CPSSQ
Centre for Patient Safety& Service Quality

UCL

Imperial College Healthcare NHS
NHS Trust

Medication safety and technology
- A view from the UK -

Professor Bryony Dean Franklin
bryony.deanfranklin@imperial.nhs.uk
August 2012

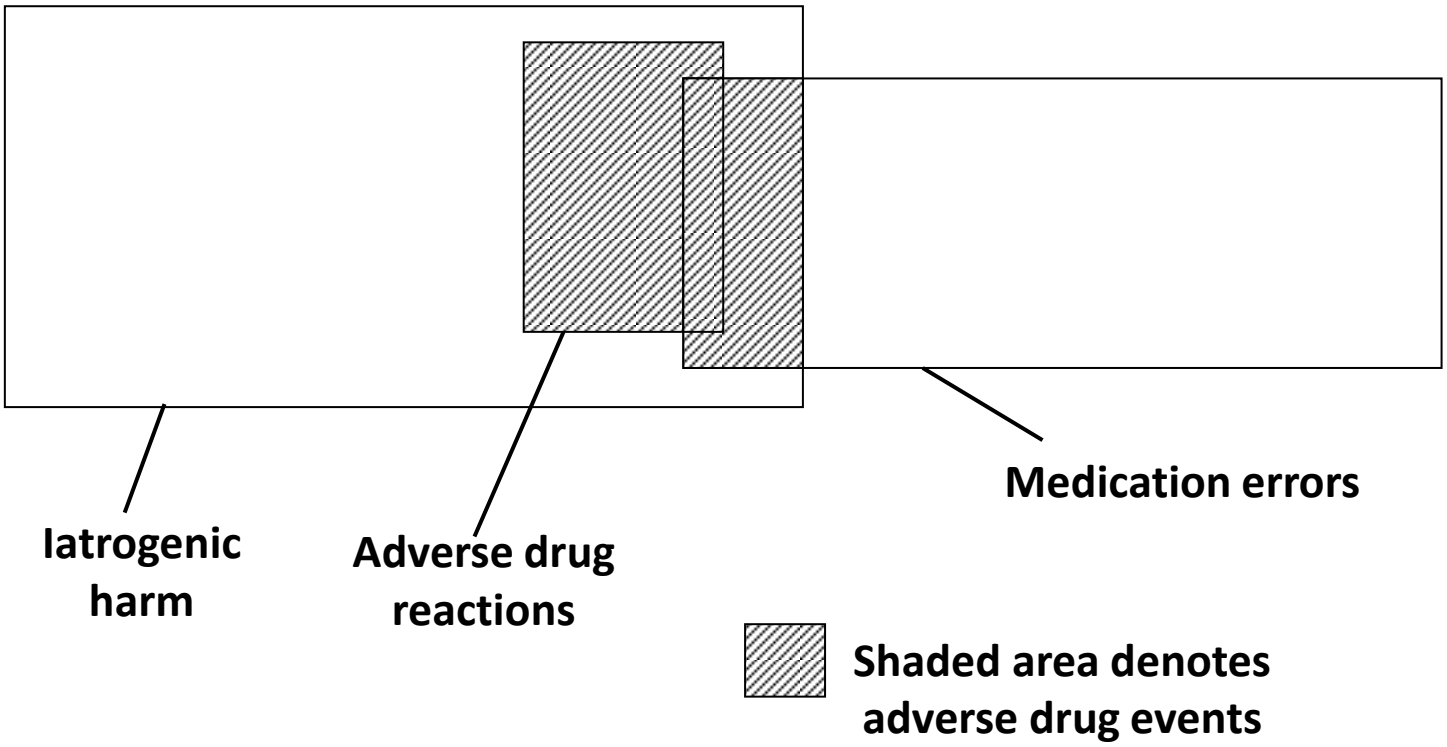
CMSSQ
Centre for Medication Safety & Service Quality

Imperial College Healthcare NHS Trust

- 3 main hospitals + 2 smaller hospitals
- 1,200 beds
- 70 pharmacists
- 70 pharmacy technicians
- 70 assistants / other staff
- Medicine information
- Parenteral nutrition
- Preparation chemotherapy
- Prescribing is paper-based
- Original pack dispensing (not unit dose)

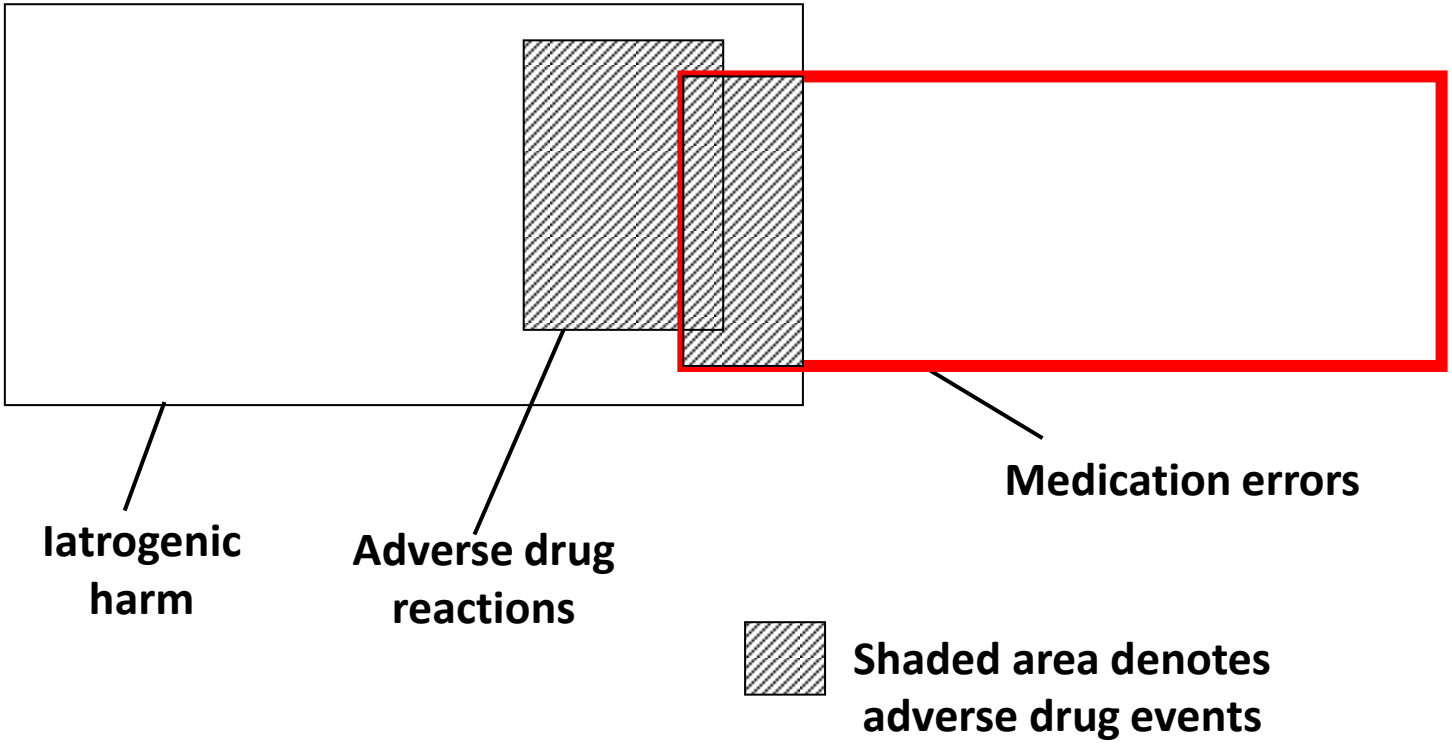

London 2012
London 2012

Key terms


Iatrogenic harm
Adverse drug reactions
Medication errors
Shaded area denotes adverse drug events

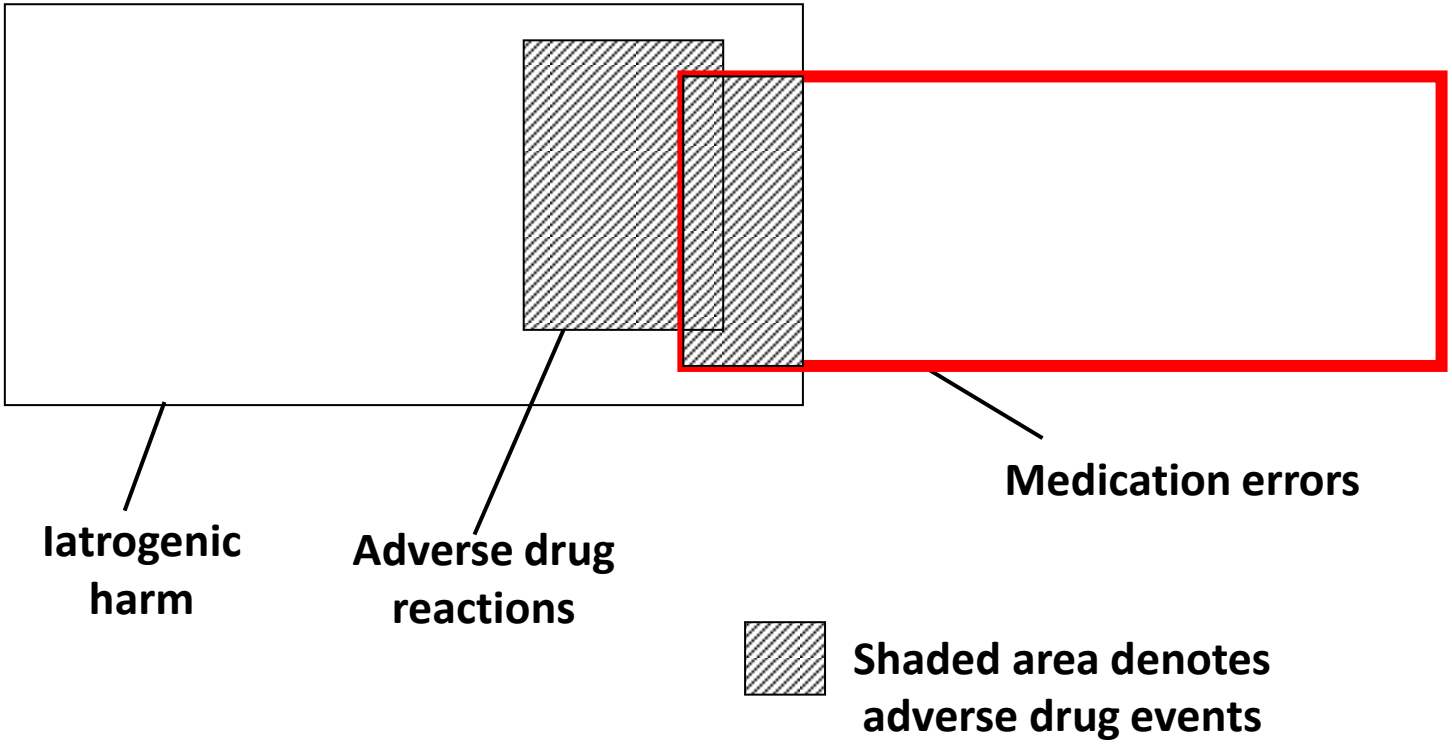
Key terms

" any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of health professional, patient or consumer."

