



# Clinical decision support systems: when do we need them ?

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# Outline

- What is a decision support system?
  - What is knowledge, & how to manage it ?
  - Clinical practice innovation and barriers to change
  - Decision support systems – when do they work ?
  - Can barriers analysis identify successful DSS applications ?
  - Conclusions
- 



# What is a decision support system ?

An active knowledge tool which:

- Makes inferences from patient data (interpret tests, suggest diagnoses, make predictions...)
- Gives advice, suggest actions





# Clinical knowledge and knowledge management





# What is knowledge ?

*“The property of intelligent agents that helps them reach their goals efficiently “*

*Allen Newell, 1981*





# What is the problem with clinical knowledge?

**Size:** internal medicine comprises 2m facts (Gorry '76)

**Growth rate:** biomedical literature doubles every 19

biomedical literature doubles every 19 years  
ry 19 years (Wyatt '91); 10000 RCTs pa.

**aged creation:** from research question to published  
lished article - 6 years

**n:** expert reviews / book chapters lag years behind  
linical research results (13 years for streptokinase  
aves lives - Antman '92)

till adopted in practice a further 15+ years (Balas





# Knowledge management

*The activity of enhancing the status,  
identification and use of knowledge to improve  
individual, team and organisational  
performance*





# KM in health vs. business

## Health:

**Motive:** quality

**Hard decisions:** taken by professionals

**Explicit K:** huge amounts, changing, hard to access

**Tacit knowledge:** rely on prof. training, CPD

**Encounter (patient) records:** good ?

**KM deficit:** dissemination, use of explicit K by professionals

## Business:

**Motive:** profit (+ Q ?)

**Hard decisions:** taken by executives

**Explicit K:** much less, more static, easier to access

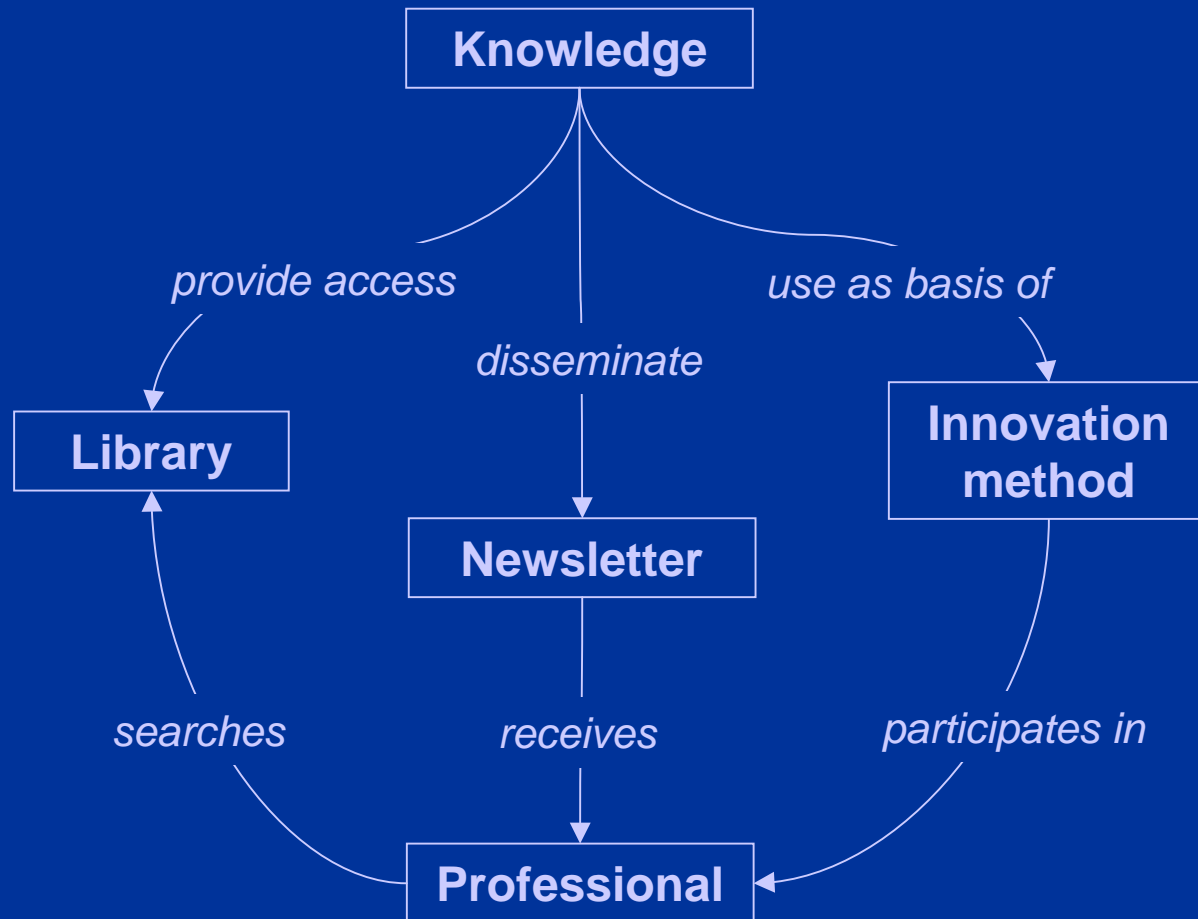
**Tacit knowledge:** rely on in-service training, networks

