The Socio-Economic Burden of Hospital Acquired Infection (HAI)

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The socio-economic burden of hospital acquired infections (HAI)

- Terminology
- Socio Economic Burden of HAI
  Plowman *et al*, 2001
- Cost effectiveness of MRSA Screening methods
  Kunori *et al*, 2002
- Cost of MRSA Containment
  Cooper *et al*, 2004

Terminology
Direct Costs

of the provision of (hospital) patient care comprising:

- fixed costs: unrelated to volume (e.g. core staff)

PLUS

- variable costs: related to volume, additional "demands" (e.g. drugs, agency staff)

Terminology
Indirect Costs

- Many terms including
  - "Intangible costs"
    - Anxiety, Stress in the family
    - Loss of work for patient and informal carers

Cost Identification

- What does it cost to produce an intervention or an alternative?
- Identifies items and activities and puts costs to them
- Approaches
  - Retrospective: cheap, limited & one often makes assumptions
  - Prospective: actual, dependent on collection intensity, expensive
  - Simulations

Cost Identification Methods

- Analytical approach : identify process steps and resources used e.g. Soc. Eco. Study
- Adjust for factors affecting estimates e.g. Deterministic, Stochastic, "Nodal" modeling
- Multi-disciplinary approaches to inform model designs and sensitivity analyses

The Socio- Economic Burden of Hospital Acquired Infection (HAI)

Plowman et al,
J Hosp Infect 2001; **47**:198-209.

Studies Estimating the Economic Impact of HAIs

- Consistently demonstrate that:
  - HAIs are a substantial economic burden to the health sector
  - the magnitude varies with site of infection
- BUT provide limited data on the distribution of in-patient costs
- AND in general limit costs incurred by the hospital alone

next

Aims and objectives of Our Study

1. Determine the overall burden of HAI in terms of:
   - Costs to secondary and primary health care sectors and community care services
   - Impact on the health status of patients
   - Costs to patients, informal carers and the economy
2. Establish the relative costs of different types of HAI

