

**Role of Systems Modelling and Simulation in
Promoting Research Implementation in
HealthCare
University of Cambridge**

*”Successful Applications, Current Challenges and
Future Opportunities”*

**David Bensley
Formerly Operational Research Programme
Manager, Department of Health, Leeds
19th March 2012**

Contents

- **Introduction**
- **Modelling**
- **Example Successful Applications *and their Impact***
- **Two Selected Applications**
 - **Choice**
 - **Short Term Cost Savings from Prevention**
- **Current Challenges**
- **Future Opportunities**
- **Summary**

Contents

- Introduction
- **Modelling**
- Example Successful Applications *and their Impact*
- Two Selected Applications
 - Choice
 - Short Term Cost Savings from Prevention
- Current Challenges
- Future Opportunities
- Summary

“a model is a simplified rendering of the real world used to capture the *essence* of reality *while dispensing with much of the complicated excess baggage that accompanies reality, but makes analysis difficult*”.

(Rittenhouse (1996))

- **“Simulation models can save making *expensive mistakes*”**
- **“Simulation often produced no surprises but provided quantitative evidence for making changes.”**
- **Simulation can provide a common dialogue and as a communication tool for winning hearts and minds.**

Quotes from:

“Simulation in Healthcare Management”

Operational Research Society Conference June 1994

Contents

- Introduction
- Modelling
- **Example Successful Applications *and their Impact***
- **Two Selected Applications**
 - Choice
 - Short Term Cost Savings from Prevention
- Current Challenges
- Future Opportunities
- Summary

- **Peak load capacity planning (hospitals, walk in centres, NHS Direct)**

Impact: Understanding capacity requirements.

- **Modelling the impact of military casualties returning from Iraq.**

Impact: Policy colleagues feedback.

No hospital actually failed but:-

“Ministers had confidence that the plan would work”

“Best example of modelling with an immediate application and which impacted on decisions to be made in the short time available”.

- **Modelling the feasibility of introducing total booking systems into the NHS. Evaluation of pilot sites.**

Impact: Policy funded and implemented throughout NHS based largely upon the analysis.

- **Modelling the impact on Capacity of increasing the proportion of day cases.**

Impact: Contributed to capacity requirements for the 5 year Strategy Plan.

- **Assessments of a 100% 4 hour target for A/E departments.**
Impact: 100% target clinically and operationally inappropriate – reduced to 98% and met.
- **A Generic simulation model for analysing the flow of patients through A/E.**
Impact: Model used by A/E departments to identify bottlenecks.
- **Develop a high level stroke toolkit for best practice.**
Impact: Widely distributed for use throughout the NHS.
- **Modelling the impact on Capacity of establishing a Treatment Centre.**
Impact: Understanding capacity requirements.
- **Generic Modelling for achieving the 48 hour access target for GUM clinics.**
Impact : Model well received and continued support for it.

- **System Dynamics Model of a Chlamydia Screening Strategy.**

Impact: Understanding the long term implications of introducing screening.

- **Implications of Screening for Abdominal Aortic Aneurysms.**

Impact: Screening for males aged 65 recommended in principle subject to patient information and service configuration.

- **Short term incentives for implementing Public Health Interventions.**

- Impact of brief interventions to problematic drinkers on A/E targets
- Impact of pre-operative smoking cessation on waiting times

Impact: Used to demonstrate short term effectiveness of prevention policies. Raised the credibility of public health with Treasury.

- **Whole Systems Analysis underpinning a strategic framework supporting self care.**

Impact: Evidence used to assess the benefits and implications of the policy and to provide significant funding for further expansion..

Contents

- Introduction
- Modelling
- Example Successful Applications *and their Impact*
- **Two Selected Applications**
 - **Choice**
 - **Short Term Cost Savings from Prevention**
- Current Challenges
- Future Opportunities
- Summary

Choice Objective

“To evaluate the operation of total **booked admission systems** in practice and to address the implications for the NHS as a whole if all elective admissions were to be booked”

