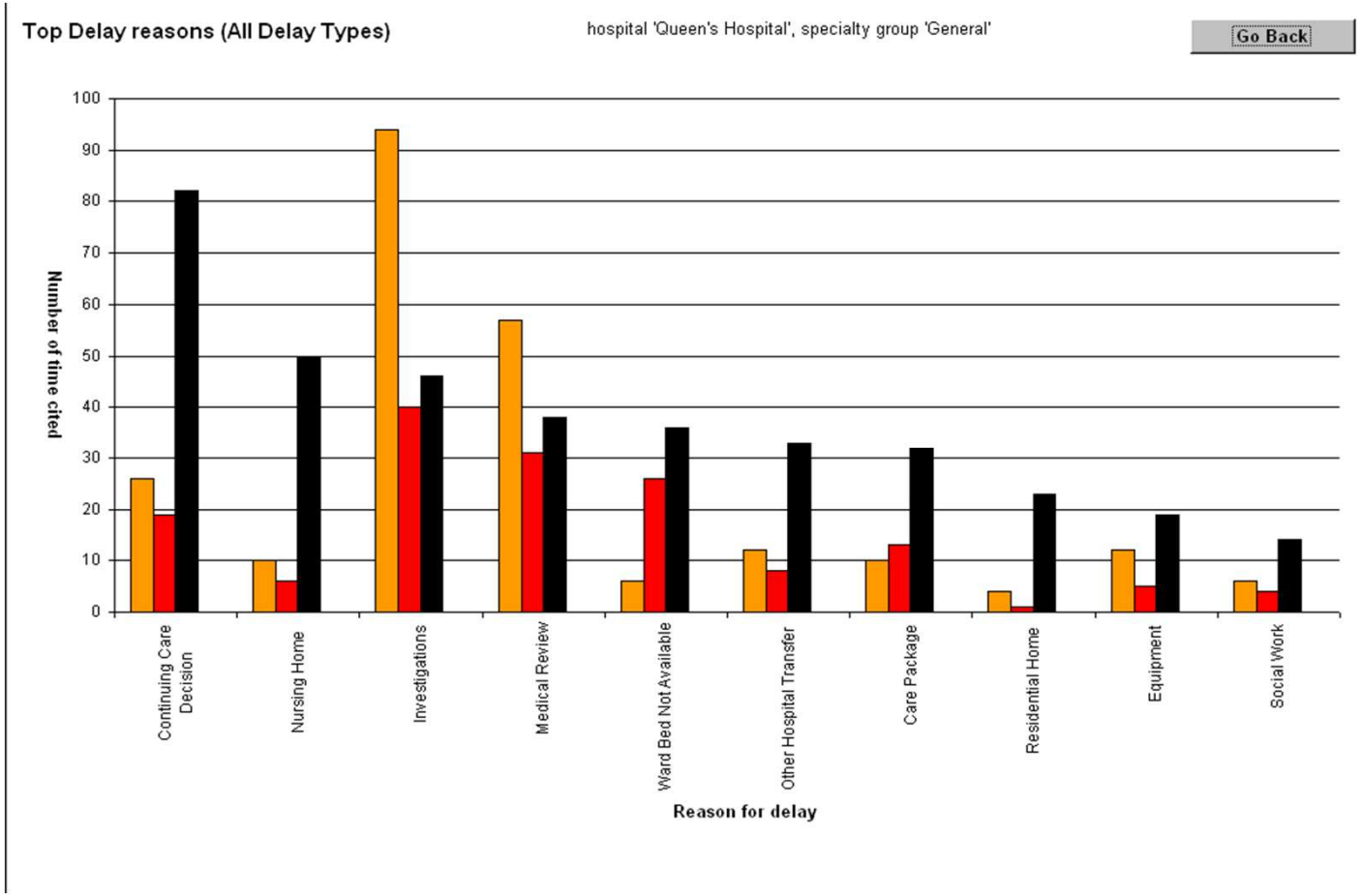


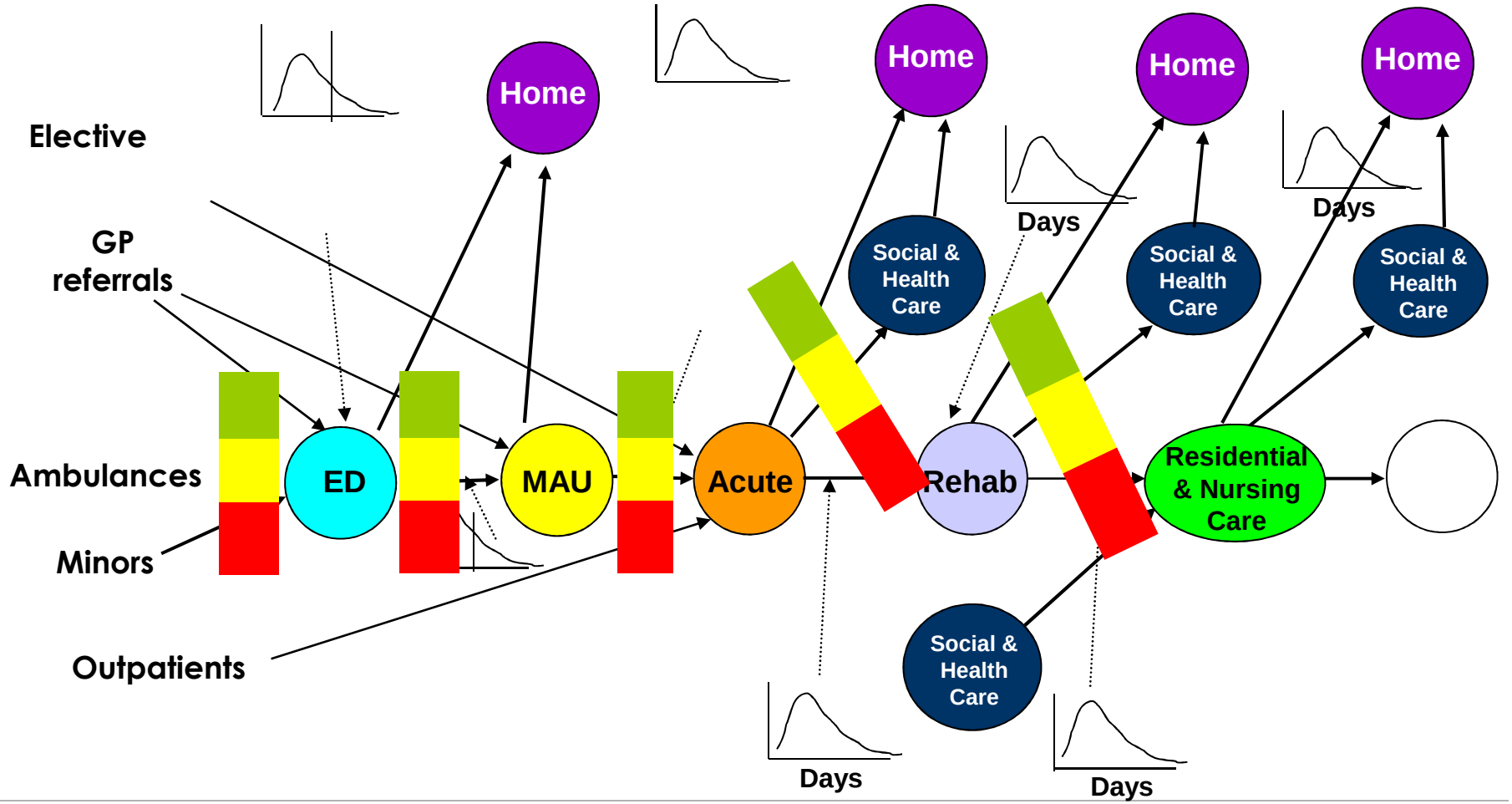
- *The current time is in the green zone but projected to be in the red due to an activity duration of 3 days*

Remaining duration reviews and buffer meetings

Discharge QFI Jonah top delay reasons by region



Health and social care:a systems perspective



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How and why has time buffer management contributed to improved patient flow?

- ***Prioritise*** *the flow of work (buffer penetration).*
  - *A&E UK fixed lead time (4 hours)*
  - *Complicated by planned discharge dates changing*