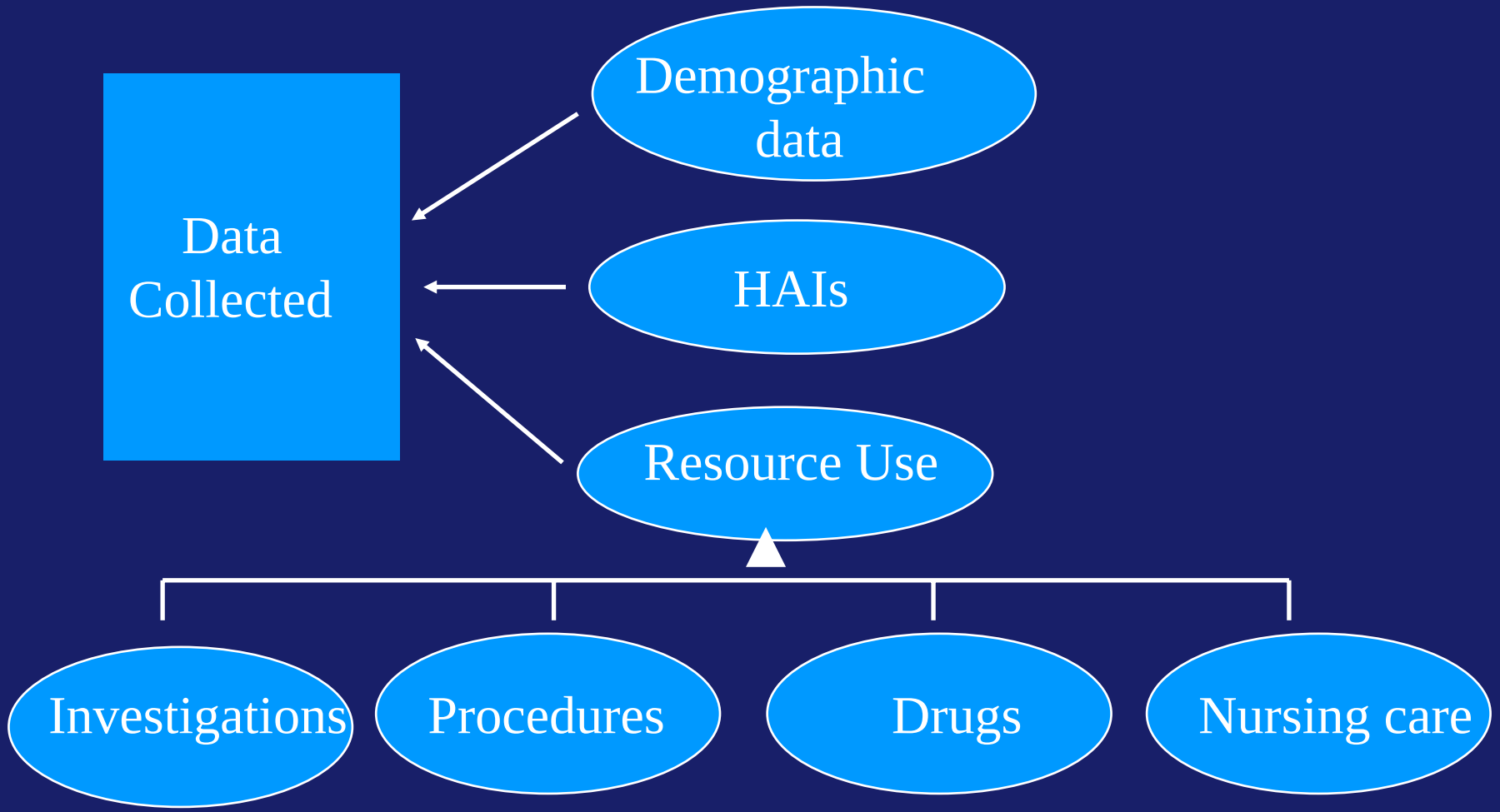
Aims and objectives of Our Study

3. Determine the type of patients who incur the highest costs for specific infections

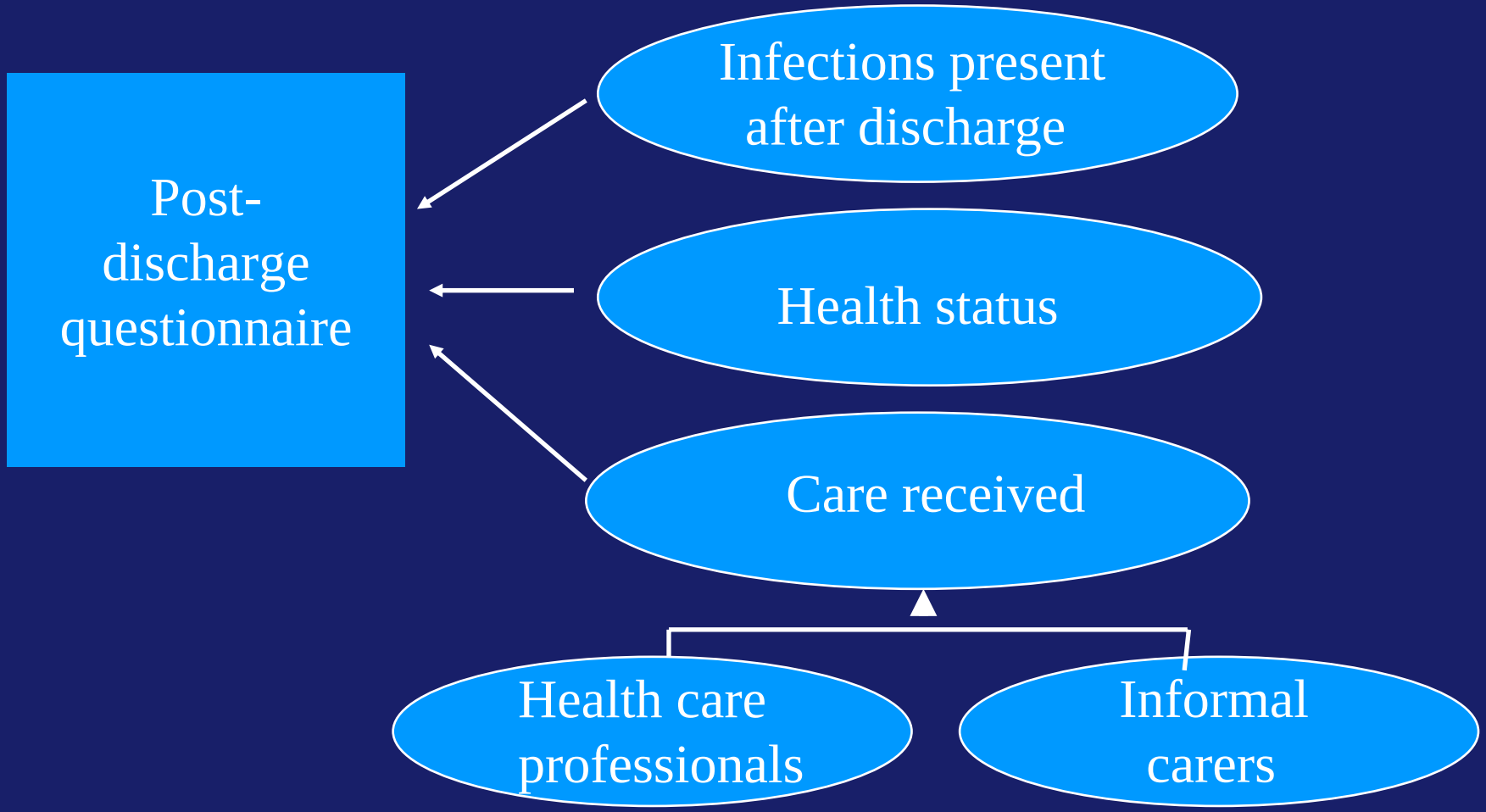
Methods

- Between April 1994 and May 1995 adult, non day case patients admitted to selected specialties of an NHS district general hospital were invited to participate in this study
- Not ICU, paediatrics or specialised units e.g. renal
- Cost profiles were developed for each patient whether or not they had an HAI

Data collection - in-patient phase



Data collection - post-discharge



Analysis

- Statistical techniques estimated how variation in costs could be explained by the presence of an HAI

- This controlled for the effects of:
  - Age, sex and diagnosis
  - number of co-morbidities