**Encounter (sales) records:** poor

**KM deficit:** customer rel. management, tacit K exch.




# What can we do with knowledge ?





# Evidence about innovation methods

- Some methods are more effective (outreach visits, computer reminders) than others (clinical audit, educational sessions)
  - One method alone: 60% chance of success, 3+ methods, 80% chance of success
  - Some clinical practices are easier to change (prescribing, test ordering) than others (diagnosis, surgical procedures)
  - You are twice as likely to succeed if you mount a local study to investigate barriers
- 



# Cochrane EPOC review group

**Founded 1994** as “Cochrane Collaboration on Behaviour Change” (!)

**Now** “Effective Practice & Organisation of Care” group

**Base** in Aberdeen: [www.hsru.abdn.ac.uk/epoc](http://www.hsru.abdn.ac.uk/epoc)

**Output:** 24 completed reviews, further 17 in progress





# Identifying and addressing barriers to change





## Example of barriers to change

**Problem:** GPs prescribing too many antibiotics to patients with non-bacterial chest infection

**Assumption:** GPs do not know about costs, side effects, bacterial resistance...

**Action taken:** educational sessions for GPs - *no effect*

**Real barriers** (found using GP focus group): patients demand antibiotics, expect immediate cure

**Innovation method used:** leaflet for patients

**Results:** antibiotic prescribing and re-attendance rates reduced; more satisfied patients

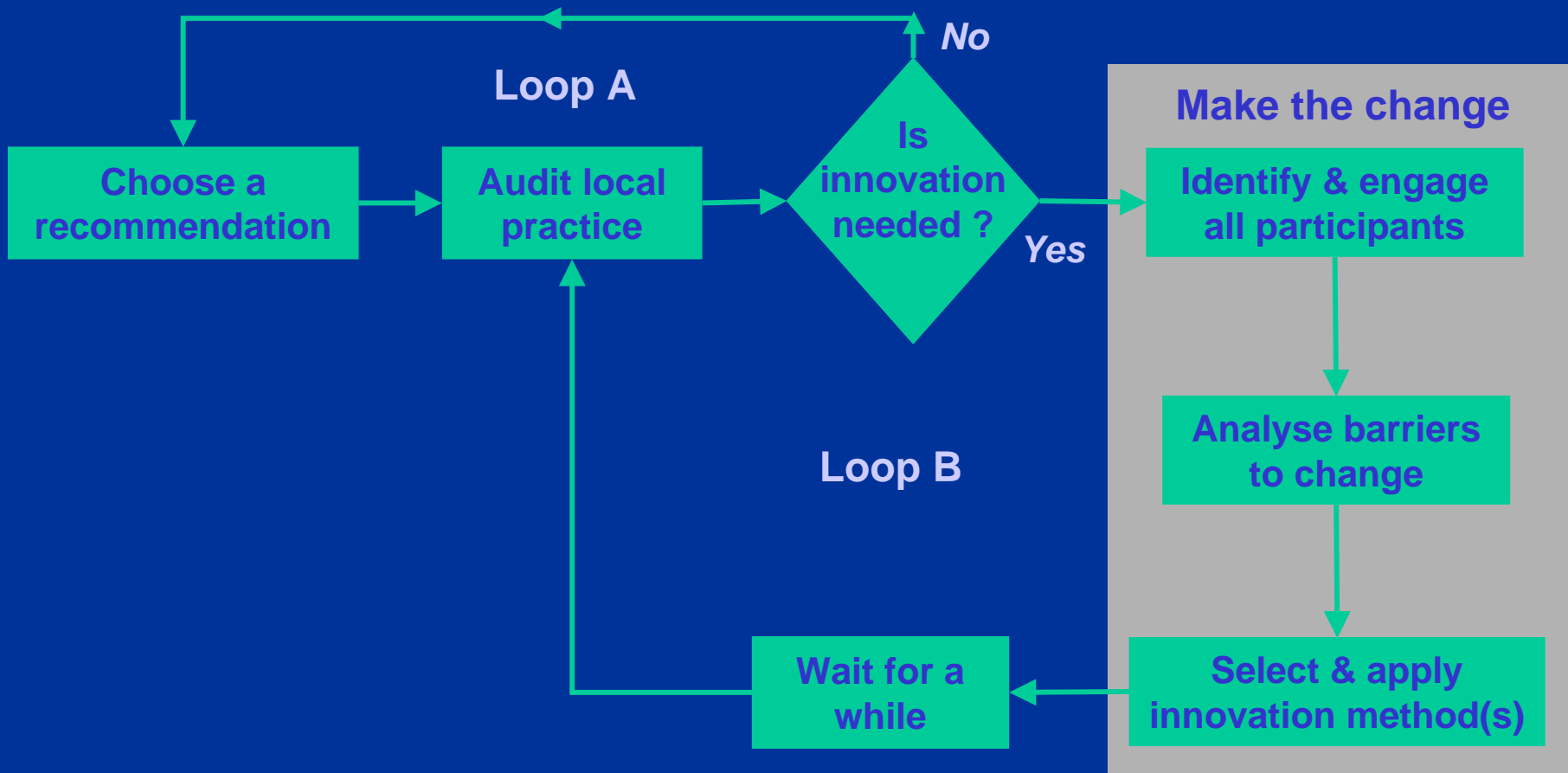