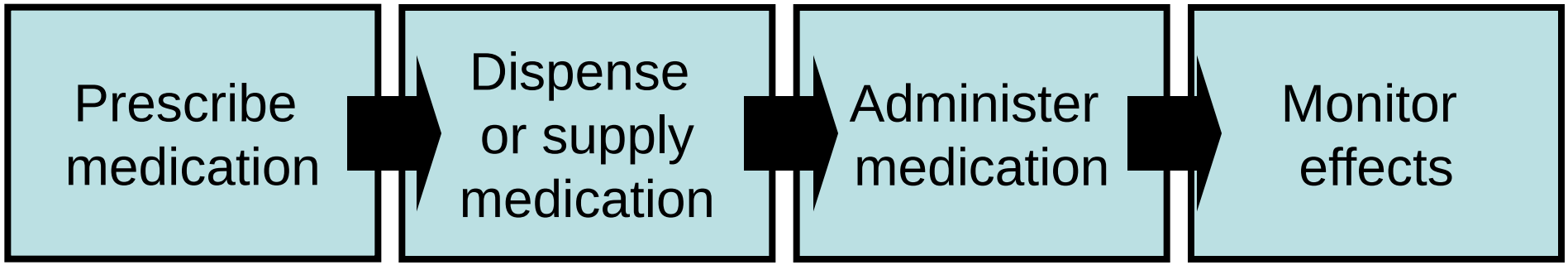


Key terms

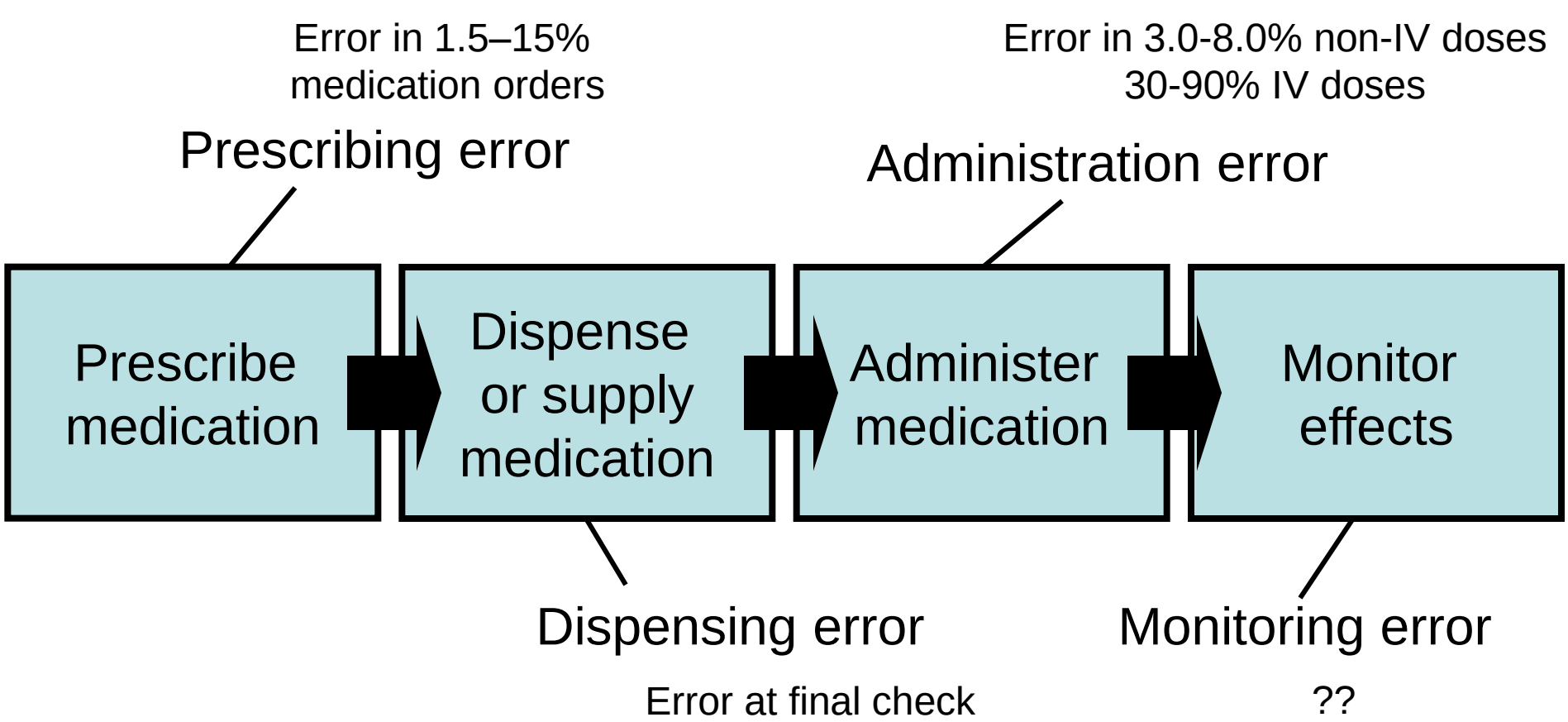
" any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of health professional, patient or consumer."