  - admission type and specialty
  - time of return of questionnaire

Results

- Complete in-patient data sets for 3980 patients
- 1449 patients were selected for follow-up after discharge of which 215 (14.8%) had an HAI identified in hospital
- 71% of patients selected for follow up returned the questionnaire

Incidence of HAI

- In-patient phase:
  - 7.8% with one or more HAIs
- Post Discharge:
  - 19% (symptoms/signs): interpretation of association and diagnosis difficult!
  - 30% of in-patients with an HAI met the study criteria for one or more infections present after discharge

Cost to hospital sector

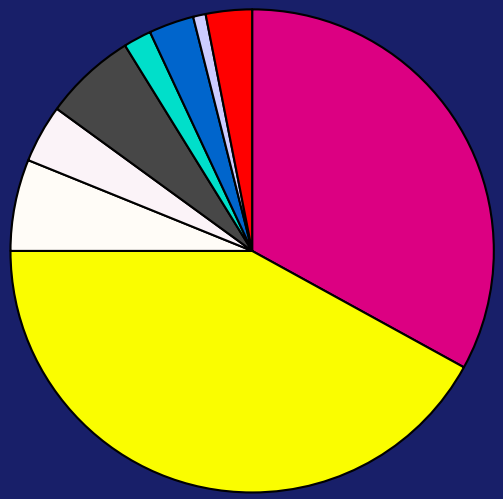
Patients with one or more HAIs presenting during the hospital stayed on average:

- 2.5 times longer (11 extra days)

and incurred:

- 2.9 times higher costs (£2917 per case)

