Improving care delivery: a study of hip fracture

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Presentation outline

- Message
  - care systems very difficult to model and to re-engineer
  - common language needed to describe patient flow
- Outline
  - modelling and simulation
  - care for patients with fractured neck of femur (hip)
  - project outcomes
  - conclusions

Why model? Why simulate?

- Modelling health care systems
  - mathematical representations (example 1)
  - based on estimates and assumptions (example 2)
  - systems thinking increases understanding
- Computer simulations (virtual hospital)
  - running more complex models on computers
  - assess likely impact of changes on outcomes
  - alternative: ethical, safety, economical considerations

Example of modelling and simulation

- Scheduling clinic appointments in surgical care
  - individual surgeon vs. pooled lists
  - three surgeons, two queues (appointment, surgery)
  - uneven availability of surgeons over days and weeks
- Results
  - policies affect patient progress in differing ways
  - reduces times to appointment and length of queue
  - increases time to surgery for low priority patients

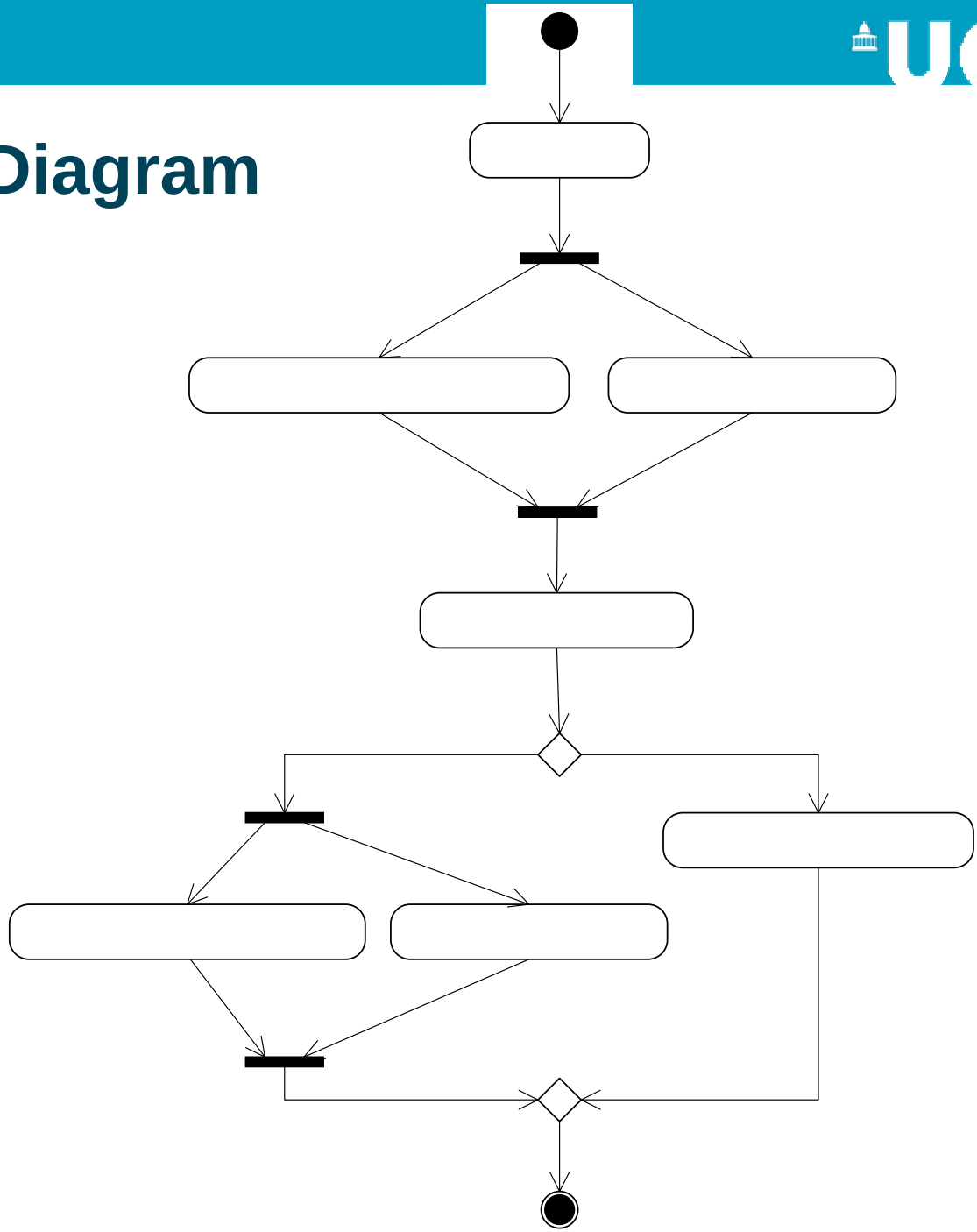
Motivation of research

- Problem
  - we know *how* to simulate
  - difficult to know *what* to simulate
  - resource consuming, lack of common ‘language’
- Unified Modelling Language - UML
  - uniform symbolic language
  - understandable by both modellers and stakeholders
  - activity diagram, state diagram etc.

Example of surgical care