- *Identify when to* ***expedite*** *potential delays.*
  - *Respond to individual red zone penetration*
- *Signals when there is a need to* ***escalate*** *increased capacity.*
  - *Respond to significant and growing red zone penetration*
- *Identify and* ***target*** *main sources of delay for improvement*
  - *Pareto analysis and target improvement activities*

Stratton, R., and Knight A., 2010. Managing Patient Flow using Time Buffers. ***Journal of Manufacturing Technology Management****, 21 (4) pp. 484-498.*

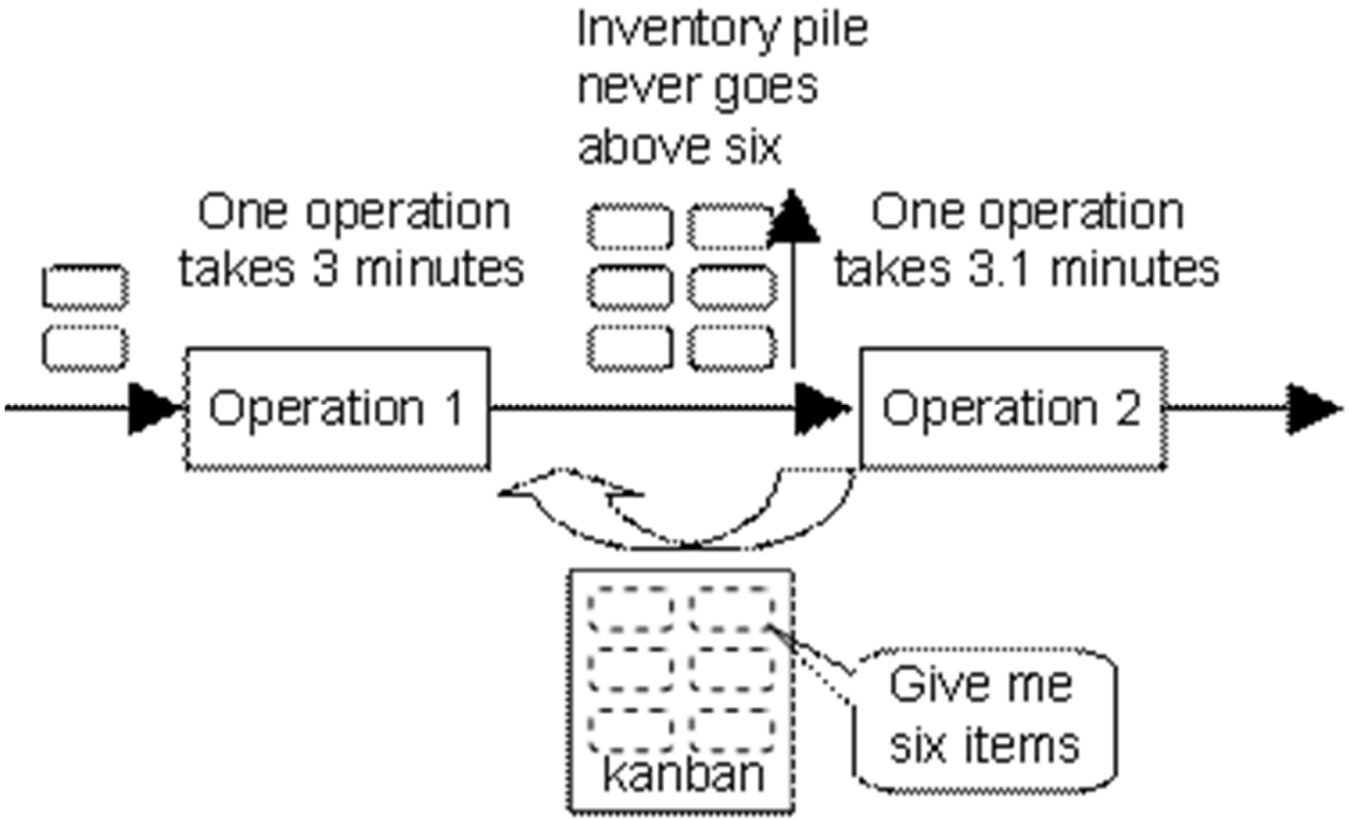
DNA rules of the TPS (Spear and Bowen, 1999)