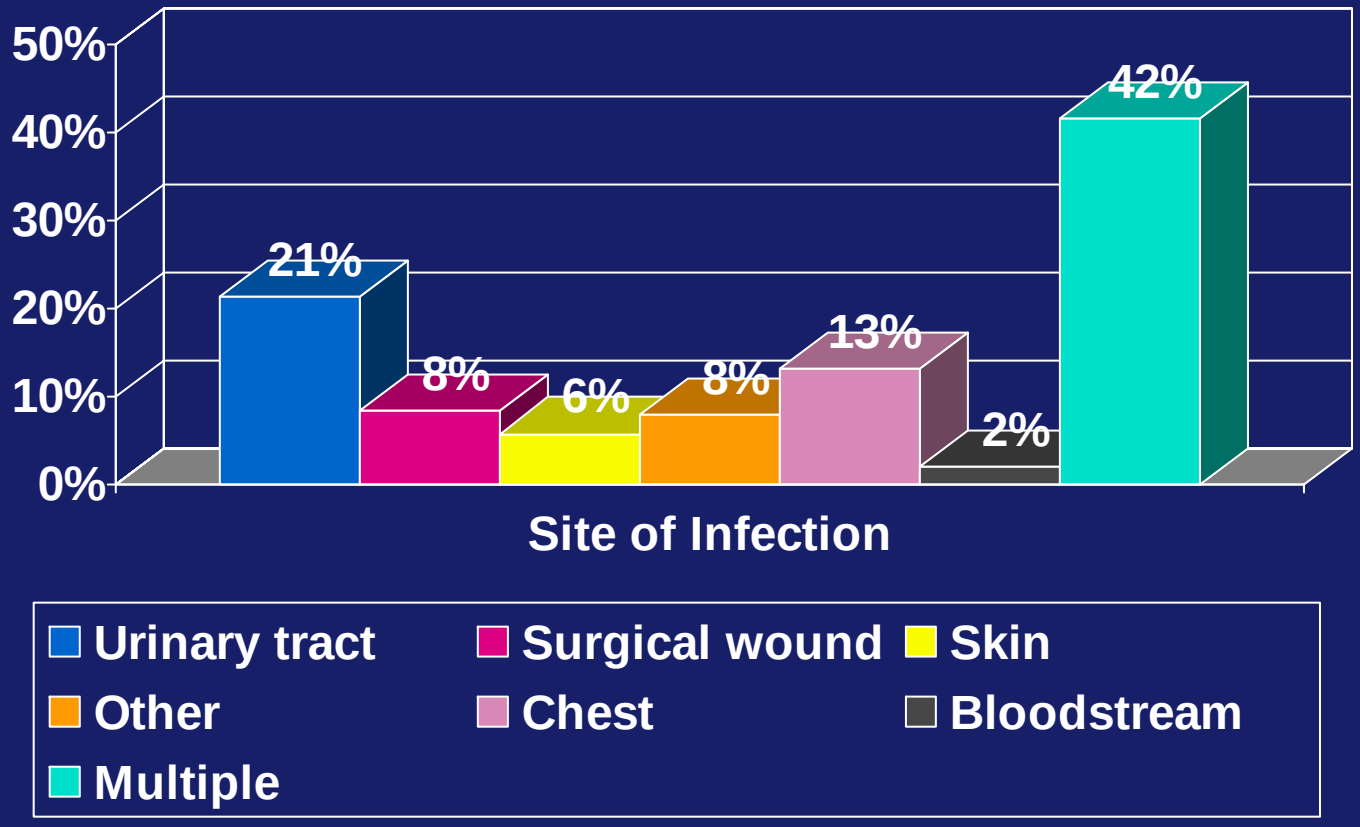
Additional in-patient costs incurred by patients with one or more HAIs



Mean costs incurred during the in-patient phase by site of HAI

Site of infection	Mean costs (£)	n	Ratio of costs (model estimate; 95% CI)		Additional costs (£) (model estimate)	
No HAI	1628	3671				
Urinary tract	2955	107	**1.8**	(1.7;1.5,1.9)	1327	(1122)
Surgical wound	3246	38	**2.0**	(2.0;1.6,2.4)	1618	(1594)
Skin	3418	25	**2.1**	(2.0;1.6,2.5)	1790	(1615)
Other	3892	30	**2.4**	(2.5;2.0,3.1)	2263	(2465)
Chest	4027	48	**2.5**	(2.3;1.9,2.7)	2398	(2080)
Bloodstream	7026	4	**4.3**	(4.8;2.6,8.8)	5397	(6209)
Multiple	10780	57	**6.6**	(6.3;5.4,7.4)	9152	(8631)
Any infection	4782	309	**2.9**	(2.8;2.6,3.0)	3154	(2917)

Percentage of Total Costs for different HAIs



Costs incurred post-discharge

- If HAI identified in hospital and/or had an infection identified post-discharge on average there was more contact with their:
  - general practitioner
  - district nurses
  - doctor/nurse at the hospital
- Increase depends on whether HAI identified in hospital and/or an infection identified post-discharge