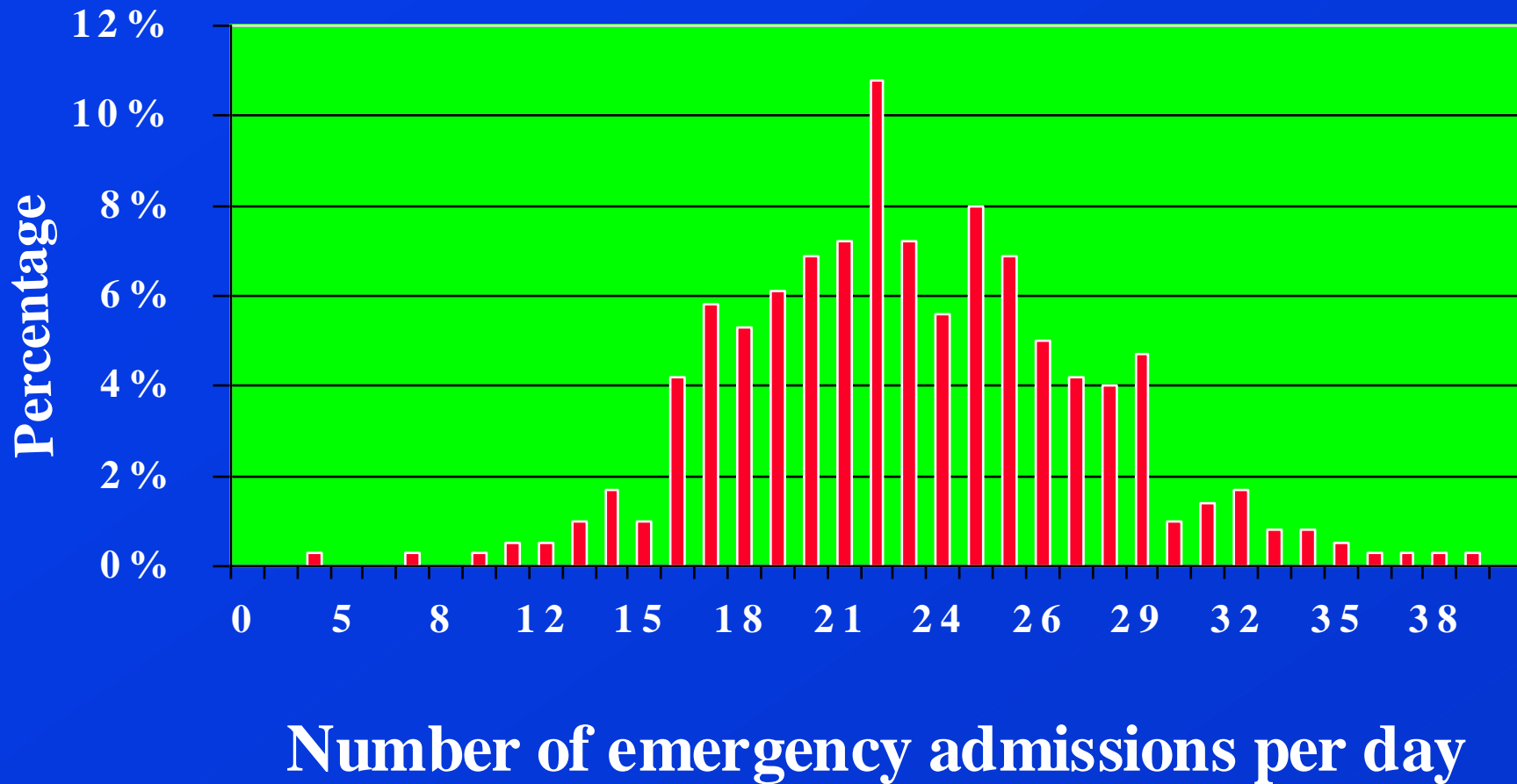
Assumptions for National Application

- In practice most waits 3-6 months
- Require major organisational/cultural change Programme
- Support Systems
 - Information Technology
 - Decision Support
 - Staff

Assumptions for National Application

- In practice most waits 3-6 months
- Sufficient capacity to:
 - ‘Ring Fence’ Electives
 - Allow Emergencies
- Require major organisational/cultural change Programme
- Support Systems
 - Information Technology
 - Decision Support
 - Staff