- Rule 1 All work shall be highly specified as to content, sequence, timing, and outcome.
- Rule 2 Every customer-supplier connection must be direct, and there must be an unambiguous yes- or- no way to send requests and receive responses.
- Rule 3 The pathway for every product must be simple and direct.
- Rule 4 Any improvement must be in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organisation.

How does TPS kanban apply in the context of patient flow?

- *In reality practicing these rules [the six rules of kanban] means nothing less than adopting the Toyota Production System as the management system of the whole company.* (Ohno, 1988:41)

Kanban illustration



Kanban functions/rules

Functions of kanban	Kanban rules of use
1. Provides pick-up or transmission information.	1. Later process picks up the number of items indicated by the kanban at the earlier process.
2. Provides production information.	2. Earlier process produces items in the quantity and sequence indicated by the kanban.
3. Prevents over production and excessive transport.	3. No items are made or transported without a kanban.
4. Serves as a work order attached to goods.	4. Always attached a kanban to the goods.
5. Prevents defective products by identifying the process making the defectives.	5. Defective products are not sent on to the subsequent process. The result is 100% defect free goods.
6. Reveals existing problems and maintains inventory control.	6. Reducing the number of kanban increases their sesitivity.

The functions and rules of kanban (source: Ohno, 1988: 30)

Kanban and TBM assumptions

TPS/Kanban assumes:	TBM assumes:
Predefined process steps	No predefined processing steps
Buffering is based on inventory and held at each processing step	Buffering is based on time and pooled
Process delays (quality problems) are not passed on to the next process	'Delays' are only expedited when they threaten delivery
Level scheduling	Demand may vary, triggering (timely) escalation
Continual improvement is encouraged through reducing inventory to expose problems that are then targeted.	Continual improvement is enabled by targeting the causes of delay (e.g. red zone penetration) then reducing the time buffer.

Is a broader understanding of Buffer Management base kanban part of the next phase?