Costs incurred by patients and informal carers

- On average patients who had an HAI identified in hospital and/or an infection identified post-discharge:
  - incurred higher personal expenses
  - received more care from informal carers

Impact on health status

- delayed recovery
- in-patient death rate was considerably higher in patients who had an infection
- took longer to resume normal daily activities and/or return to work
- infected patients had lower health status 4 weeks post-discharge than uninfected patients

English National Estimates of Adult HAI burden

- Patients admitted to the specialties covered in this study - approx. 70% of all adult non-day case admissions
- Analyses showed that the DGH was typical of all DGHs

- HAIs cost the health sector in England £986.36 million annually and utilise 3.64 million bed days

English National Estimates of Adult HAI Burden

- In-patient hospital costs £930.62 million
- General practitioners £8.40 million
- Outpatient hospital costs £26.83 million
- District nursing services £20.51 million

Implications for policy and practice

- A conservative estimate of a 15% reduction in the in-patient HAIs would release:
  - health sector resources valued at £150 million per year
  - 546,084 bed days = to ~71,853 consultant episodes per year

Hospitals that make us ill cost the NHS £1bn a year

By Helen Rumbelow

UNHYGIENIC hospitals cost the NHS £1 billion a year by making patients worse with new infections, according to a government report published yesterday.

The report is the first to show the cost of the poor prac-

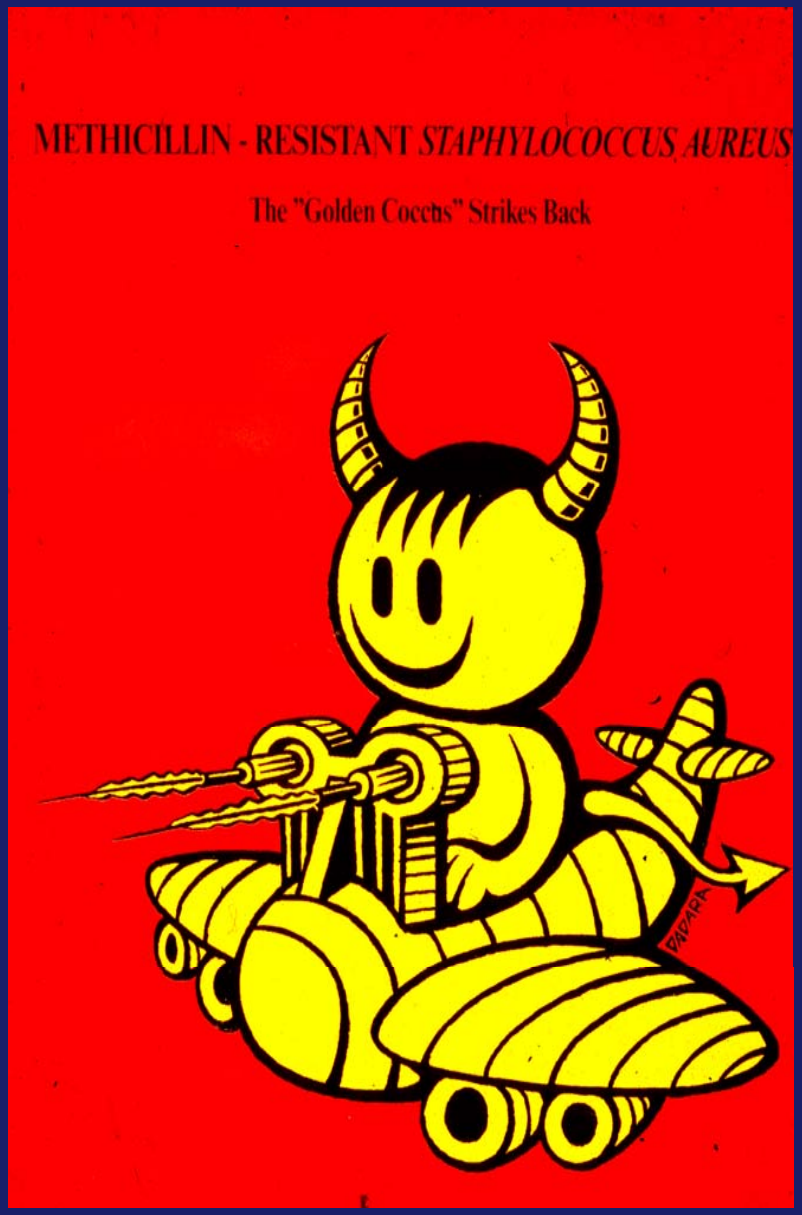
NHS, which force hospitals to move patients between wards and to perform procedures as quickly as possible, are partly to blame for the surge of "superbugs", the report said. Hospitals fail to ensure that patients are protected from risks such as doctors who do not wash their hands and the