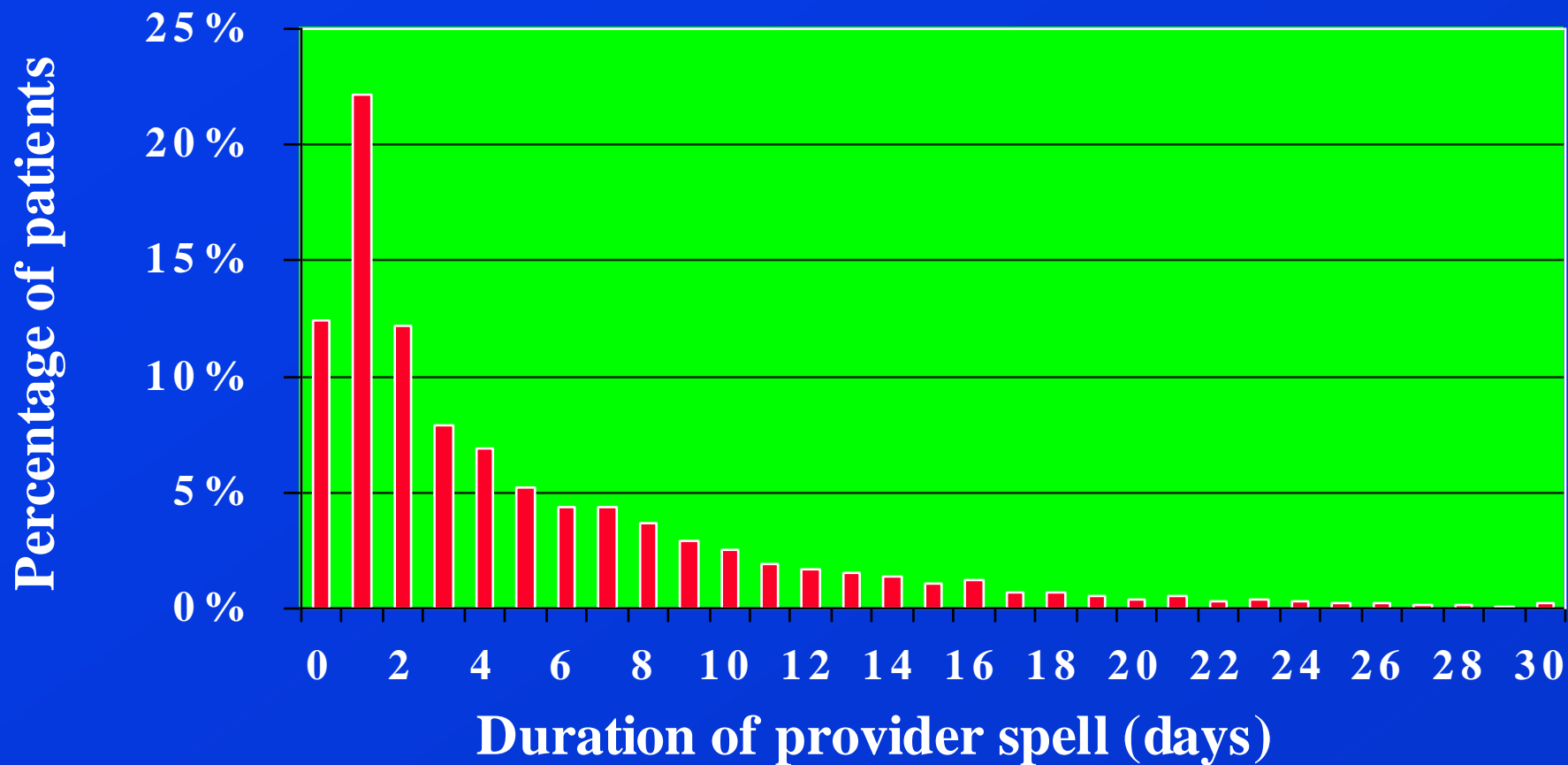
Daily Variation in Emergency Admissions Whole year, acute specialties



Source: Health Episode Statistics 1994/95, adjusted for trend, monthly & weekday variation