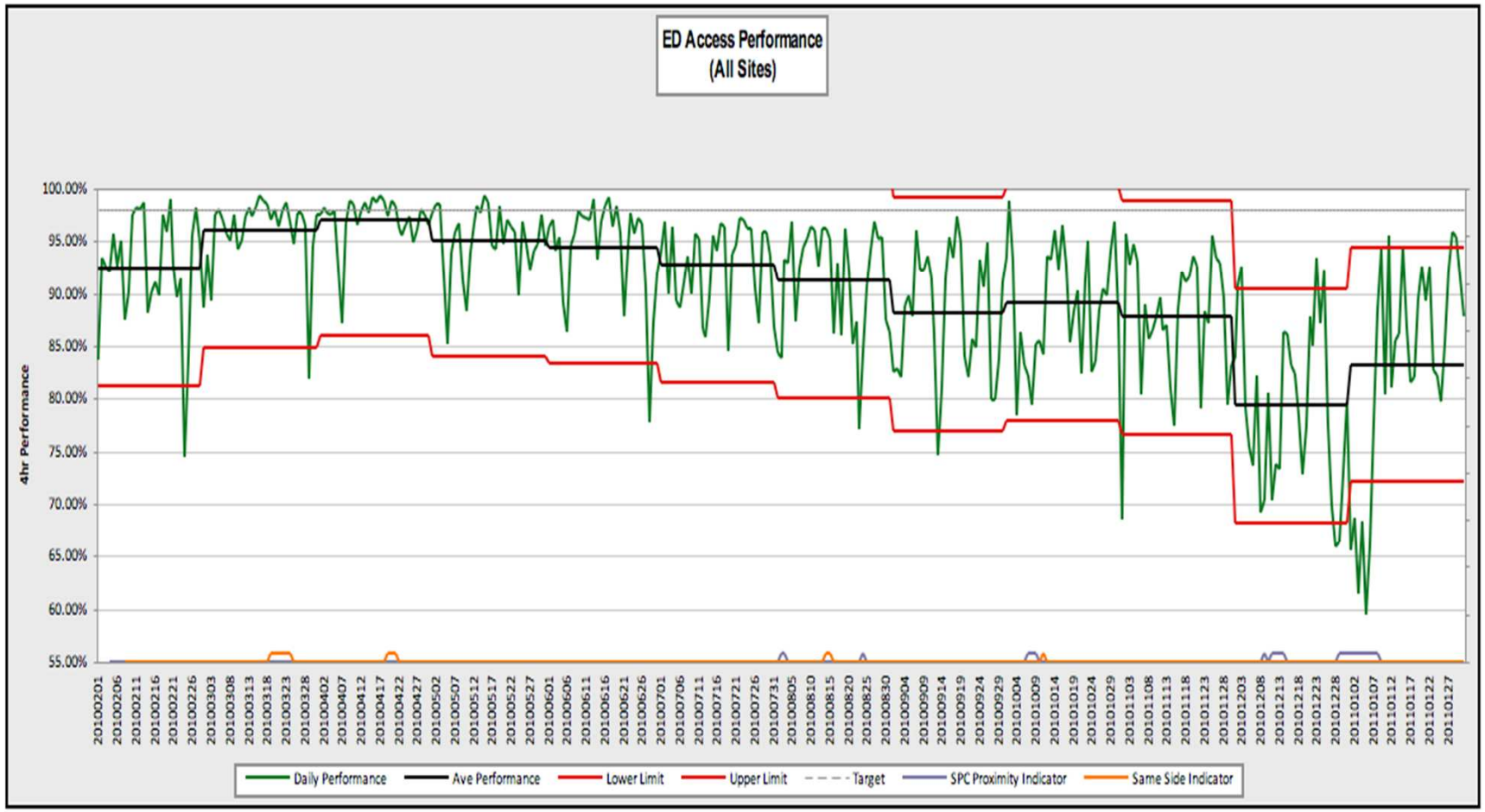
- *'The **next phase of lean** starts with top management learning to see the vital few actions, on the right products and service lines and the right customers that would have the biggest impact on the performance of the organisation. **In the hospital getting the chaotic flow of patients through A&E under control is the key to establishing stability and a common rhythm across the rest of the hospital**.'* (Jones, 2008)

Conclusions

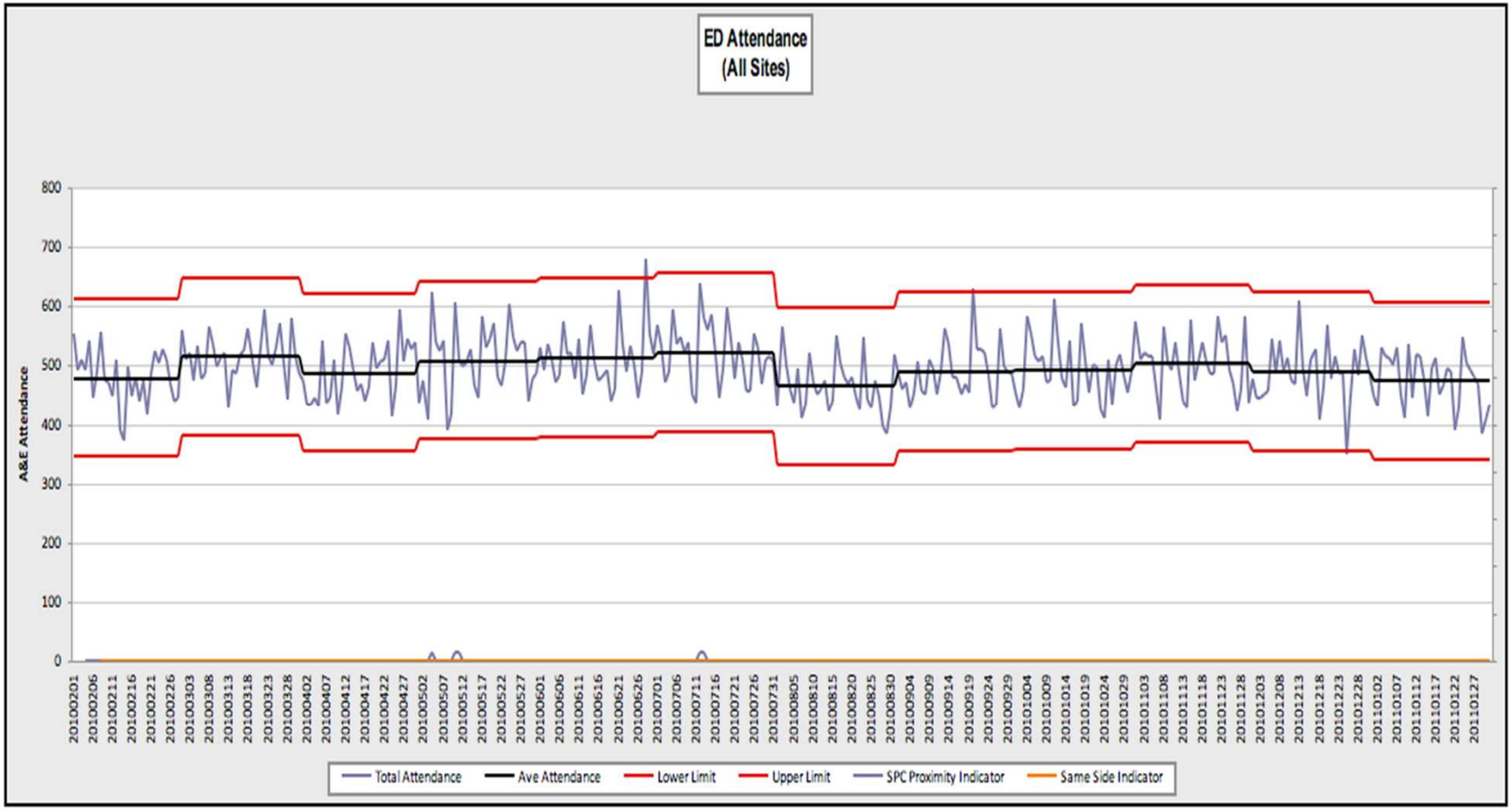
- **Time buffer management (TBM) exhibits functions (prioritise, expedite, escalate and targeting).**
- **The underlying assumptions of these four functions are aligned with a more highly variable and uncertain delivery system.**
- **Both kanban and TBM functions are based on managing and reducing disruption to flow through buffer control.**
- **Improvement in LOS can be achieved systemically and rapidly but requires discipline in its use.**
- It is proposed that **time buffer management provides a natural development to kanban control** suited to such complex and unstable environments where time rather than inventory other buffering applies.