Medication errors in UK hospitals

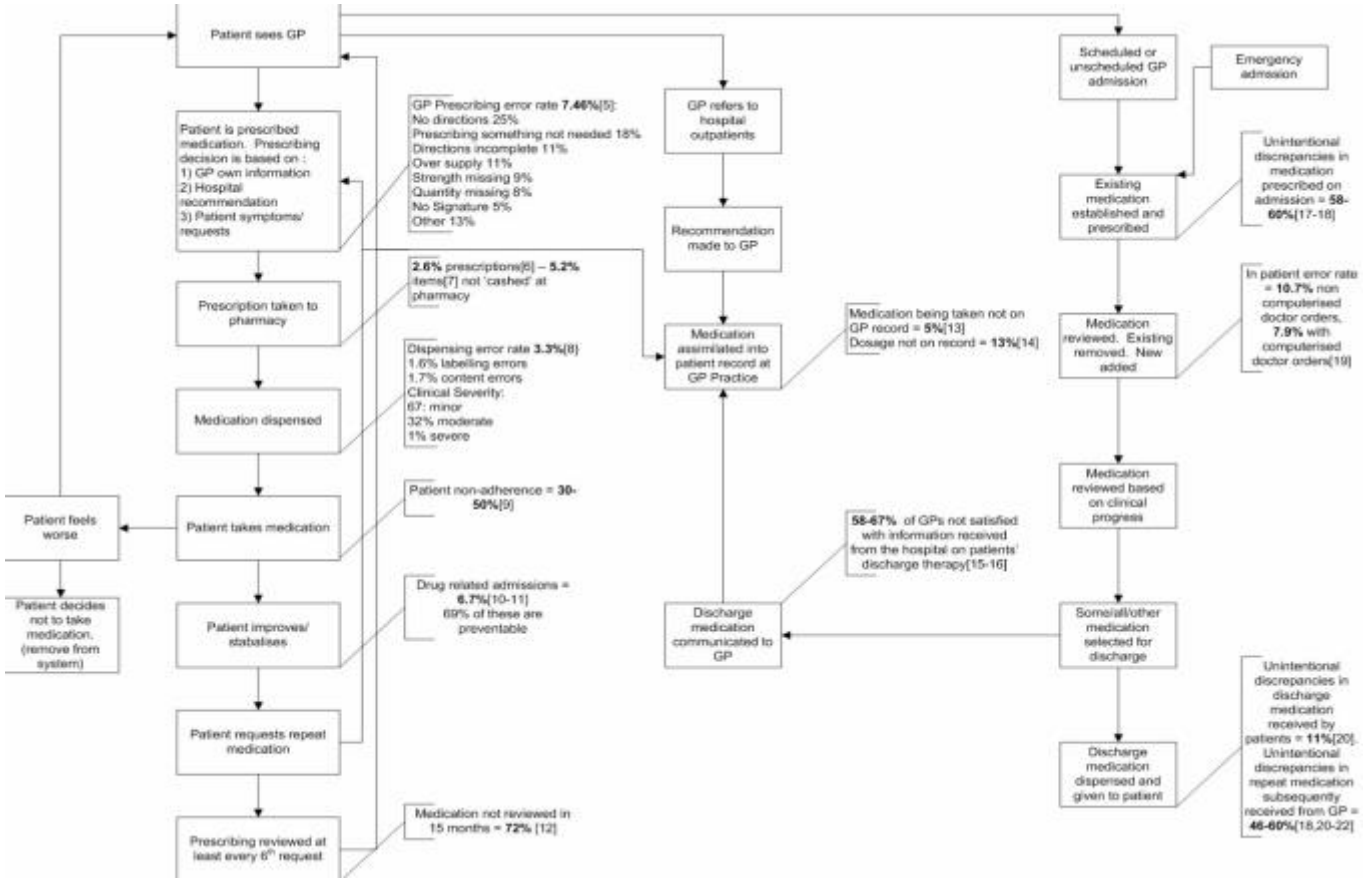


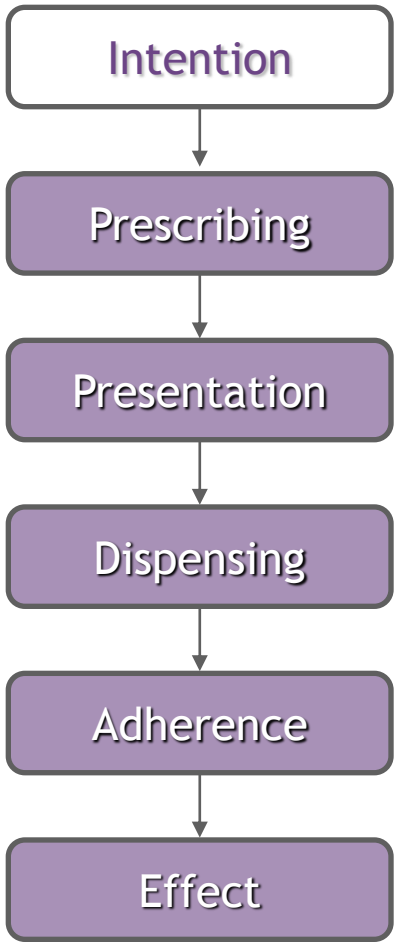
Medication errors in UK hospitals

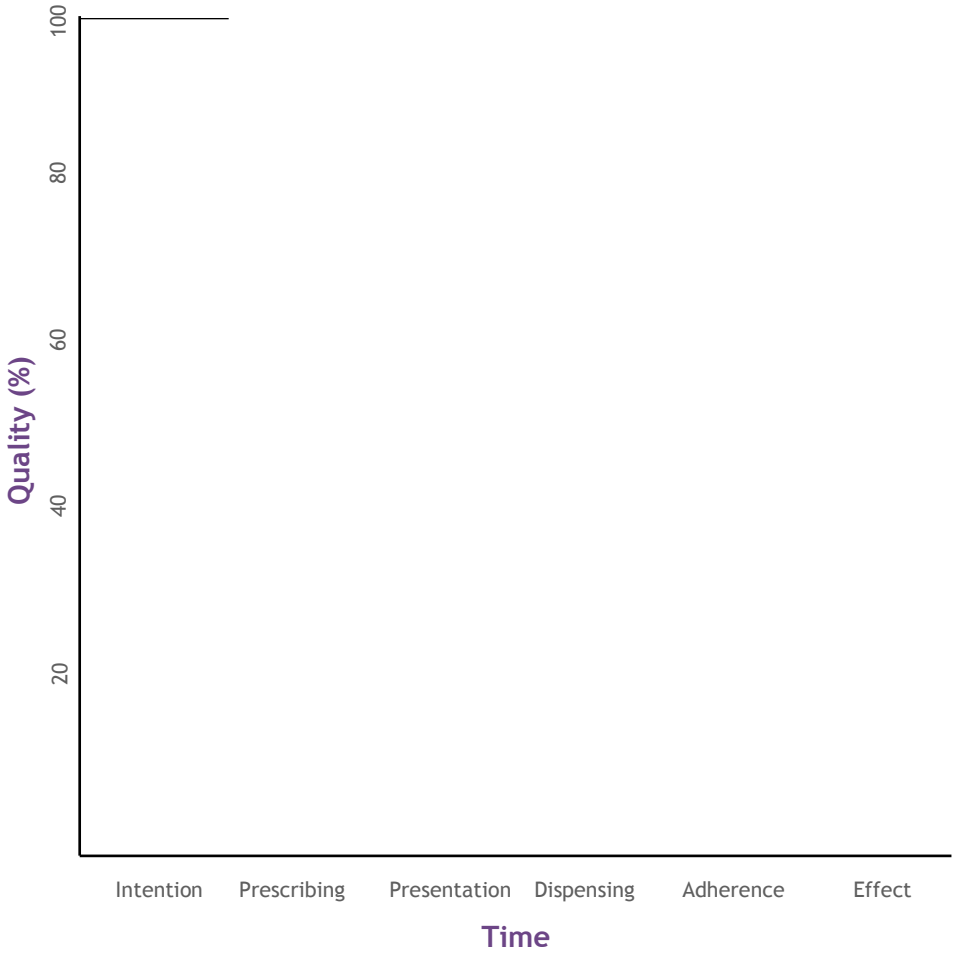


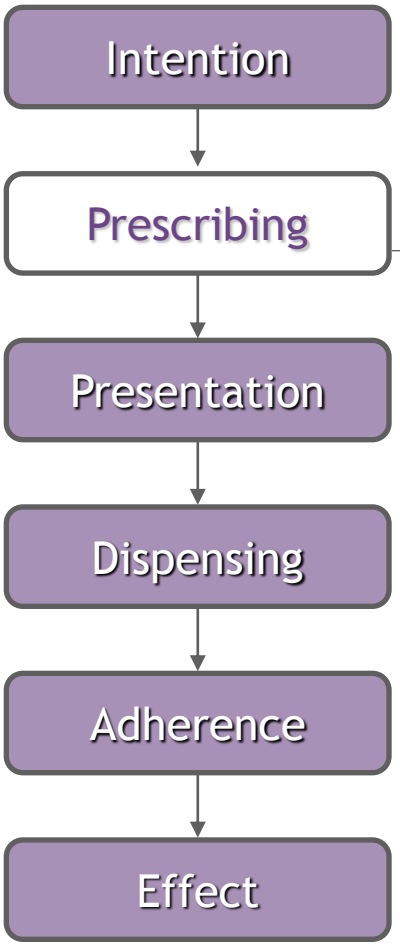
What about primary care?

Garfield et al 2009 BMC Medicine



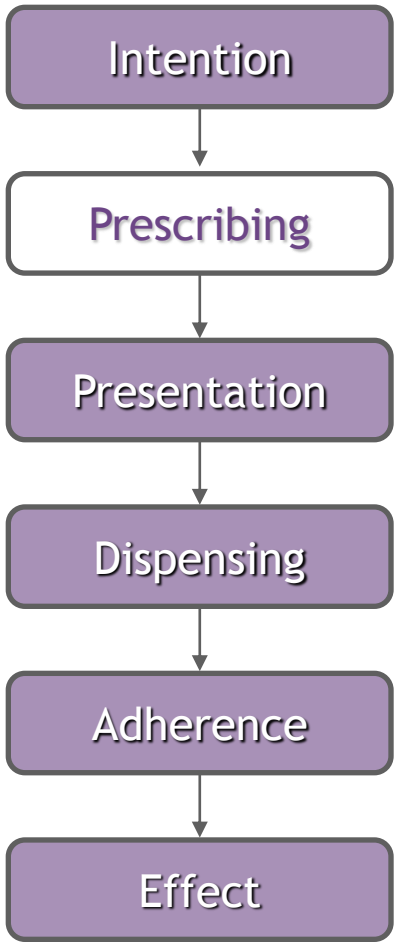

Intention
Prescribing
Presentation
Dispensing
Adherence
Effect

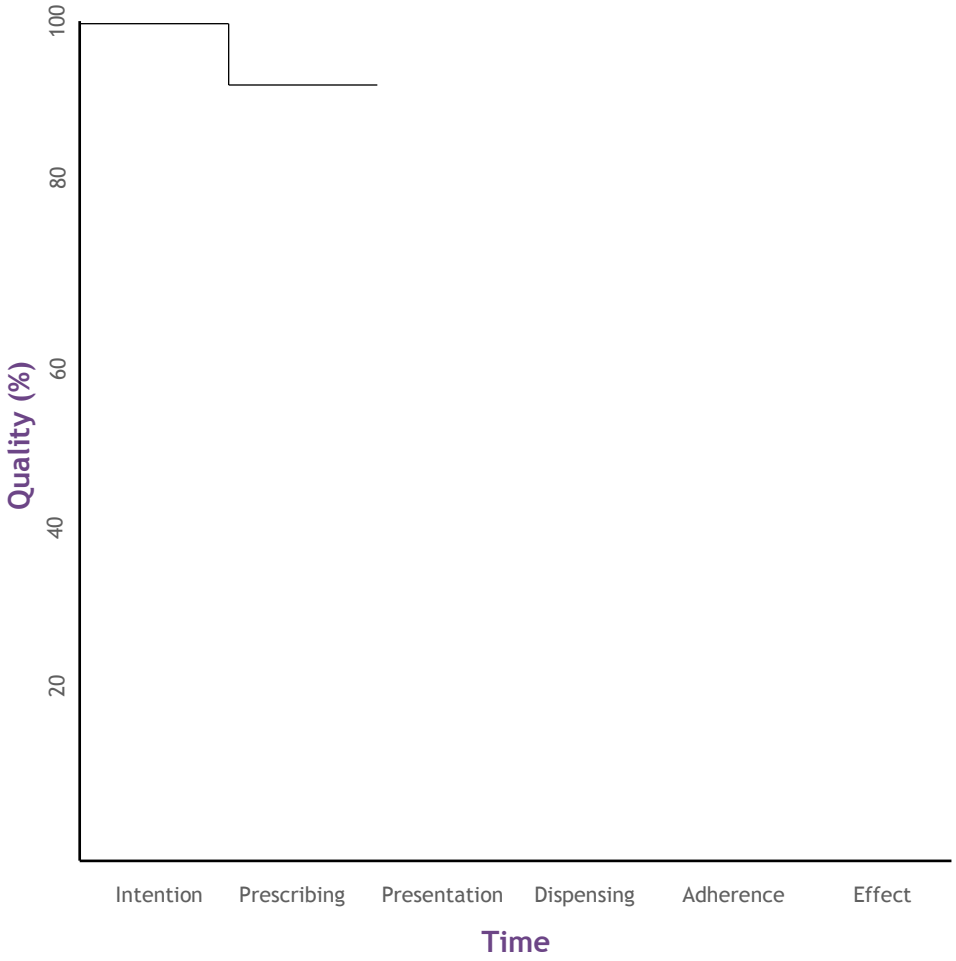

100
80
60
40
20
Quality (%)
Intention
Prescribing
Presentation
Dispensing
Adherence
Effect
Time

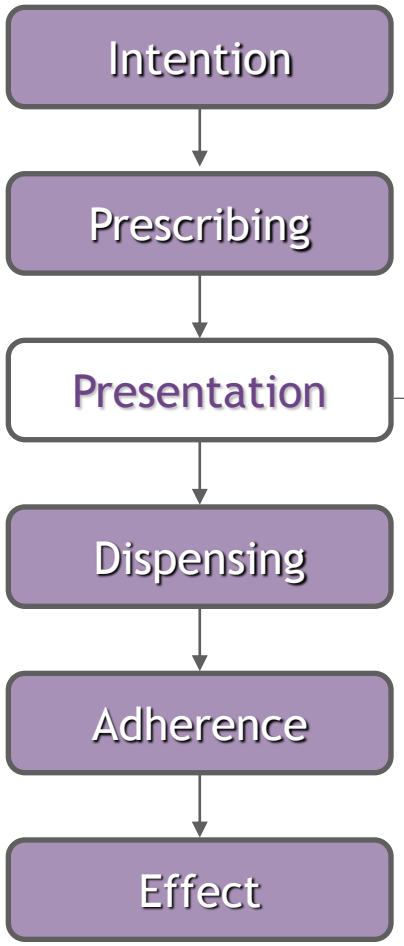


Error rate **7.46%** items (*Shah et al 2001*):