Physicians refer patients for surgical consultation if they believe the underlying health problem is amenable to surgical intervention. Following the referral, the outpatient clinic books the patient an appointment with the surgeon and also arranges for samples to be taken if further diagnostic tests are required. At the consultation, the surgeon assesses the need for an operation by evaluating symptoms and test results. Following a decision to operate, the patient's name is registered on a prioritised surgical wait list so that appropriate time can be booked at the operating theatre of a hospital. The patient may also be educated about the operation by a specialist nurse. If an operation is not deemed suitable, then the patient may be further referred for medical treatment.

UML Activity Diagram



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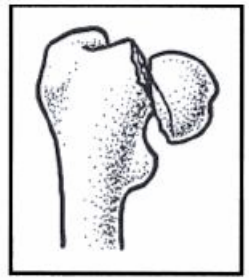
Project outline

- Aim
  - develop a method for capturing, storing and presenting details of the flow of patients through the care process
- Objectives
  - describe the activities involved in the care for older people with fractured neck of femur
  - create information library with the results of process mapping

Hip fracture



- Fractured neck of femur
  - longest and largest bone (between hip and knee)
  - associated with osteoporosis
  - higher incidence in older people
  - major cause of morbidity, mortality, use of resources
- Treatment
  - surgery
  - rehabilitation
  - management of co-morbidities

Caring for patients with hip fracture

- Complex care process
  - many diagnostic, therapeutic, administrative activities
  - A&E, orthopaedic ward, operating theatre, ICU, community hospital, home
  - geriatrician, surgeon, orthopaedic nurses, geriatric nurses, physio, occupational therapist, discharge coordinator, community nurse, GP
  - lends itself to process mapping studies