fected up to 25 per cent of surgical patients. Such bugs were dangerous and hard to treat. "We do need to be much more up to date with our infection control," he said. "Studies show that just by reducing infections by 6 per cent you would easily cover the cost of prevention."

infections from dirty catheters or inadequate washing in hospital were the cheapest to treat, they cost the most, at more than £100 million a year, because they were so common. The report found that patients who had become infected in hospital cost the economy 8.7

The Study made the front page of the Times and was quoted by the House of Lords and Commons and by the National Audit Office

MRSA Modeling of Cost Effectiveness of Interventions



Benefits and costs of MRSA Control

- Benefit of interventions: reduction of direct, indirect and intangible costs of hospital MRSA infection
  - Knock on effects of reducing other HAIs?
- Cost of interventions: includes screening tests, isolation strategies, and disposables, extra staffing.....

- Little has been done to unravel these or to determine the cost effectiveness of alternative strategies

MODELING

ALL MODELS ARE WRONG

BUT SOME ARE USEFUL

Aims of Study

Kunori et al, J Hosp Infect 2002: 51;189-200

To determine the most cost-effective method of screening tests for MRSA using mathematical modeling based on the published data from a systematic review.

Methods

- Systematic MRSA literature review:
  - Selective staphylococcal isolation media
  - Direct *S. aureus* identification
  - Methicillin susceptibility testing
  - Sensitivity of patient sampling sites
- Effectiveness of tests
  - Sensitivity (X), Specificity (S), Time of each stage from patient sampling to a laboratory result (T)

Methods: Assumptions used in modeling

- All patients entering an intensive care unit are screened: Length of Stay 7days **(Sensitivity analysis of 2d & 10d)**
- Positive MRSA patients isolated
- Infected cases reduced from 0.27 **(Sensitivity analysis of 0.13 and 0.54)** to 0.017/primary colonised patients/day
- Secondary spread only detected clinically (30% of cases), isolated and treated immediately for an average of 17 days
- Tertiary spread not considered

Assumptions for Microbiological Methods

- Microbiological methods were classified into four groups
- Data from the systematic review or where this was not forthcoming from the Royal Free Hospital were integrated to produce Sensitivity, Specificity and Time data for the various approaches
- Cost Effectiveness Ratio data were analysed within each group and then common data from this were used for the next stage