- No directions 25%
- Prescribing something not needed 18%
- Directions incomplete 11%
- Over supply 11%
- Strength missing 9%
- Quantity missing 8%
- No Signature 5%
- Other 13%


Intention
Prescribing
Presentation
Dispensing
Adherence
Effect


Quality (%)
100
80
60
40
20
Intention
Prescribing
Presentation
Dispensing
Adherence
Effect
Time

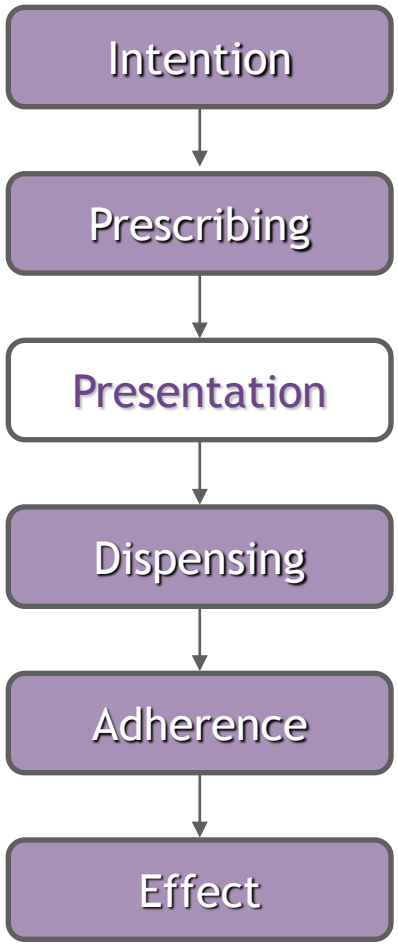


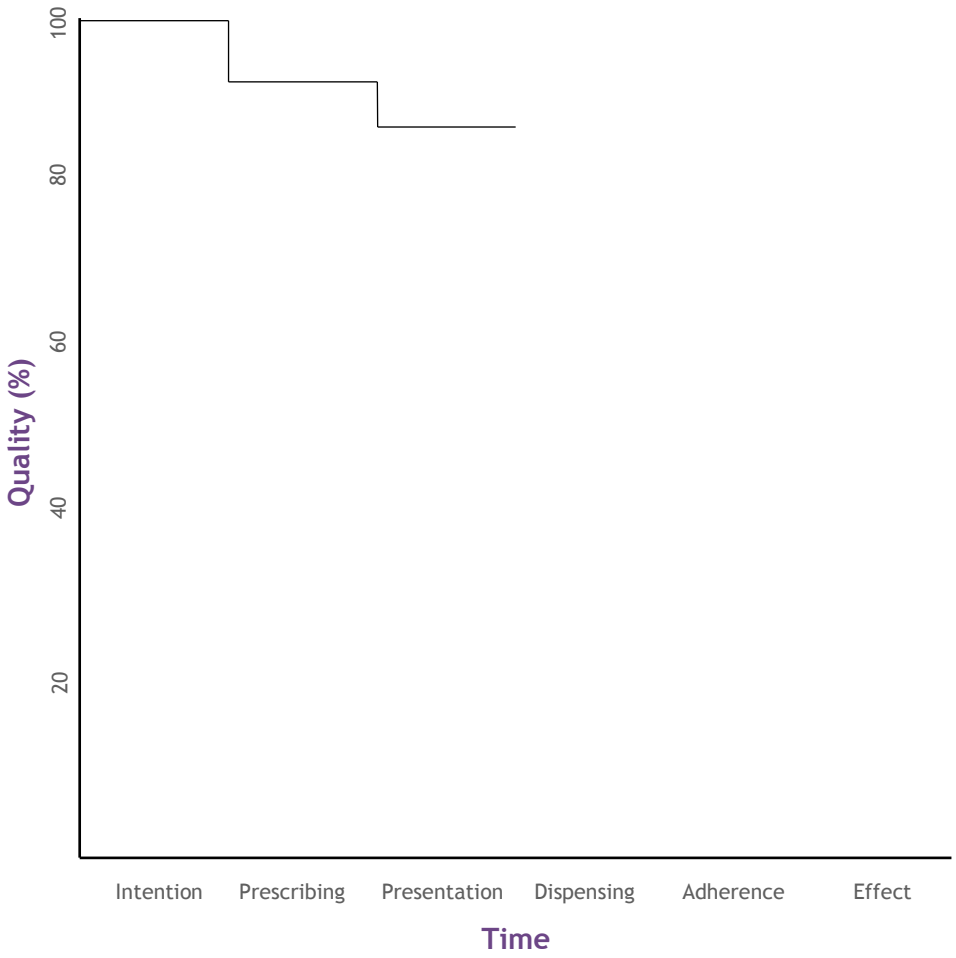
Error rate 2.9% prescriptions

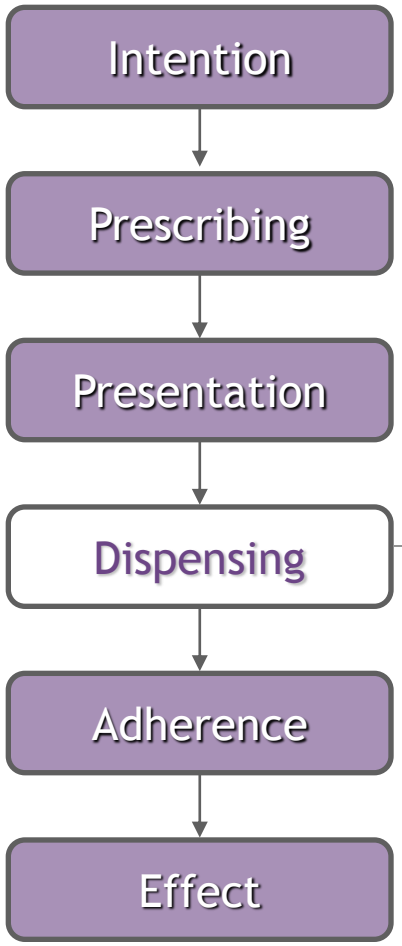
(Jones & Britten 1998)

Error Rate 5.2% items

(*Beardon et al 1993*)


Intention
Prescribing
Presentation
Dispensing
Adherence
Effect


Quality (%)
100
80
60
40
20
Intention
Prescribing
Presentation
Dispensing
Adherence
Effect
Time

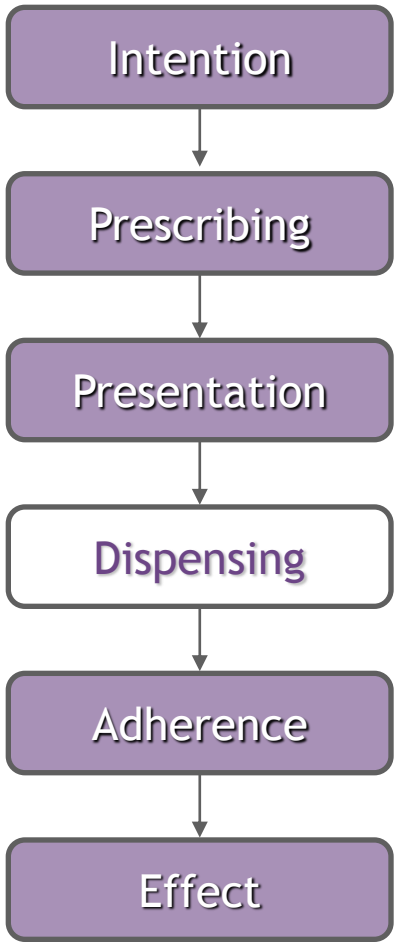


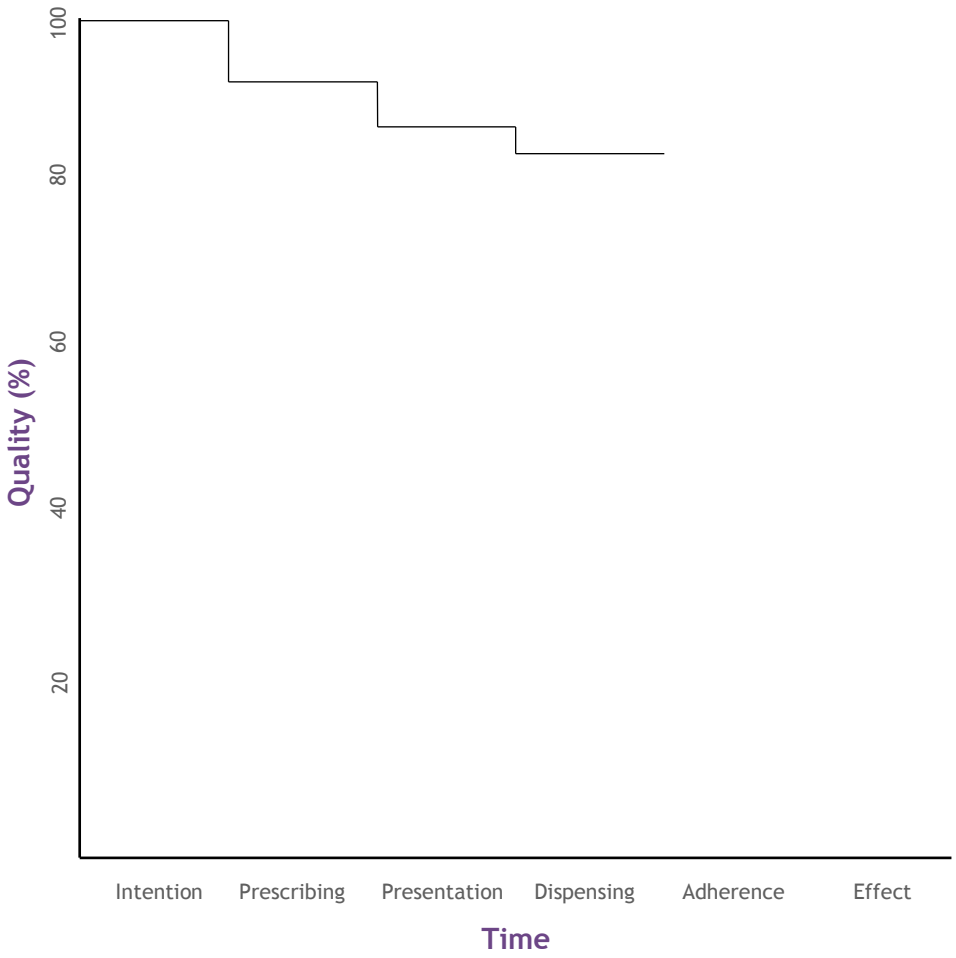
Error rate **3.3%** items (*Franklin et al 2007*):