Issues and further research

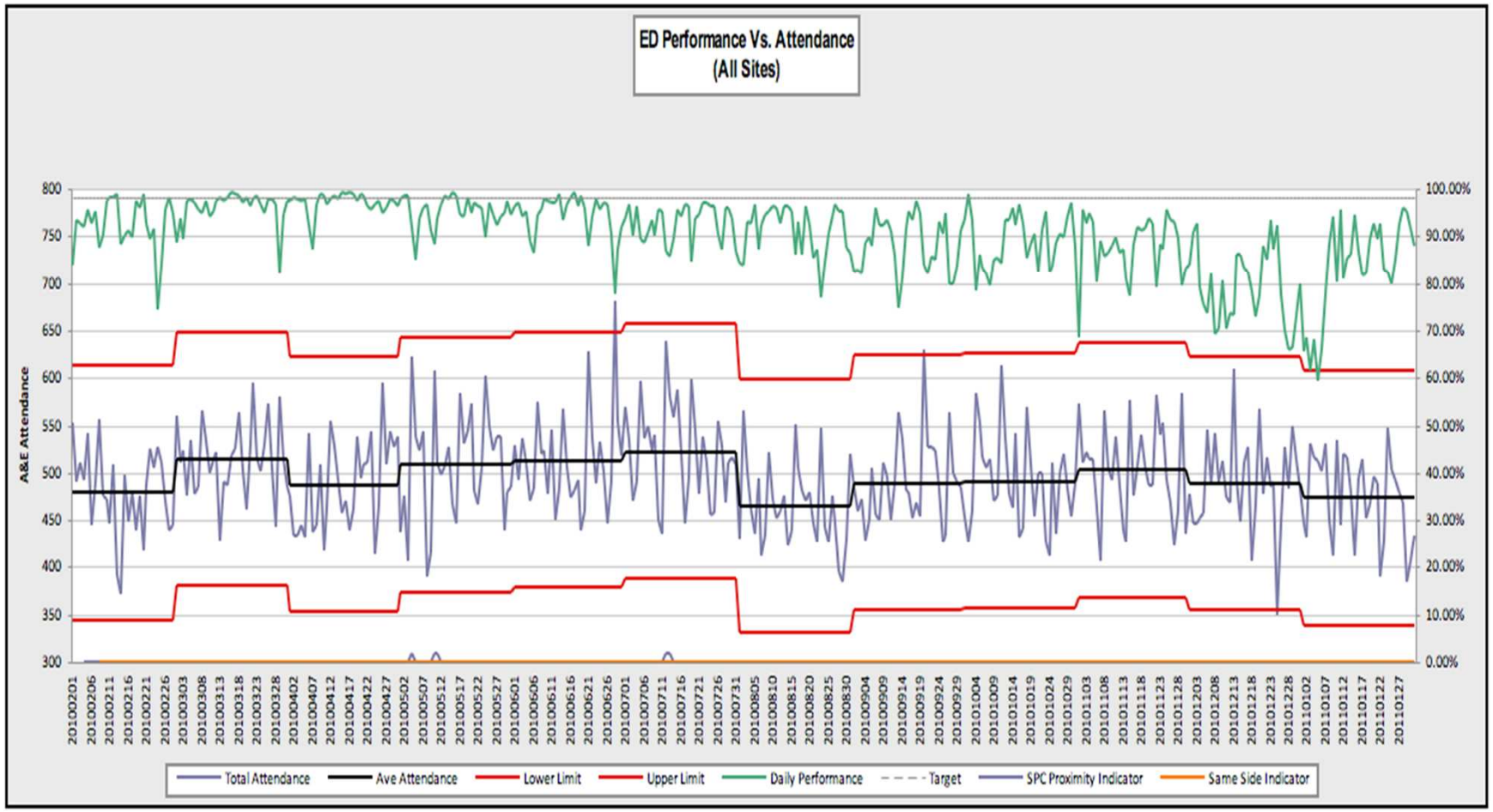
Periodic pressure on ED access performance