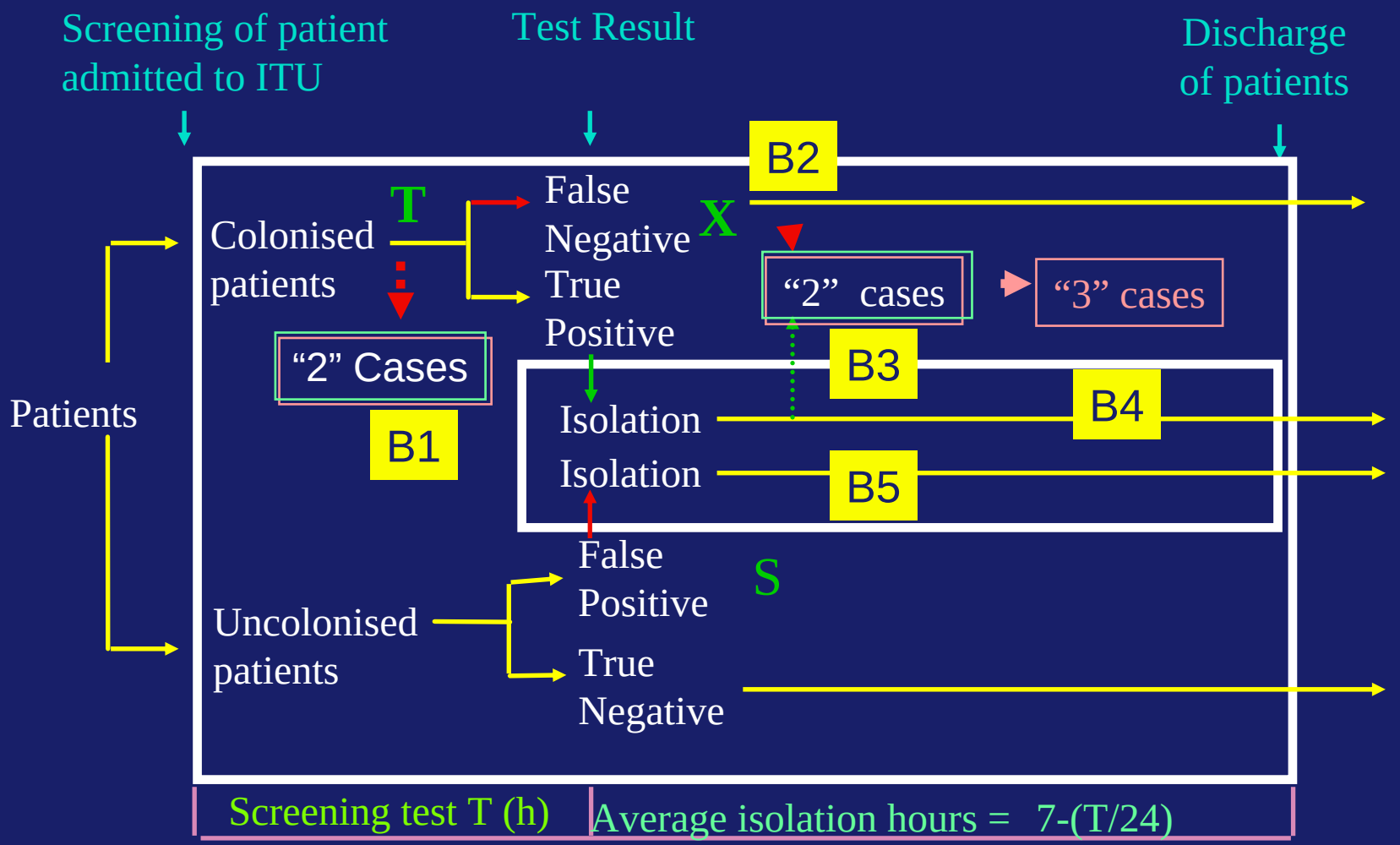
The Process of comparing the Cost Effectiveness Ratio (CER) among different screening tests

- Calculation of cost avoided (the benefit)
- Calculation of cost of intervention (the test)
- Calculation of CER
  = Benefit/Cost

Borderline Prevalence Rates

- The Prevalence of MRSA positive patients (P) in the Number of Screened patients (N) at which the benefit of screening is equal to the cost of the tests used

modeling of Primary and Secondary Cases



7 days (average hospitalisation) (2 and 10d also analysed)

Borderline Prevalence Data

- If the proportion of MRSA colonisation exceeds 2% the money saved on MRSA control measures more than covers the cost of screening programmes
- For Ciprofloxacin Baird Parker 88.2% of MRSA had to be Quinolone resistant (QR)

Advantages of the modeling

- Easy calculation and one can modify readily for local costings and other modeling scenarios (including ways of working in the laboratory)
- Cost effectiveness ratio of any combination of the screening tests can be calculated.

Some of the limitations of the modeling

- More dynamic models needed
- More sophisticated consideration of laboratory costs, including training and ease of use of molecular methods e.g. PCR
- Socio-Economic Benefit ignored