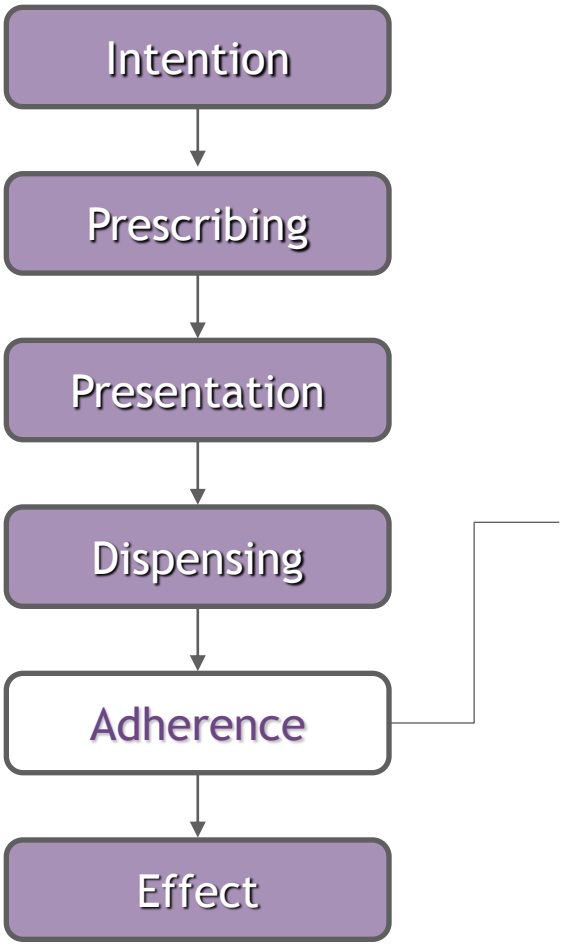
- 1.6% labelling
- 1.7% content

Clinical Severity:

- 67%: minor
- 32% moderate
- 1% severe

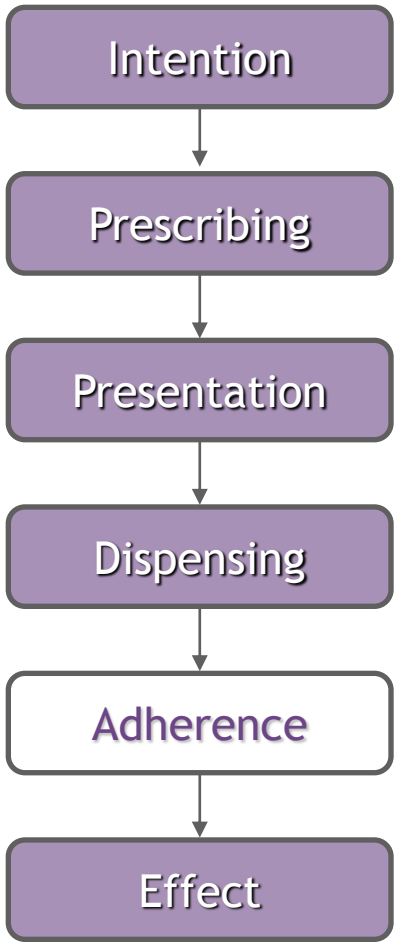

Intention
Prescribing
Presentation
Dispensing
Adherence
Effect

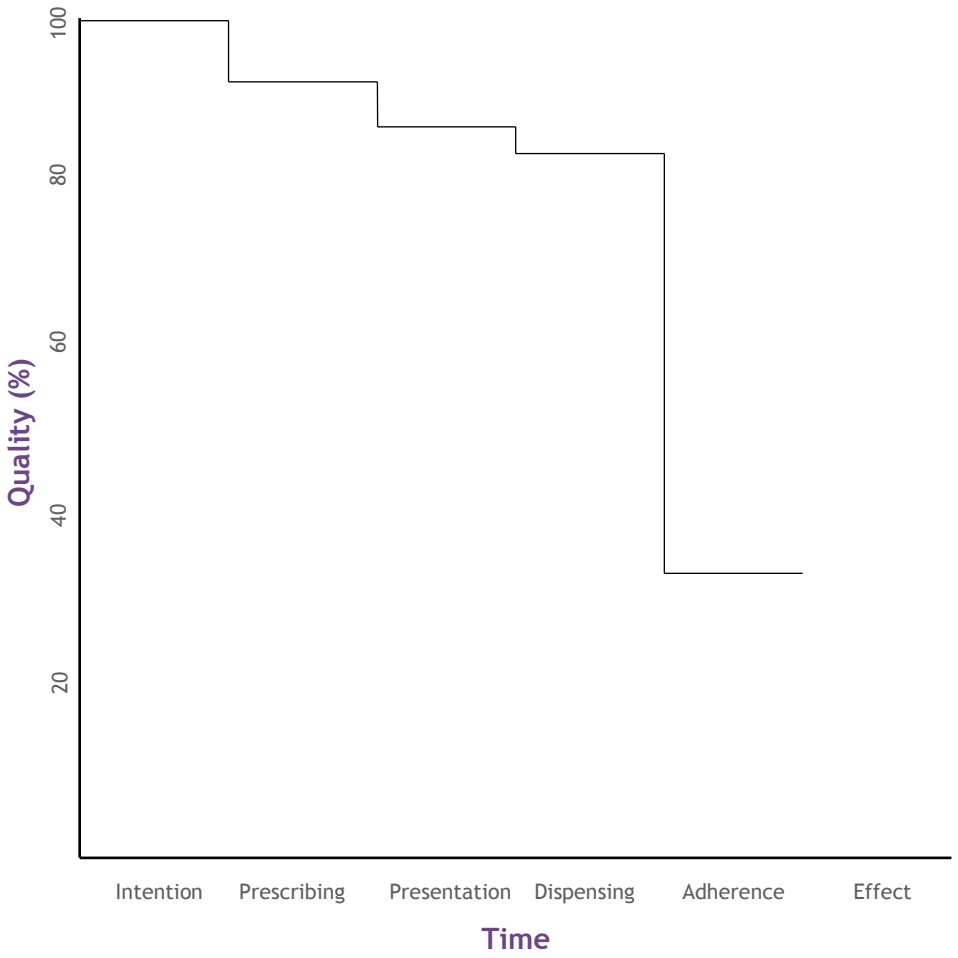

Quality (%)
100
80
60
40
20
Intention
Prescribing
Presentation
Dispensing
Adherence
Effect
Time

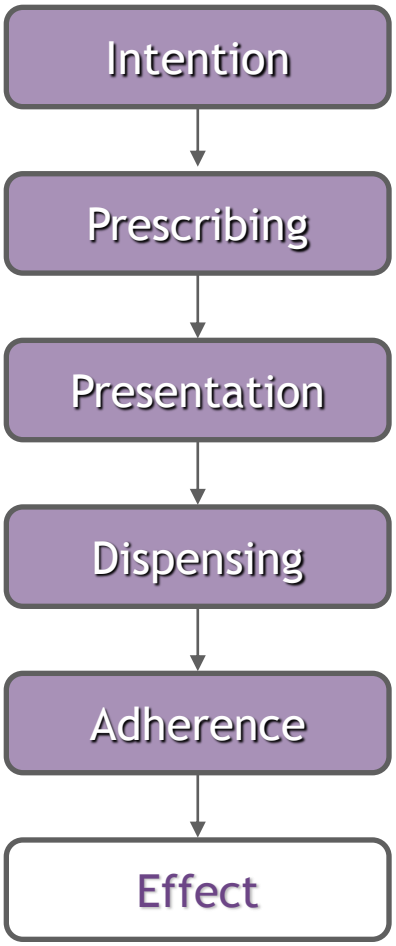


Error Rate **30-50%** patients

(*Cochrane 2008, Nice 2009*)