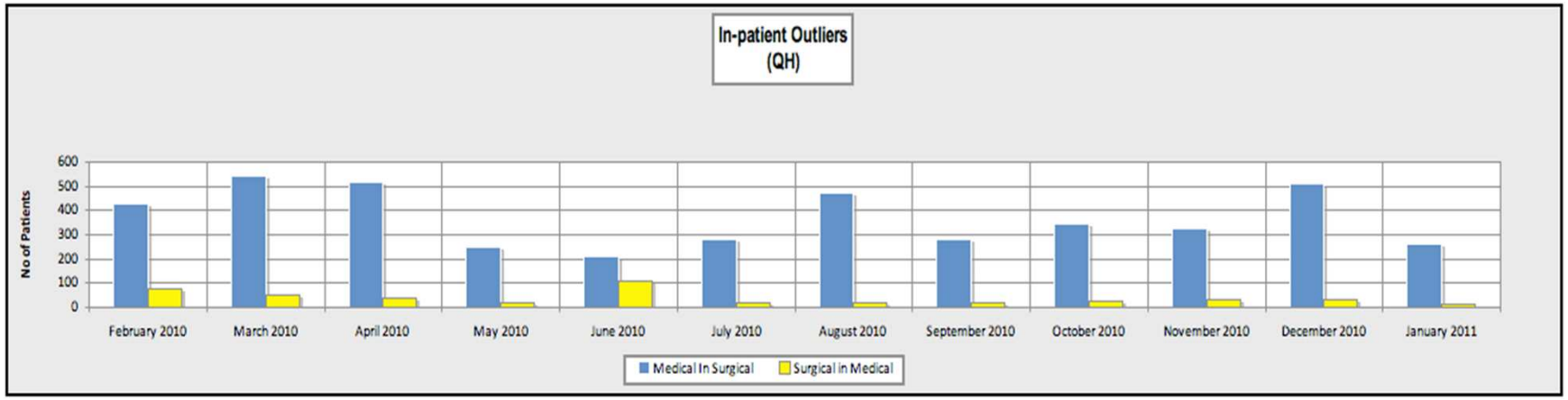
ED attendances are very predictable

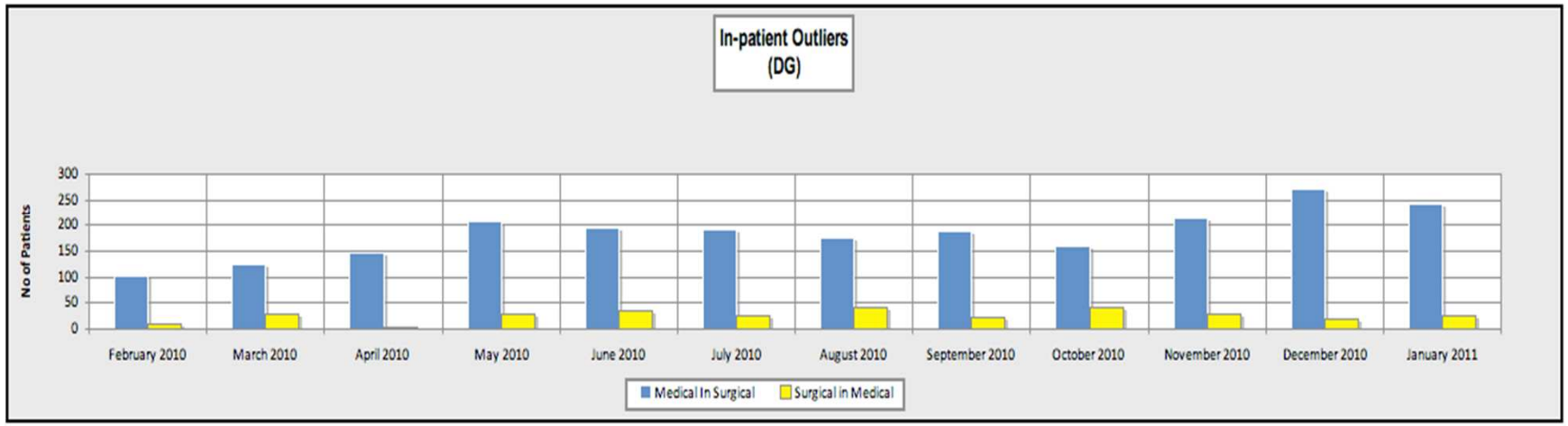


Performance versus attendance suggests internal causes



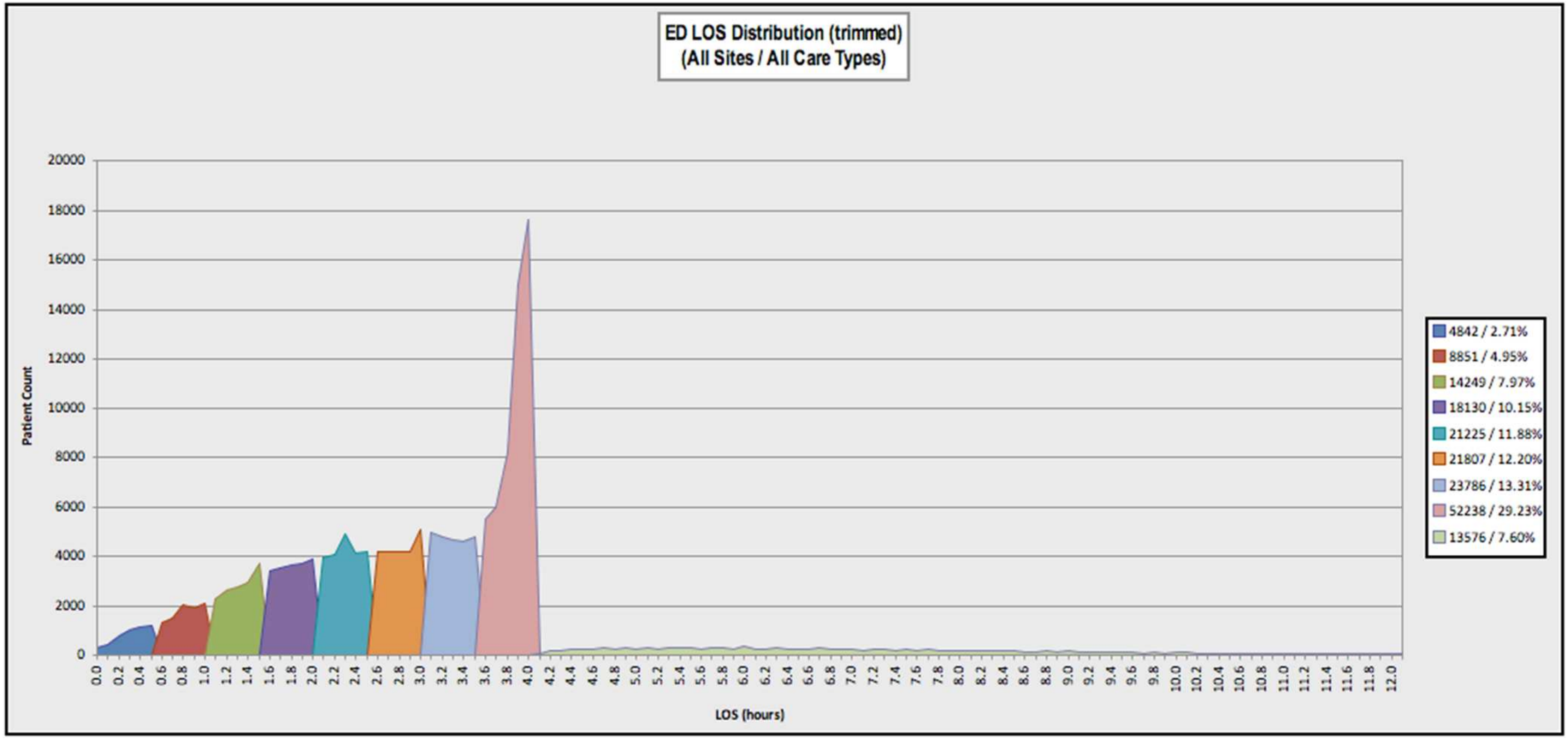
Such instability easily results in medical outliers and extended Lengths of Stay (LOS) that has chronic consequences.