- Being used in two further real life studies now

Modeling of MRSA Containment

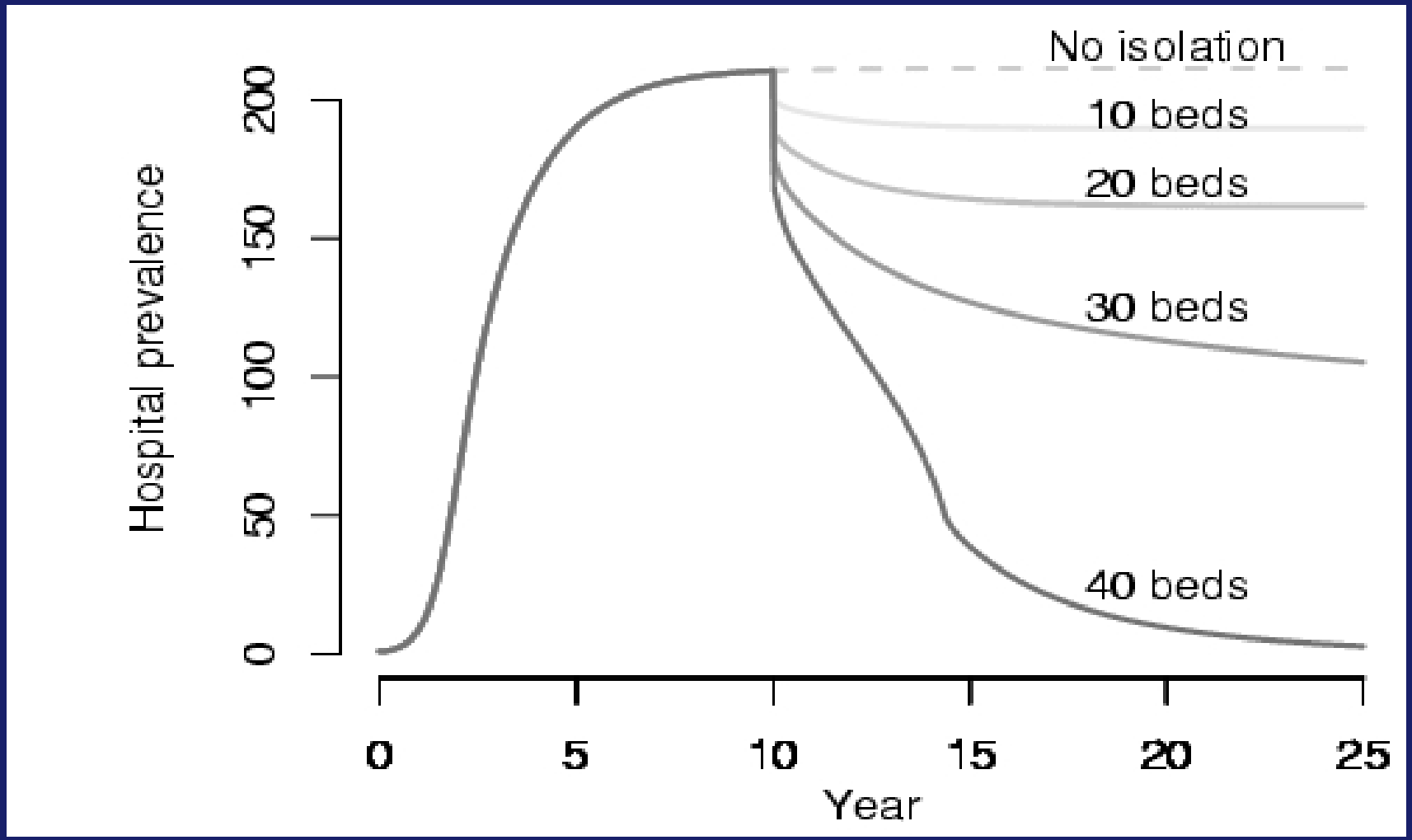
Cooper et al,
HTA Systematic
MRSA Review

Conclusions of Mathematic Modeling of introductions of MRSA to a hospital

- Increasing the detection rate reduces the endemic prevalence
- Effectiveness of intervention can depend critically on timing (the earlier the better)
- Isolation policies that do not scale with the MRSA reservoir are vulnerable to failure
- The ability of the MRSA strain to persist in the patients and to transfer between them can be key factors in the long-term dynamics

Cooper et al, *Proc Nat Acad Sciences* 2004: **6:** 10223-10228

Endemic MRSA: Isolation ward introduced after ten years.



Conclusions

- Valid over a wide range of transmissibilities and virulence levels
- Surprisingly insensitive to capital costs.
  - UNLESS extended periods with large number of unused isolation beds
  - when reduced isolation ward staffing will be more cost-effective
  - Or low infections without control measures.