Methods

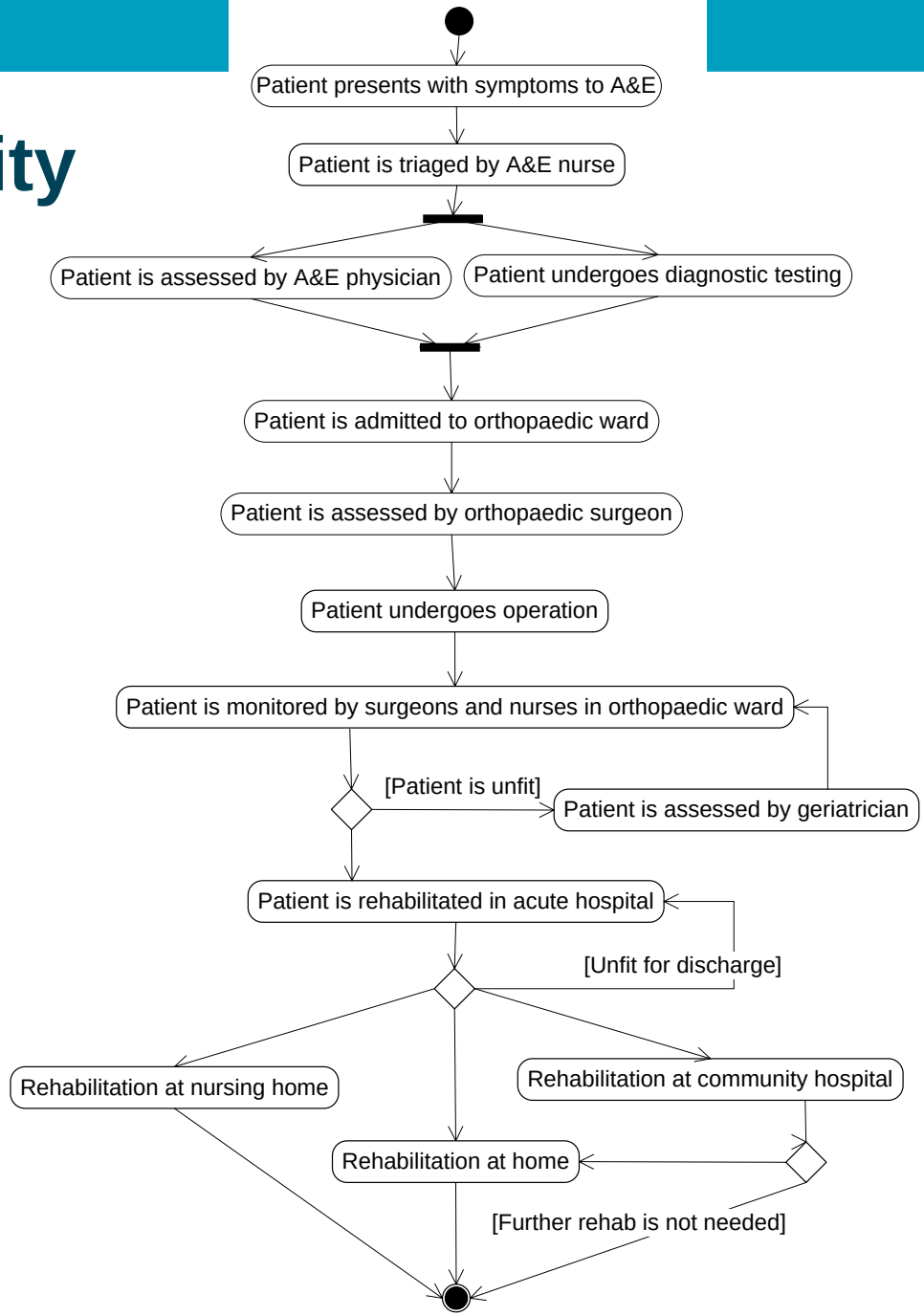
- Process mapping
  - semi-structured interviews with health professionals
  - on-site observations
- Information library
  - narrative of the progress of patients
  - UML Activity Diagrams capture the sequence and conditions of the progress of patients
  - Use Cases detail the function performed by each activity
  - UML State Diagrams capture the dynamic behaviour of patients