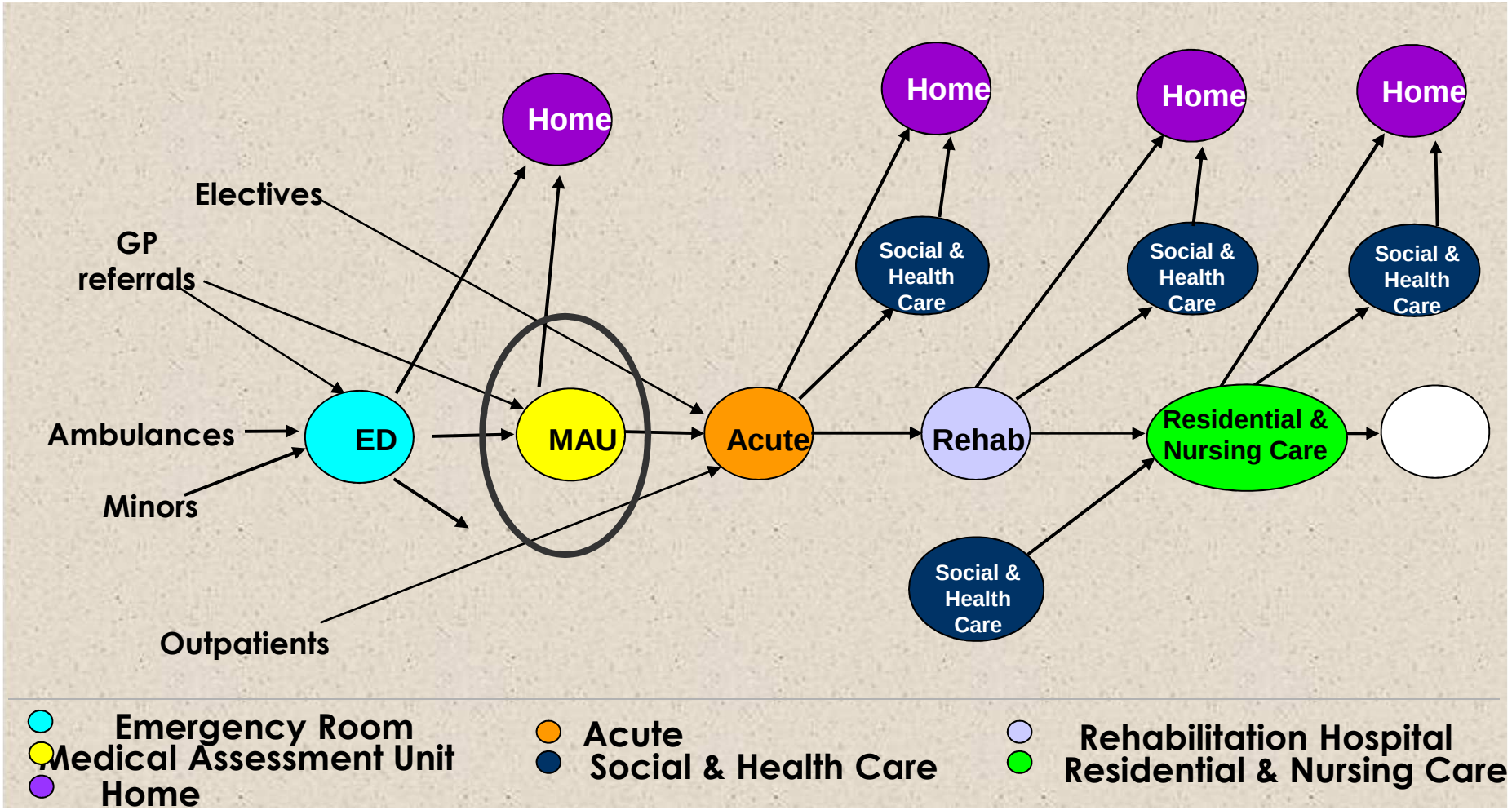


Drivers of instability

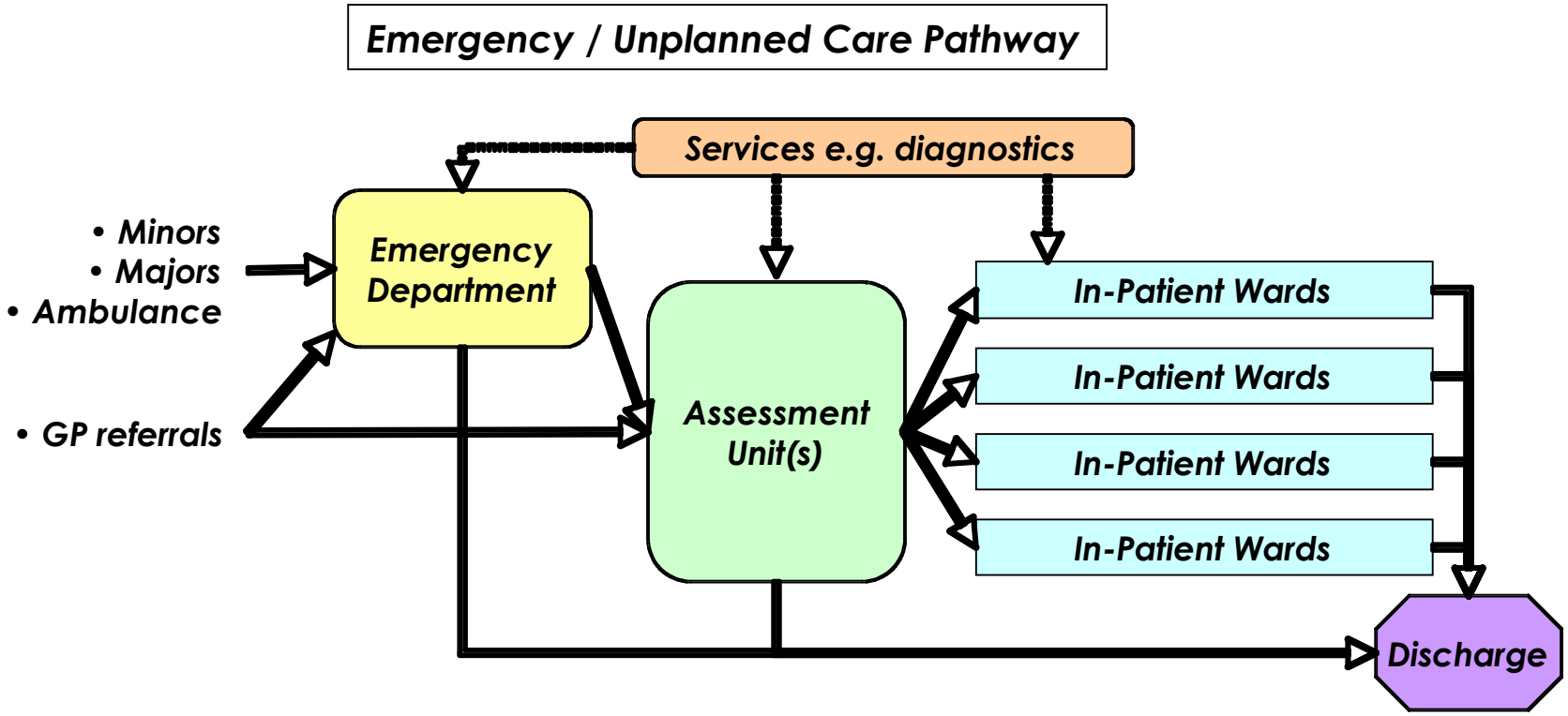
A typical example: >37% of patients are still in the ED department at 3hrs 30mins



Health and social care system - the chain of activities



The MAU is at a divergent point in the emergency pathway and acts both as a filter and a bed capacity buffer for the medical wards?



Potential MAU Logistical Benefits

- Acts as an aggregate bed capacity buffer:
  - Provides a space buffer to meet ED 4 hour target
  - Avoids holding protective bed capacity at the ward level
  - Enables advanced signaling of bed requirements by ward
  - Focuses attention on the causes of delayed discharge
  - Avoids outliers - extended length of stay (LOS)
  - Provides advanced signaling of MAU bed capacity adjustments.

Further research questions

- Can the MAU act as a control point in a health and social care system
  - How should MAU be managed?
  - What MAU performance measures are appropriate?
  - How should MAU capacity be adjusted?
  - How can it be used in tandem with TBM?


Questions