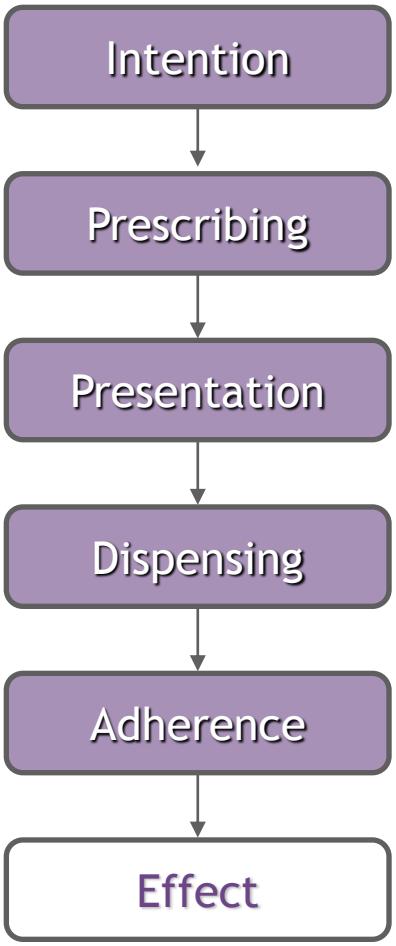

Intention
Prescribing
Presentation
Dispensing
Adherence
Effect

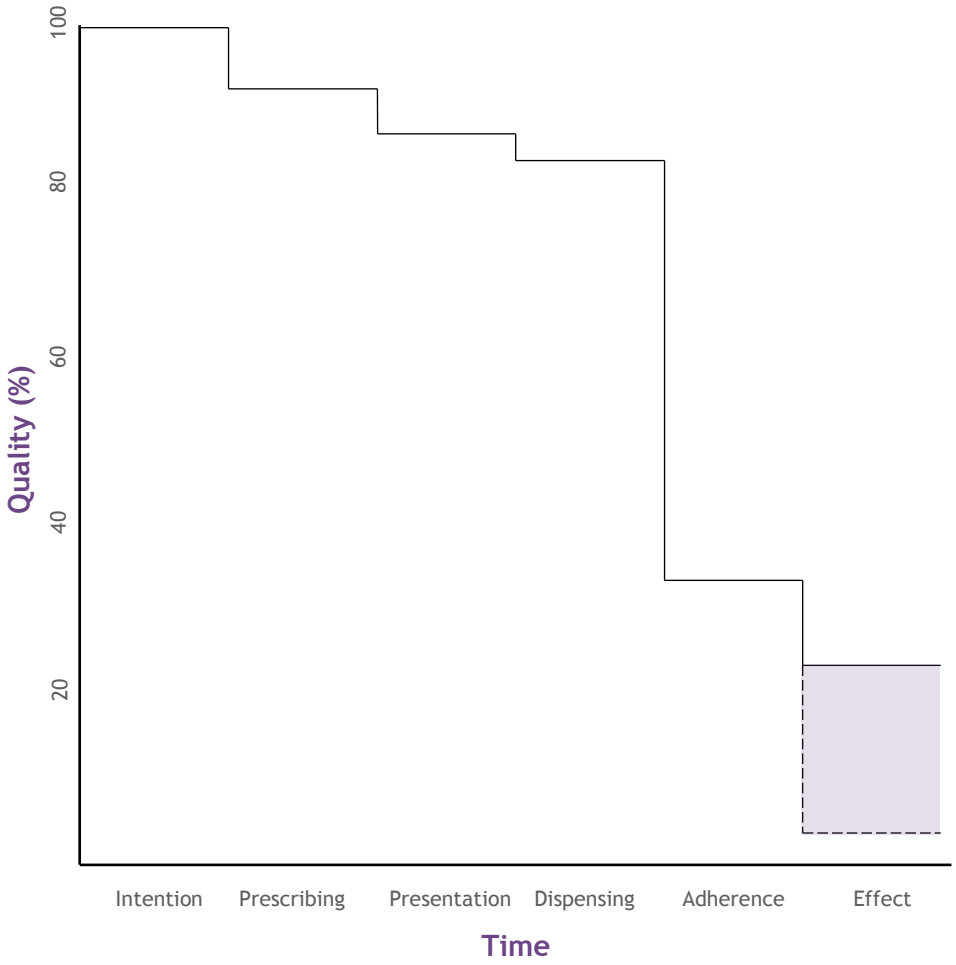

Quality (%)
100
80
60
40
20
Intention
Prescribing
Presentation
Dispensing
Adherence
Effect
Time



Medication ineffective = **50%-90%**
(NNT medication 2-10)
Drug related admissions = **6.5%-7.5%** admissions
(*Pirohamed 2004, Howard 2003, Green 2000*)

- 69% of these are preventable

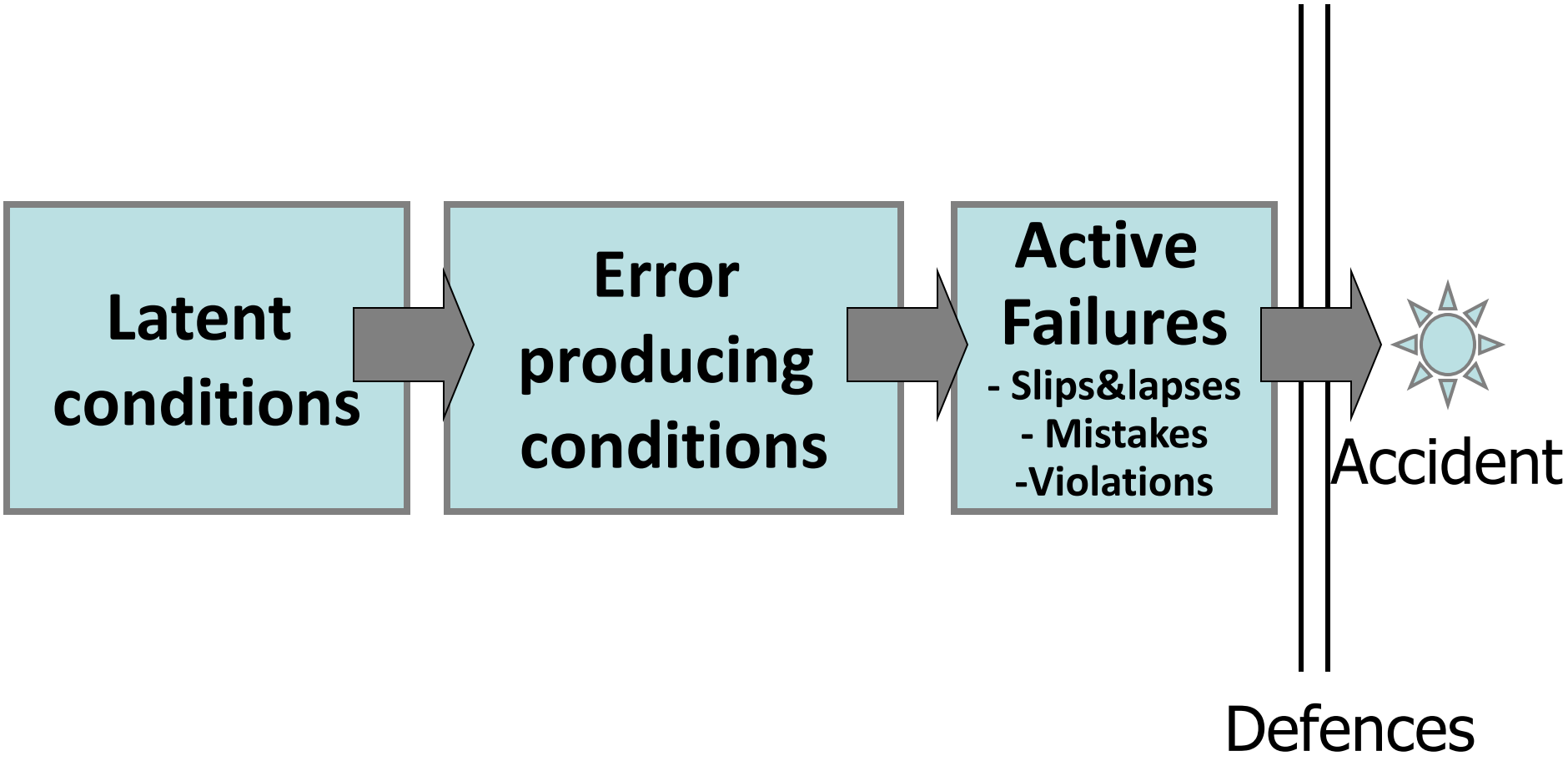




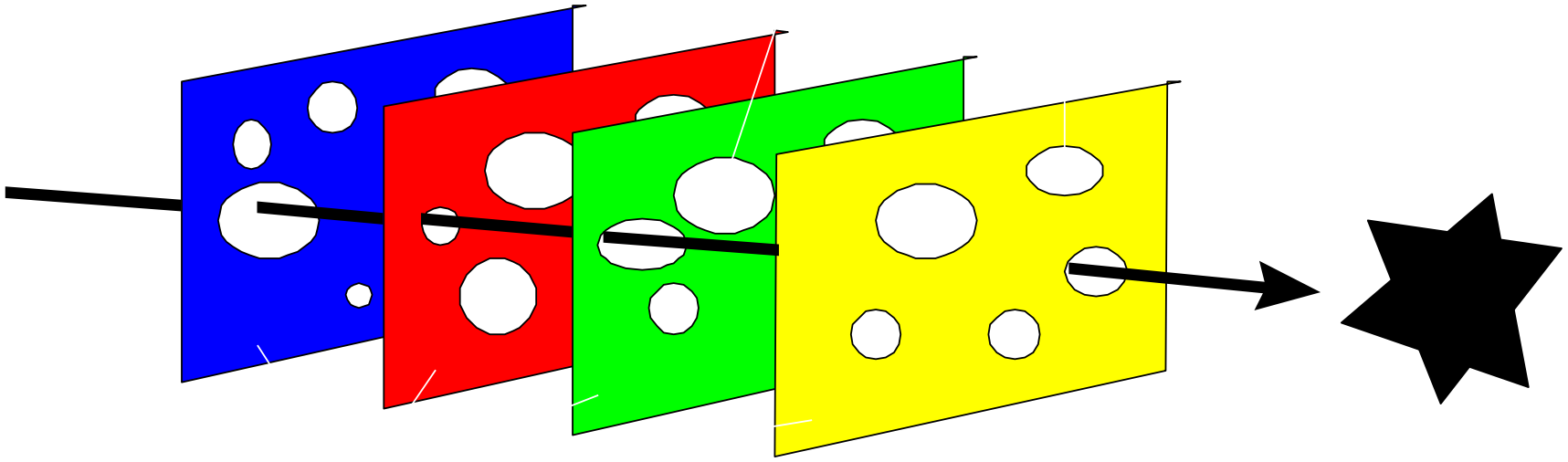
With thanks to Nick Barber

Why do errors occur?