Duration of Hospital Stay

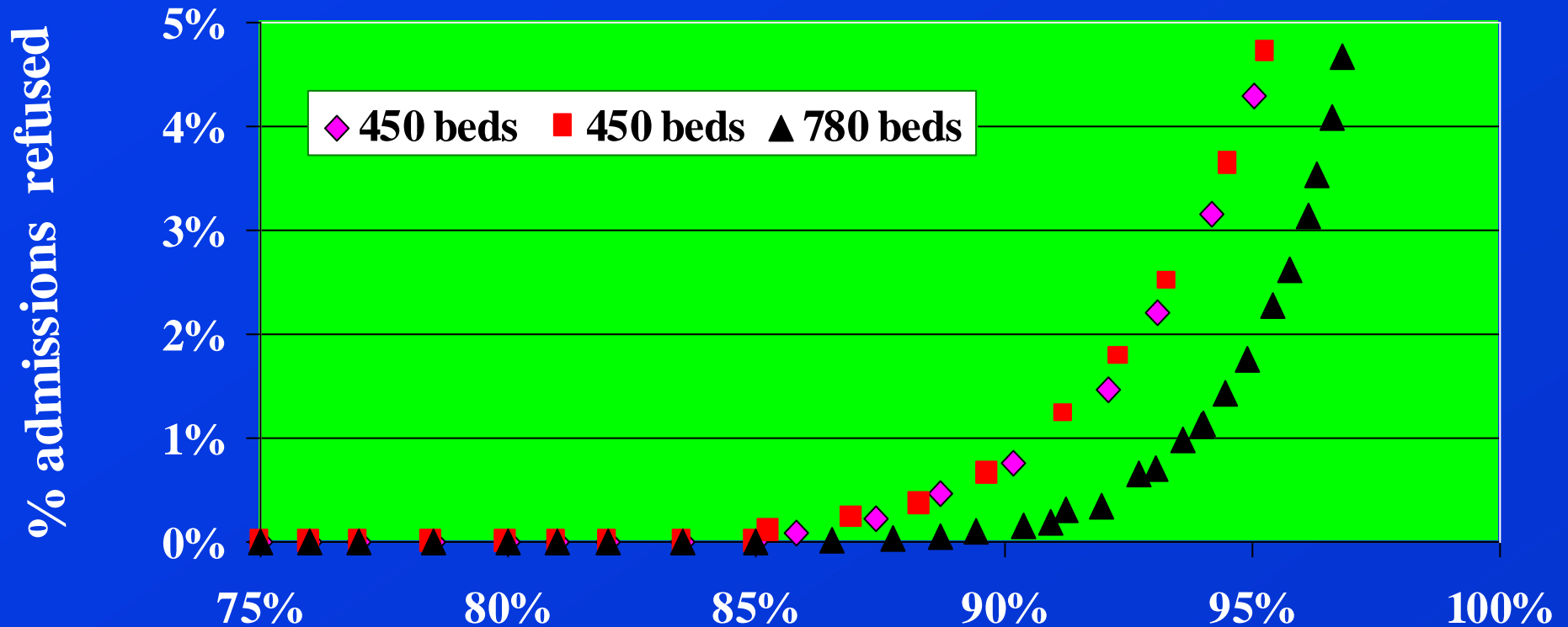
(Emergency admissions to acute specialties, 1994/95)



Source: Hospital Episode Statistics 1994/95 (ungrossed)