*Macfarlane J. BMJ 2002*



# Barriers to change in clinical practice



# KMC innovation model

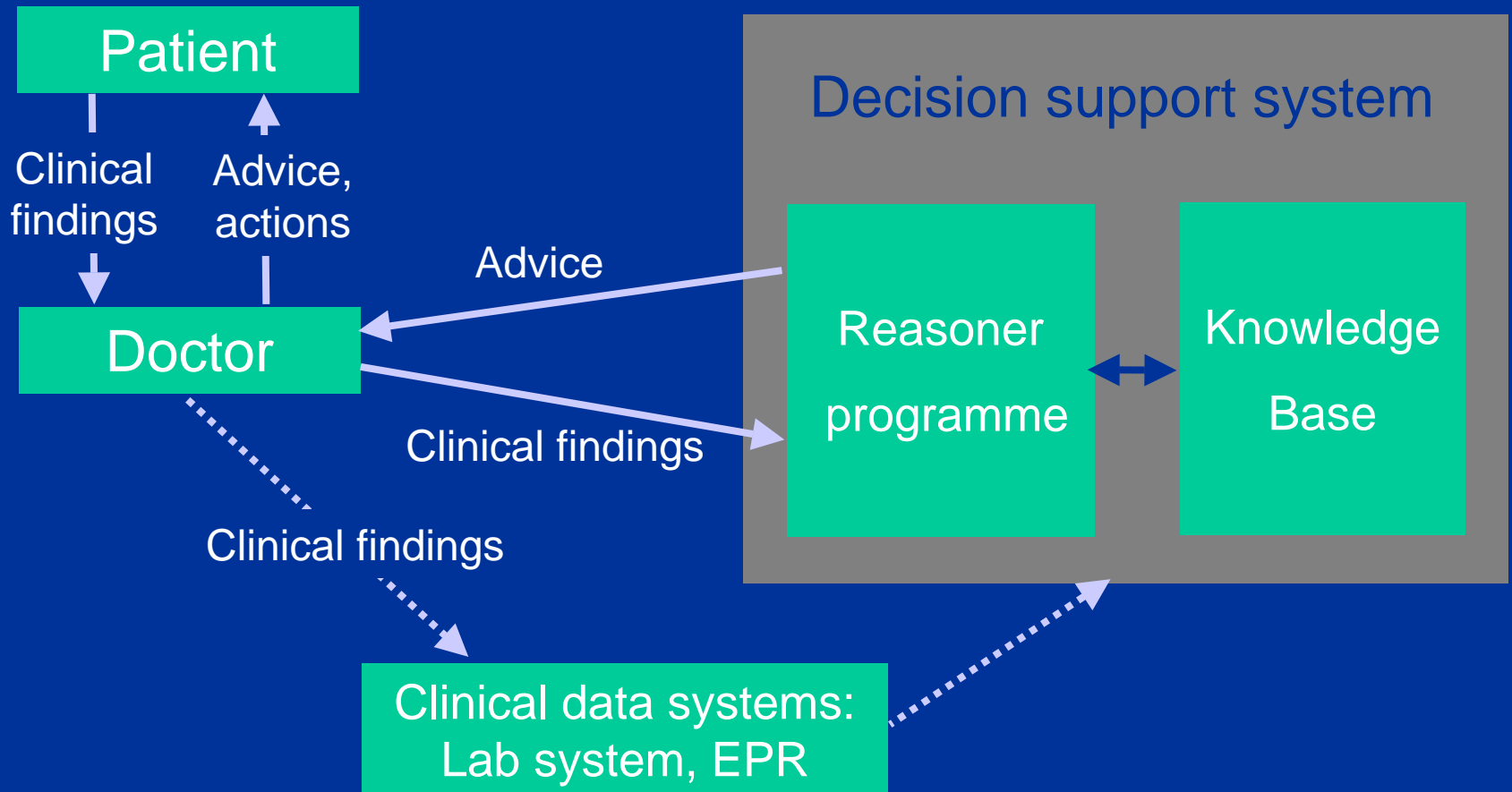




# Decision support systems



# Anatomy of a decision support system





# Regenstrief Medical Record system

- Alerts or recommendations described in literature, eg:
  - If* treatment includes cardiac glycoside
  - and* last premature ventricular systoles/minute > 2
  - then* “Consider cardiac glycoside as cause of arrhythmia”
- Integrated into systems storing patient’s laboratory, medication and vital signs data
- When data matched events, recommendation printed out for doctor
- Impact: doubled frequency with which doctors responded to target events from 22% to 51%

McDonald CJ. Protocol-based computer reminders, the quality of care and the non-perfectability of man. NEJMed 1976; 295: 1351-5






# Evaluating a DSS

**Need for decision support:** was there a problem amenable to decision support ?

**DSS structure:** is the knowledge base sound ?  
Did developers use “safety-critical” methods?

**DSS function:** is DSS fast & accurate, compared to expert / gold standard ?


**DSS impact:** does DSS improve clinical decisions and actions enough to warrant widespread use?





# Are DSS effective ?

Systematic review of 68 RCTs (Hunt JAMA '98):

- DSS improved clinical actions in 43 (66%) of 65 RCTs
  - DSS improved patient outcomes in 6 (43%) of 14 RCTs in which outcomes were studied
  - Chance of improvement varied with action targeted:
    - Diagnosis: (20%) 1 of 5 studies
    - Drug dosing: (60%) 9 of 15 studies
    - Active clinical care: (73%) 19 of 26 studies
    - Preventive care: (74%) 14 of 19 studies
  - Simple reminder systems for active / preventive care seem much more likely to improve actions
- 




# When do diagnostic DSS help ?

“Three amigos” study (Freidman et al '99):

- Written scenarios based on difficult patients
- Pre-post study of impact of QMR and ILIAD on differential diagnosis in 216 US doctors


Results:

- Correct diagnosis on 40% of Drs' diagnosis list pre-DSS, 45% post DSS (11% increase in diagnostic accuracy)
  - In 12% of cases, DSS caused doctor to add correct diagnosis
  - In 6%, DSS caused Dr to drop it, ie. net overall gain of 6%
  - Net gain largest for students (9%), smallest for faculty (3%)
  - Net gain for QMR 8%, for ILIAD 4%
- 




# When to build and use DSS ?






# Requirements for a DSS to change clinical practice

1. Relevant, complete, coded patient data
  2. Clinician uses connected information system
  3. DSS is up to date, from acceptable source
  4. Advice is available at the right time
  5. Clinician perceives advice from computer as relevant and useful
  6. Clinician can respond to advice
- 



# 1. Relevant, complete, coded data

- Capturing coded data takes time and discipline
  - Few standard data definitions
  - Interpreting generic concepts (“smoker”) in terms of local data is hard
  - Doctors often seem unwilling to trust data entered by others (patients, nurses...)
- 