Reason's Accident Causation Model



The Swiss Cheese model

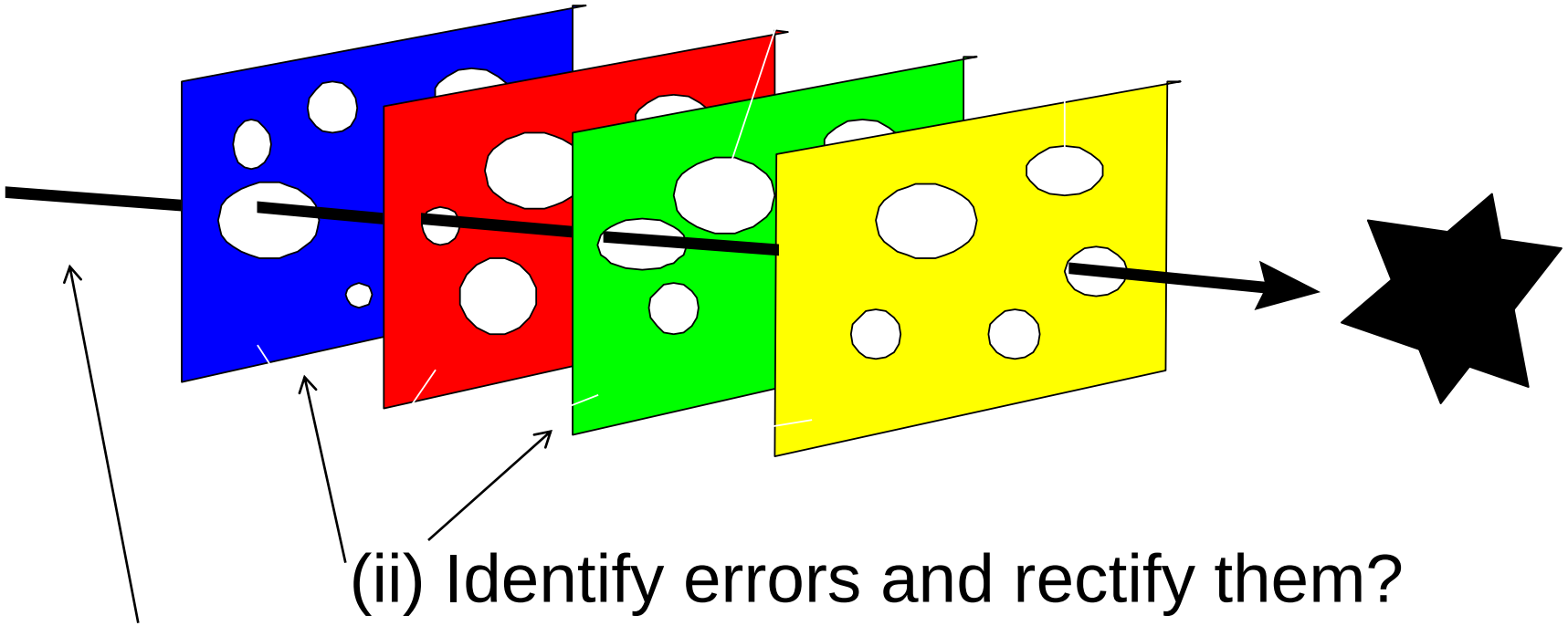


Defences

Prescribing in hospitals

- In the UK, most prescribing is done by the most junior doctors
- Specialist prescribers often have to prescribe drugs outside of their specialty
- Results in a prescribing error in 1-15% prescriptions

How to prevent these?

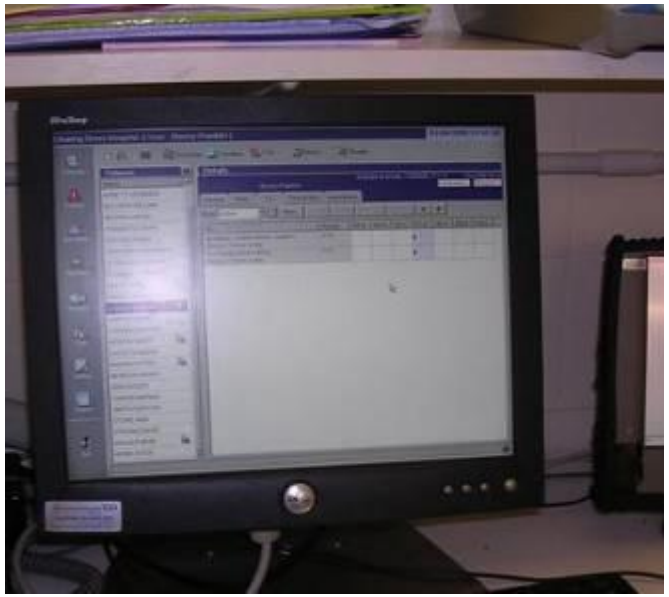


(ii) Identify errors and rectify them?

(i) Prevent prescribers from making errors?

(i) Reducing prescribing errors

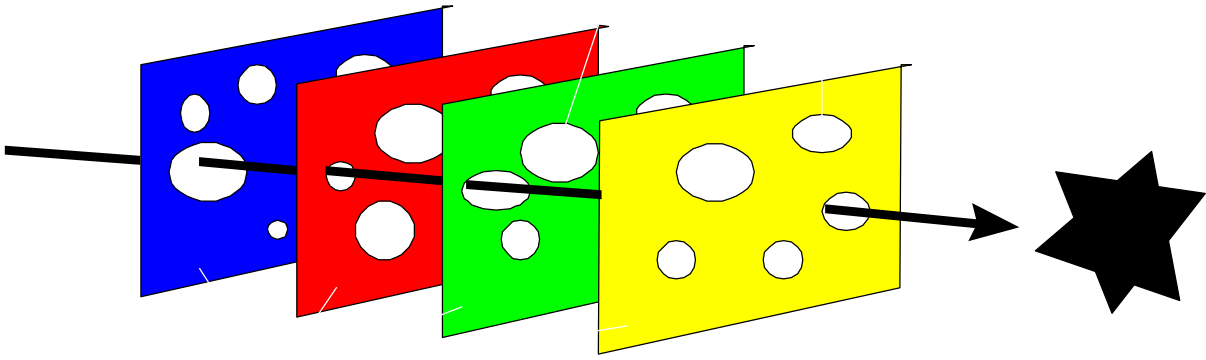
- Educational interventions?
  - Some evidence for benefits, but not dramatic
- Feedback on errors?
  - Some evidence for benefits
- Electronic prescribing?



(ii) Identifying and rectifying errors

Identifying and rectifying errors

- Appropriate use of checks and alerts (where using electronic systems)
- Clinical pharmacy services
- Nursing staff
- The patient?



Technology

Is technology the answer?

Patient's Name: PAUL DOLAN

Hospital Number:

Regular Prescriptions

Time	Date 23	24	25	26	27
4	DK	DK	DK		
8	DK	DK	AE		
12	AE	DK	DK		
18	AE	DK	DK		

Additional Instructions

Medicine (approved name) PARACETEMOL

Dose 1gm | Route PO | Frequency qds

Signature | Start 23/3 | Stop

Pharmacy

Additional Instructions

Patient Medicine on admission | New

0	X	X	DK		
6			(		
12	X	AE	AE		
18					
5	X	DK	DK		

Additional Instructions

Medicine (approved name) METRONIDAZOLE

Dose 500mg | Route PO | Frequency tds

Signature | Start 23/3 | Stop

Pharmacy

Additional Instructions

ssion | New

6	DK	AE	AE		

Medicine (approved name) E45 CREAM

Route | Frequency od

Why are you still studying medication errors? There won't be any soon, once we have electronic prescribing…

The technologies available

- Electronic prescribing (+/- electronic medication administration records in hospital and care home)
  - with various levels of decision support
- Automated dispensing
  - Pharmacy based (“robots”)
  - Ward based (“vending machines”)
  - Aseptic compounding robots
  - Automated CD storage
- Barcode verification of medication and/or patients
- “Smart” IV pumps

Electronic prescribing

- EP is commonplace in UK primary care
  - Vast majority of prescribing is electronic
- Most prescribing for hospital inpatients is paper-based, although electronic prescribing becoming more widespread
  - Small number hospitals used electronic prescribing for more than 10 years

Hospital electronic prescribing (EP)

- 101 (61%) of 165 hospital trusts responded in survey of English hospitals
  - 70 (70%) had at least one EP system in place
  - 56% of sites with EP had more than one system in place. Four sites had more than 4 systems.
  - 63 **different** systems
- Electronic discharge prescriptions now common - but often mainly a word processor, no decision support
- Inpatient EP will become more common once electronic health records become established

Ahmed, Franklin and Barber, 2012

Automation of dispensing in hospitals

- Automated dispensing systems
  - Pharmacy based (“robots”)
  - Aseptic compounding robots
  - Ward based (“vending machines”)
    - 6 of 91 respondents
  - Automated CD storage
    - 2 of 91 respondents

McLeod, Barber and Franklin, 2012

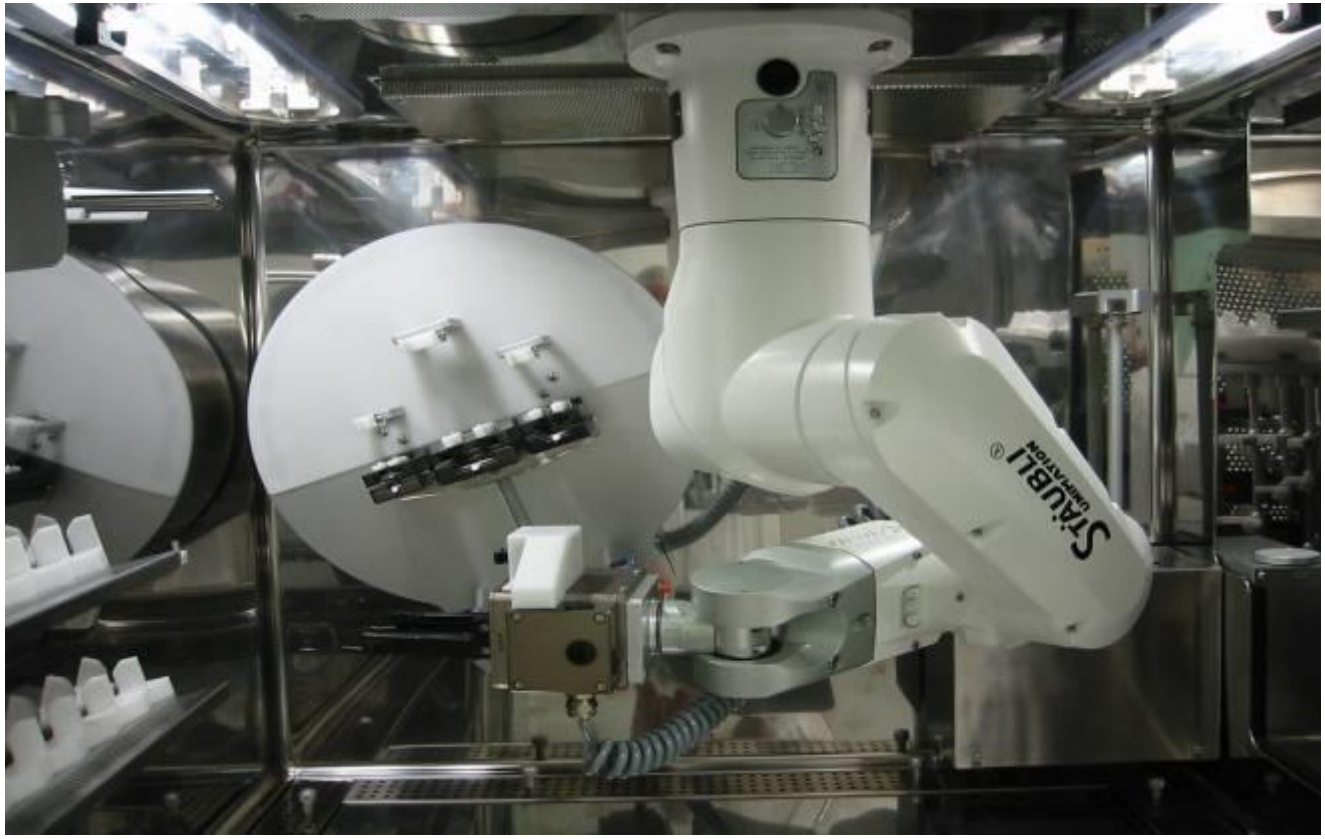
Dispensing robot

Recognises products on loading, using barcode and dimensions of pack

Ward-based automated storage

Verifies product on loading, using barcode

Aseptic compounding robot



Verifies bags using barcode
Verifies vials using photo recognition

Automated CD storage

Smart pumps

- Drug “libraries” to permit checking of doses and infusion rates
- Require standardisation of infusion concentrations etc
- Potentially safer infusion of intravenous medication.
- However, bypassing of the safety software is common

What is technology good at?