NHS Responsiveness : how many “spare” beds

Effect of bed capacity on refused admission



Mean % bed occupancy = occupied bed days/available bed days

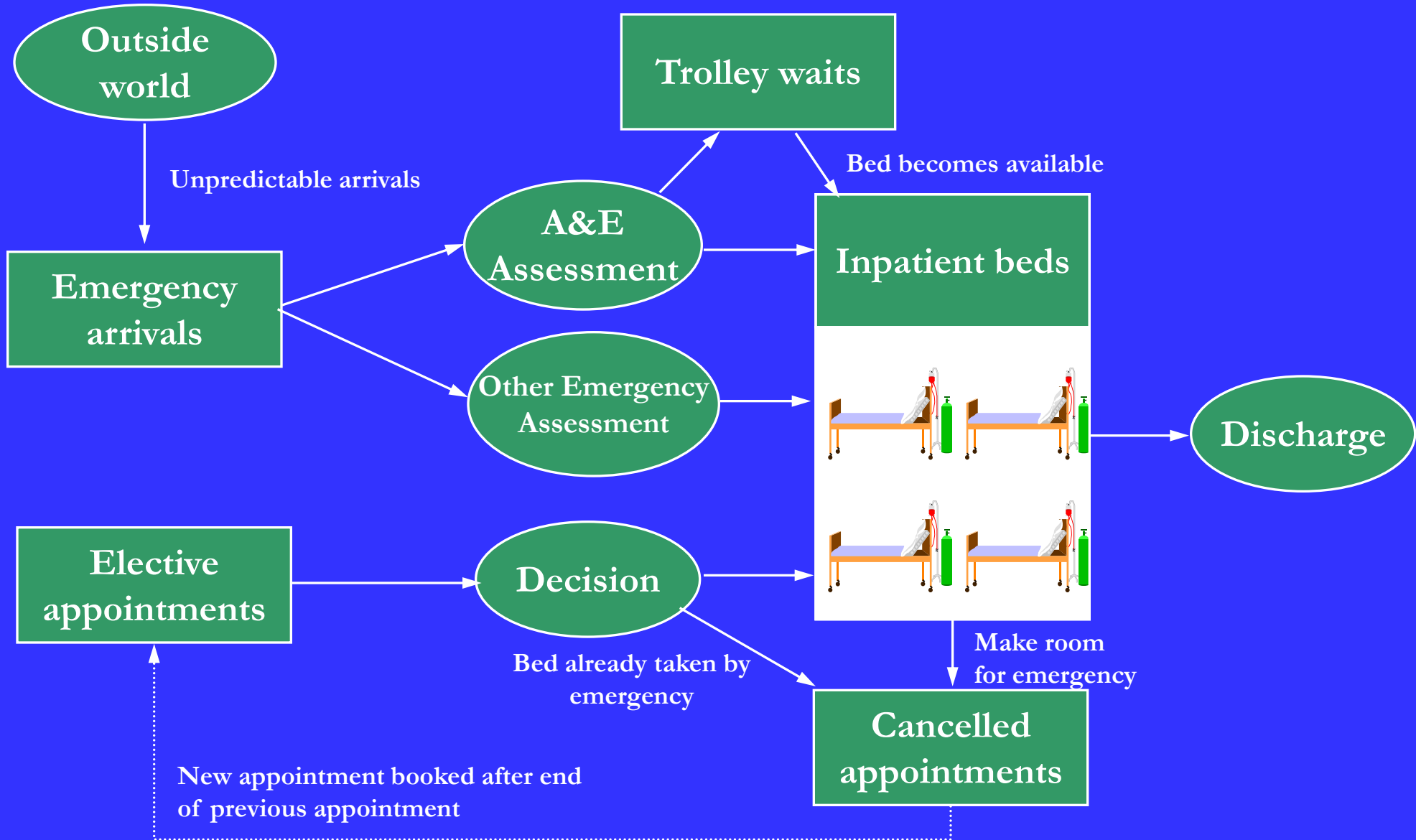
Preliminary results from simulation model of 3 acute hospitals