Narrative

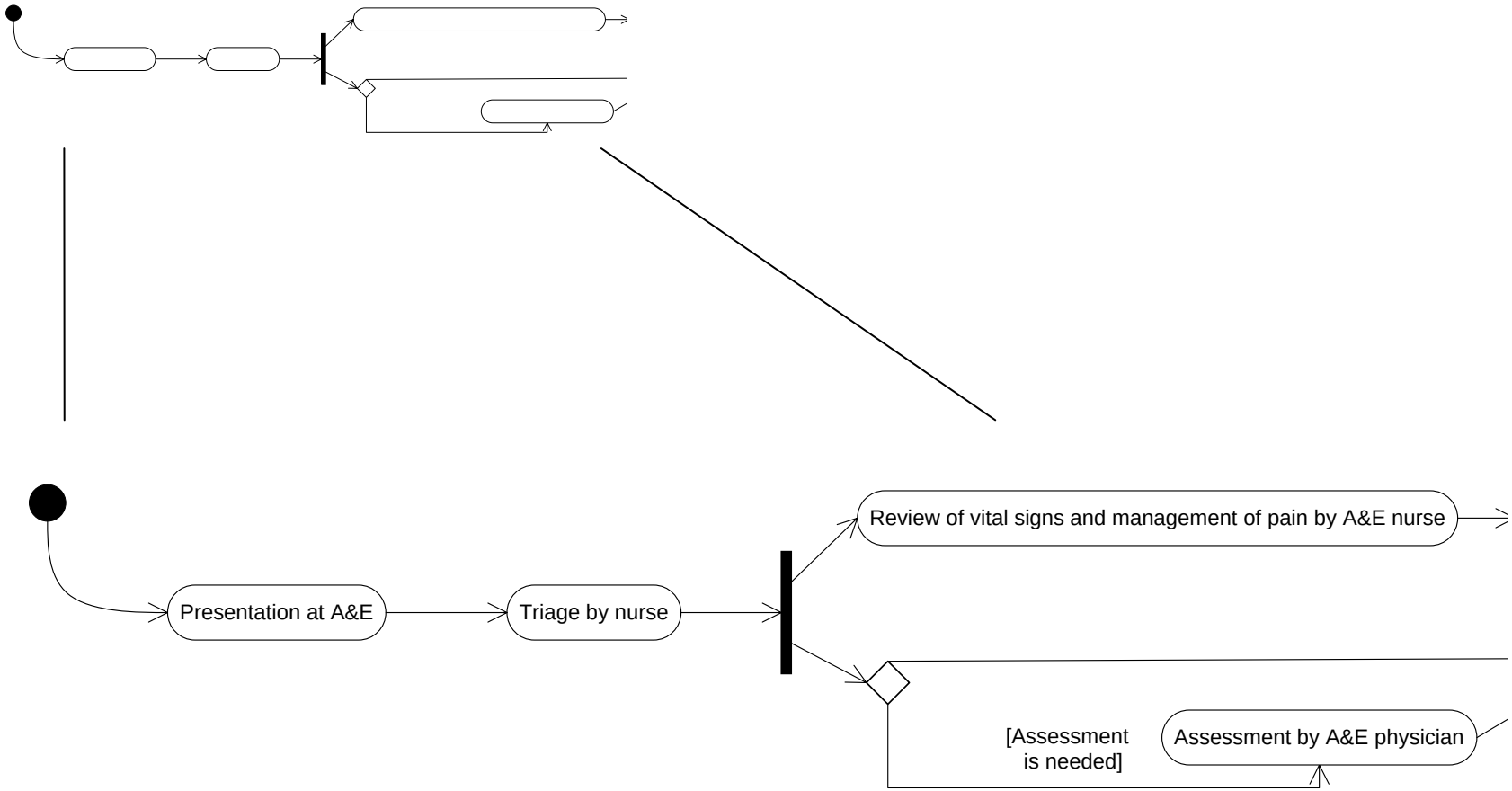
ACUTE CARE: ADMISSION TO HOSPITAL

The pathway begins when an older person falls and suffers a fracture. The person is transferred to the Accident and Emergency (A&E) department of the hospital by ambulance or private means. The triage nurse assesses the patient's condition in the A&E department. The patient is classified according to the severity of the case (red, yellow, or green). A patient with symptoms of fractured neck of femur is most commonly assigned a yellow classification, which indicates an emergency but not life threatening condition. An A&E physician or nurse then checks the patient's vital signs, records the pre-fall health condition of the patient and makes sure that the patient receives pain medication. Subsequently, in consultation with an A&E physician (if available), several basic tests (such as blood tests) and X-rays (hip and often chest) are ordered and performed…