- Repetitive tasks, same every time
- Follows the rules
- Forcing functions
  - Can’t proceed until you’ve completed all the fields
- More legible than handwriting
- Reminders
- Supporting formularies, protocols, standardisation of treatment
- Audit trail

But…

- Can be inflexible
- New error types
  - Selection errors from menus
  - Menus often present very long lists of options which prescribers not familiar with
  - Assumptions - “the computer must be right”
- New work processes may be required, which can themselves increase or decrease errors
  - Checking of patient identity can be enforced
  - Development of workarounds

Selection errors

- Selection of penicillamine, instead of penicillin
- Menu arranged alphabetically in hospital system
  - Paracetamol soluble tablets
  - Paracetamol suspension
  - Paracetamol tablets
- Many patients prescribed paracetamol soluble tablets
  - At risk of hypernatraemia

Selection errors

- Selection of penicillamine, instead of penicillin
- Menu arranged alphabetically in hospital system
  - Paracetamol suspension
  - Paracetamol tablets
  - Paracetamol tablets soluble

Assumptions

- Human-computer interaction causes most deaths of all IT induced fatalities
  - Eg a UK hospital: ~1000 cancer patients under-dosed with radiotherapy over 9 years. Decision support software incorporated in machine, staff did not know and applied a second, manual dose reduction calculation
    - McKenzie ‘Knowing machines’ 1996
  - Common assumption that EP systems include allergy checking, when it sometimes doesn’t...

Workarounds

Workarounds

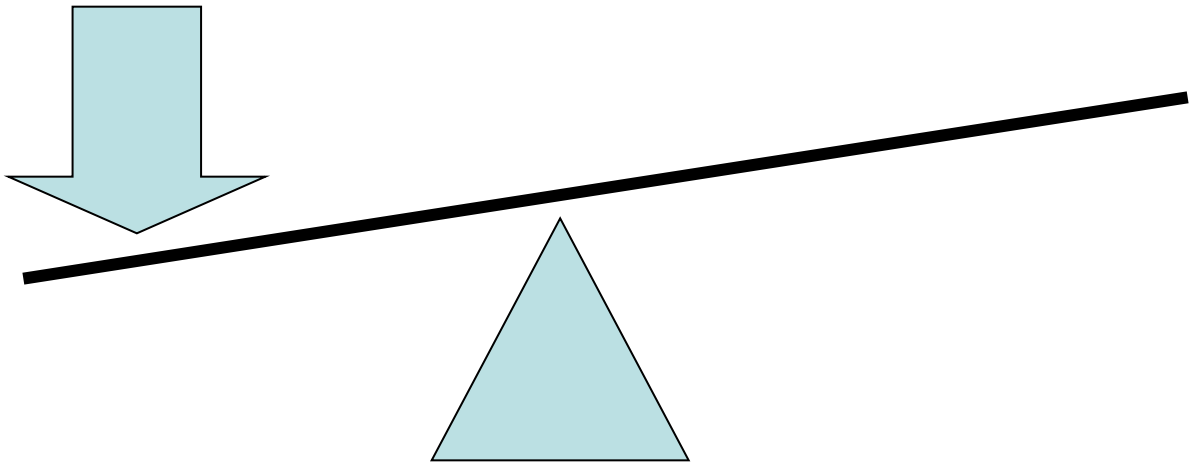
- Increased patient identification from 17% of doses with manual system, to 81% with barcode system
- Why only 81%?
- Staff sometimes found the wristband hard to scan, and so stuck the barcode to the patient's table…

Franklin et al, 2008

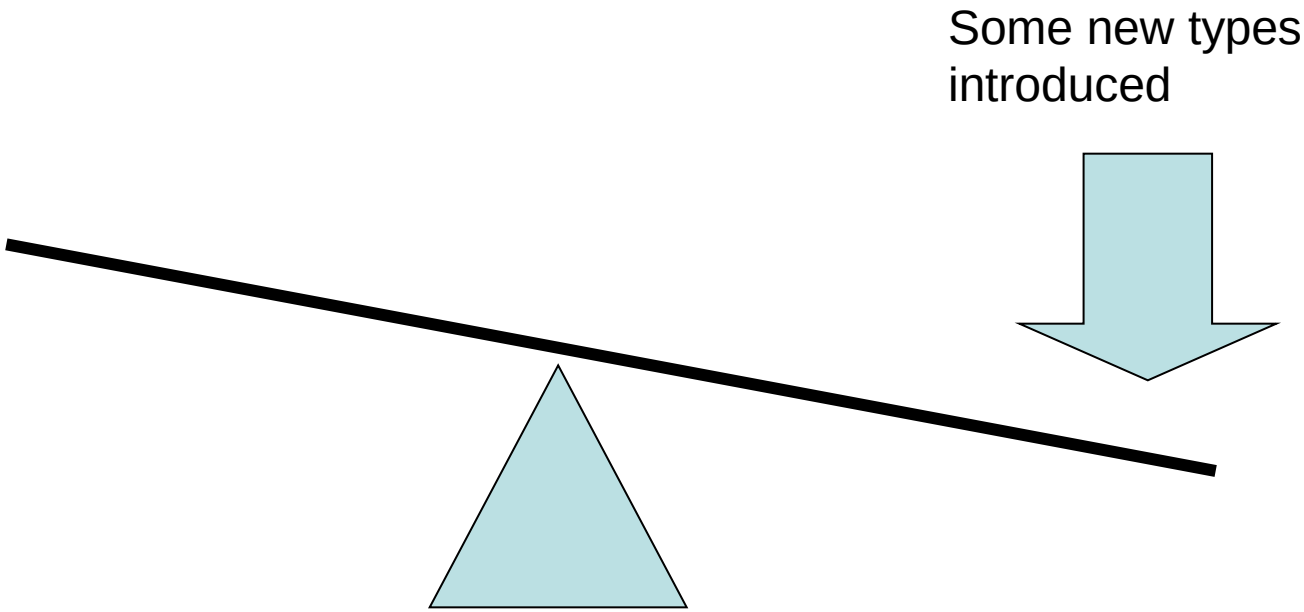
Violations

The result?

Some types of error reduced



The result?



Local evaluation therefore essential

What to measure?

Some measures that are easy to do:

- Omitted doses for hospital inpatients
  - Find the number and the causes...
- Prescribing errors
  - Pharmacists recording errors identified...
- Adherence to prescribing protocols eg prophylaxis of thromboembolism
- Do not assume that benefits in other health systems / other countries will extrapolate to your own context

When do we measure the effectiveness of the system?




With thanks to Nick Barber

UK evaluations

- Electronic prescribing
  - Most (but not all) evaluations show a modest reduction in prescribing error
- Closed loop ward based automated dispensing system with barcode verification
  - More dramatic reduction in administration errors
- Dispensing robots
  - Reduction in “wrong content errors”

How to maximise the benefits?

Professionals need to engage early with change

Good relationship with suppliers

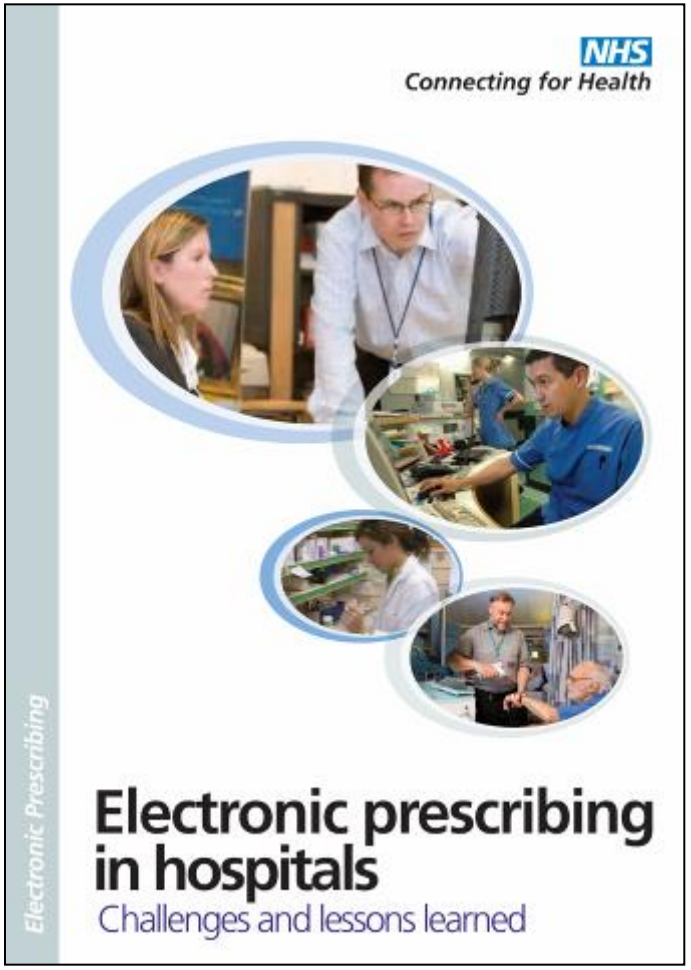
Software adaptable locally

Individuals need to see the benefits for themselves

Local evaluation essential

Conclusions

- Not easy – otherwise would have been solved by now
  - Not just “plug and play”
  - Unintended consequences
  - Do not assume that solutions from elsewhere will translate into local practice. Evaluation essential
- A useful tool, when used with care



IT – approach with care

With thanks to Eric Poon