# Errors and communication

- 328 errors reported by 42 members of US family practice research network during RCT of paper vs. computer reporting
- Qualitative analysis of first error in each report
- **38% (124) were information access / communication errors**
  - **21% (68) getting access to information in the record**
  - **7% (24) getting test results**
  - 6% (18) communication errors
  - 4% (14) taking / distributing messages
- 23% (75) were decision / knowledge errors :
  - 18% (58) ordering the wrong treatment
  - 4% (13) wrong or missed diagnosis
  - 1% (4) ordering the wrong tests
- 39% were other kinds of error

Dovey SM et al. A preliminary taxonomy of medical errors in family practice. Qual Saf Health Care 2002; 11: 233-8





## 2. Clinicians uses information system


- Availability:
  - OK in office based practice, GP
  - Outpatient clinics – space a problem
  - Wards ?
  - On the move in hospital ?
  - Home visits ?
- Rejection of physician order entry systems in Calgary, other centres





### 3. DSS: up to date, respected source

#### Guideline based DSS:

- How long does it take to enter, validate guideline ?
  - How often do guidelines change ?
  - Localising guidelines – how to achieve ?
  - Will professional bodies publish their GLs as a KB as well as text ?
- 



## 4. Advice available at right time

- When is the right time:
  - Before patient contact ?
  - During history, examination, discussion ?
  - After patient leaves ?

*“The alert came too soon to be useful – before you had defined the problem” - Rousseau, BMJ 2003*





## 5. Advice perceived as useful

- Depends on current problem / decision
- How much can you infer about clinical motives from scanty patient data ? (van der Lei '92)

*“it does get annoying when asthma advice comes up and you think well I’m seeing them for their big toe... I simply find these obstructive to the consultation process” – Rousseau, 2003*





## 6. Clinician can respond to advice

- Usually OK for test ordering, prescribing – if within local guidelines
- How to respond to suggested diagnosis ?
- May fail, eg. if:
  - Clinician suspects advice does not apply to this patient
  - Action requires discussion, referral
  - Patient disagrees, requests more time / information
  - Medico-legal concerns






# Identifying barriers to change





# What can DSS do for doctors ?

- Help them collect more complete data
  - Interpret or present patient data in a more coherent way
  - Calculate drug doses, disease etc. probabilities
  - Remind them to carry out actions
  - Monitor safety of patient, actions
  - Detect a mismatch between a guideline and clinical practice
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# Which barriers can DSS help overcome?






# Conclusions





# Summary of challenges

- Access to current, complete, coded patient data
  - Need to match what DSS offer with clinical barriers
  - Need to make DSS as evidence-based as possible
  - Problems keeping DSS up to date
  - Doubts over legal status of DSS advice
  - Stronger evidence that simple reminders improve practice & outcomes than complex DSS
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# So, how to implement guideline based DSS ?


1. Get local agreement for innovation, identify up-to-date EB guideline
2. Identify, tailor guideline recommendations to local circumstances
3. Examine individual / organisational barriers to change
4. Assess viability of DSS reminders as method for overcoming main barriers
5. Identify significant entities behind recommendations: pt. data, normal ranges, actions (drug, test...); ensure local information systems (EPR, LIS, prescribing systems) name them (eg. pts with “recent antibiotic use”)
6. Model guideline recommendations in DSS knowledge base, mapping significant entities to local codes for data & actions
7. Test & debug DSS with past data, check advice is appropriate
8. Train staff to respond to reminders etc. then release new KB
9. Monitor impact on clinical decisions, actions, pt outcomes, revise as needed





# Error factors

<b>Factor</b>	<b>Risk ratio</b>
<b>Unfamiliar with task</b>	<b>17</b>
<i>Short of time</i>	<i>11</i>
<b>Poor signal to noise ratio</b>	<b>10</b>
<b>Poor human – system interface</b>	<b>8</b>
<i>Designer-user mismatch</i>	<i>8</i>
<i>Errors cannot be corrected</i>	<i>8</i>
<b>Information overload</b>	<b>6</b>
<i>Negative transfer between tasks</i>	<i>5</i>
<b>Risk poorly perceived</b>	<b>4</b>
<b>System gives poor feedback</b>	<b>4</b>
<i>Disturbed sleep patterns</i>	<i>1.6</i>
<i>Boredom, monotony</i>	<i>1.1</i>





# Conclusions

1. Building DSS is interesting, but hard
2. DSS can sometimes improve clinical practice
3. If you want to improve a specific clinical practice, try this:
  - Identify all who are involved & their barriers
  - Consider which innovation methods are most likely to overcome the barriers
  - If relevant barriers, you have coded data & clinicians might use a DSS, go ahead and build one !