UML activity diagram - overview



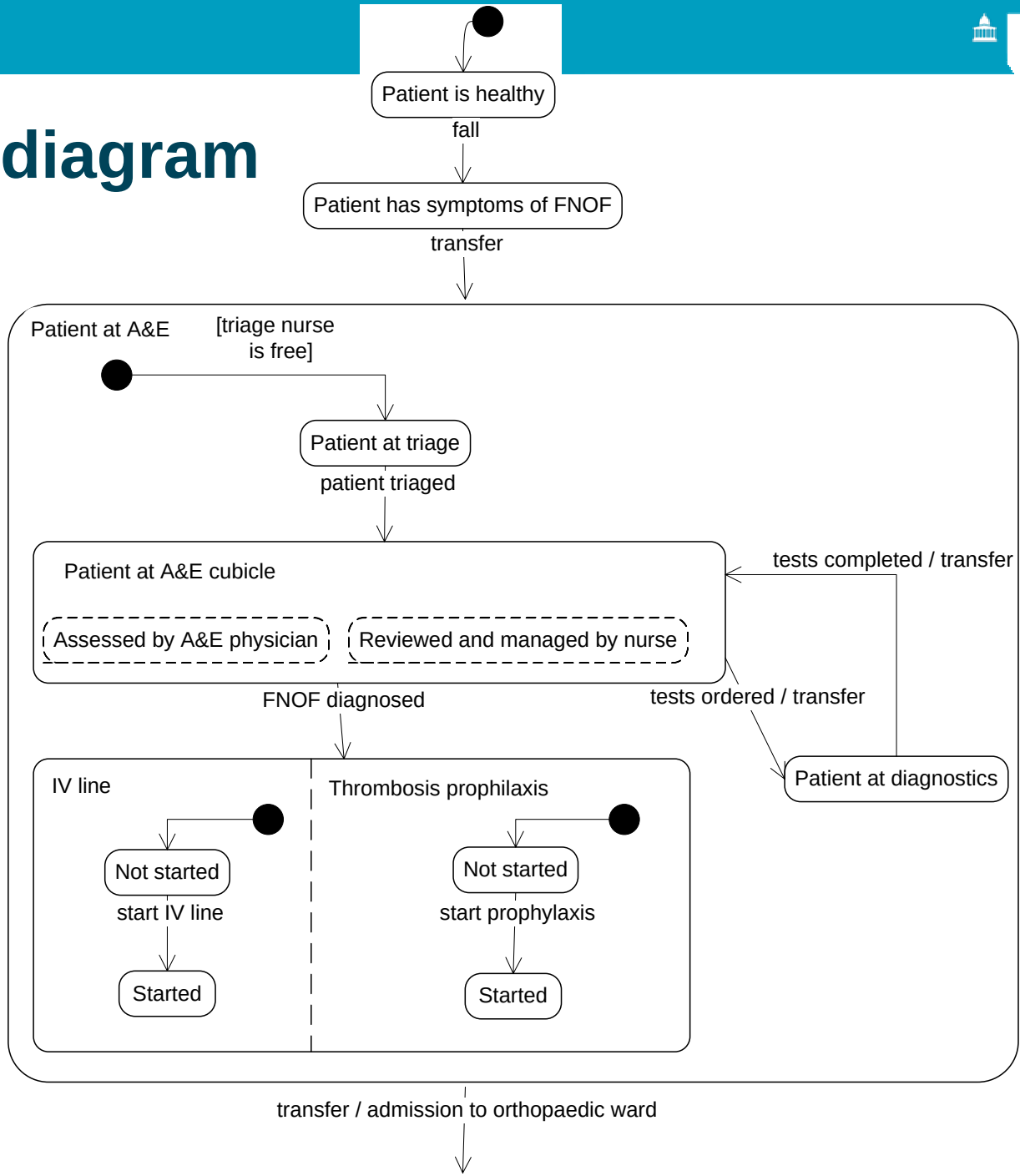
UML activity diagram - complete



Use case example

Use case	**Triage by nurse; AE_2**
Aim	The use case is concerned with classification of patient's condition on arrival to A&E and assessing the need for pain relief.
Actors	Patient, nurse practitioner (triage nurse)
Associated prior activities	Presentation to A&E
Preconditions	None
Typical sequence of events	The use case begins when the triage nurse sees the patient at A&E. The patient's condition is classified according to the severity of the case (red, yellow, green). A patient with symptoms of fractured neck of femur is usually assigned a yellow classification which means emergency but not life threatening condition. The nurse then checks the patient's vital signs, records the pre-fall health condition of the patient and then makes sure that the patient receives pain medication to manage his/her pain. The use case ends when the patient is classified on the triage scale and his/her pain is managed.
Alternative sequences	None
Associated post activities	Review of vital signs and management of pain by A&E nurse; Assessment by A&E Physician

UML state diagram



Conclusions

- Main outcomes
  - first attempt to systematically map this very complex care process
  - blueprint for other pre-simulation process mapping exercises
- Intended usage of information library
  - help in preparing an effective integrated care pathway
  - inform future simulation studies

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Example 1: mathematical models

$$E = mc^2$$

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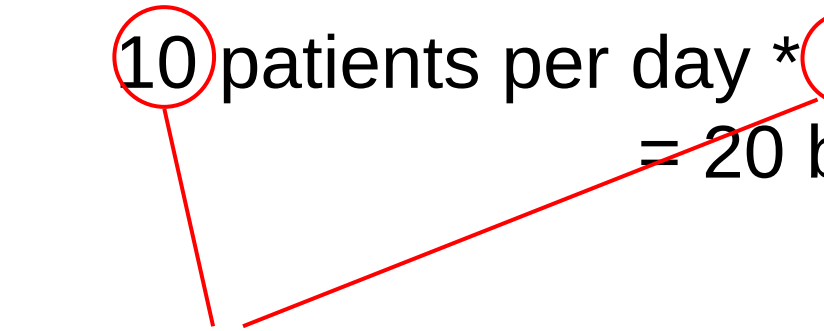
Example 2: average daily occupancy

admission rate * average length of stay
= average daily occupancy

10 patients per day * 2 days average stay
= 20 beds



estimations

stable system assumption

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