Ten simulated years for each trial, 6 trials for each data point on graph

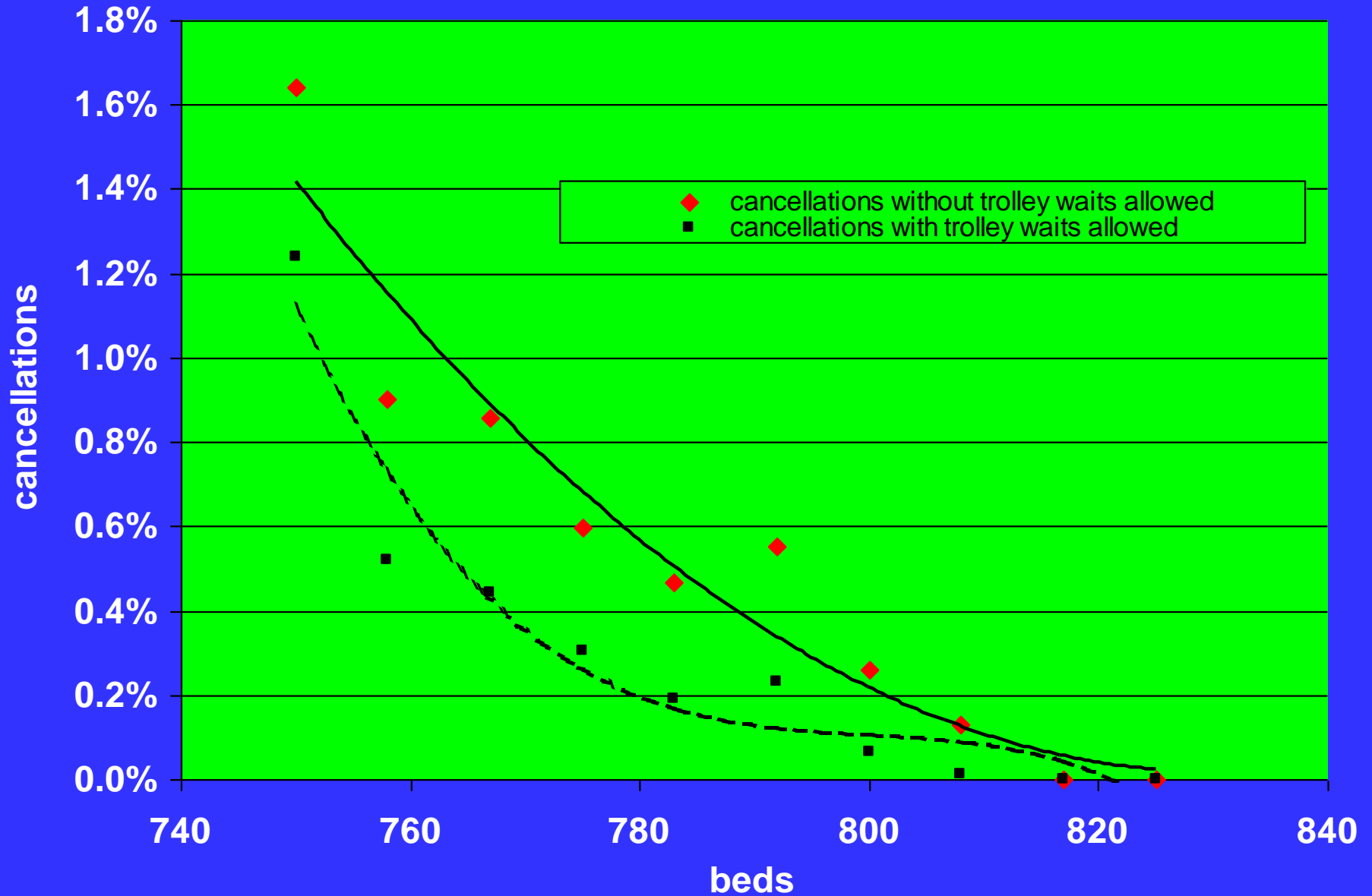
Bed Capacity Implications Model (BECIM)

“User friendly **generic** simulation model, that enables exploration of the interactions between **Variations** in Trolley Waits, Hospital Cancellations, Delayed Discharges and Bed Occupancy at a local level”.

Structure of Bed Capacity Implications model



Graph showing the effect when increasing beds



Some National Applications

- Impact of Military casualties returning from Iraq
- Impact of Major Incidents *
- Capacity requirements for Extra Burns casualties
- Implications of Specialised Stroke Units
- Impact on Trust Capacity of a Treatment Centre
- Implications of a flu pandemic
- Incentives: Public Health Interventions and Access Targets
- * Linked to OR Waiting Time Models

Capacity Impact of an Orthopaedic Diagnostic Treatment Centre (ITC)

- **150 bedded ITC unit**
- **Before transfer of activity to ITC Trust**
Orthopaedic Department had 2700 emergency admissions and over 4000 planned annual admissions
- **Only electives transferred**
- **Orthopaedic department ring fenced**
- **Only electives can be cancelled**

Bed Occupancy and Cancellations *before and after* activity transferred to the ITC

Scenario 1

75.0% 0.0%,

78.3% 0.0%,

80.1% 0.0%,

81.6% 0.1%,

86.5% 1.1%,

88.0% 2.8%

Scenario 2

75.0% 0.0%

76.3% 0.1%

80.2% 0.4%

81.7% 1.4%

86.4% 13.0%

Scenario 1: Before Transfer

Scenario 2: After transfer of 4000 planned cases

Short Term Incentives for Implementing Public Health Interventions

- **“Example of how smoking cessation can reduce length of stay in hospital and modelled impact on capacity and waiting times”**
- **Impact of Brief Interventions to Problematic Drinkers on A&E Targets.**

Use of Existing Models of Access

- **Bed Capacity Implications Model (BECIM)**
- **Inpatient Waiting Times Model**
- **Outpatient Waiting Times Model**
- **Accident and Emergency Department Model**

- **Model the impact on capacity in the short term**
- **Model the impact on Waiting Time Access Targets in the short term**

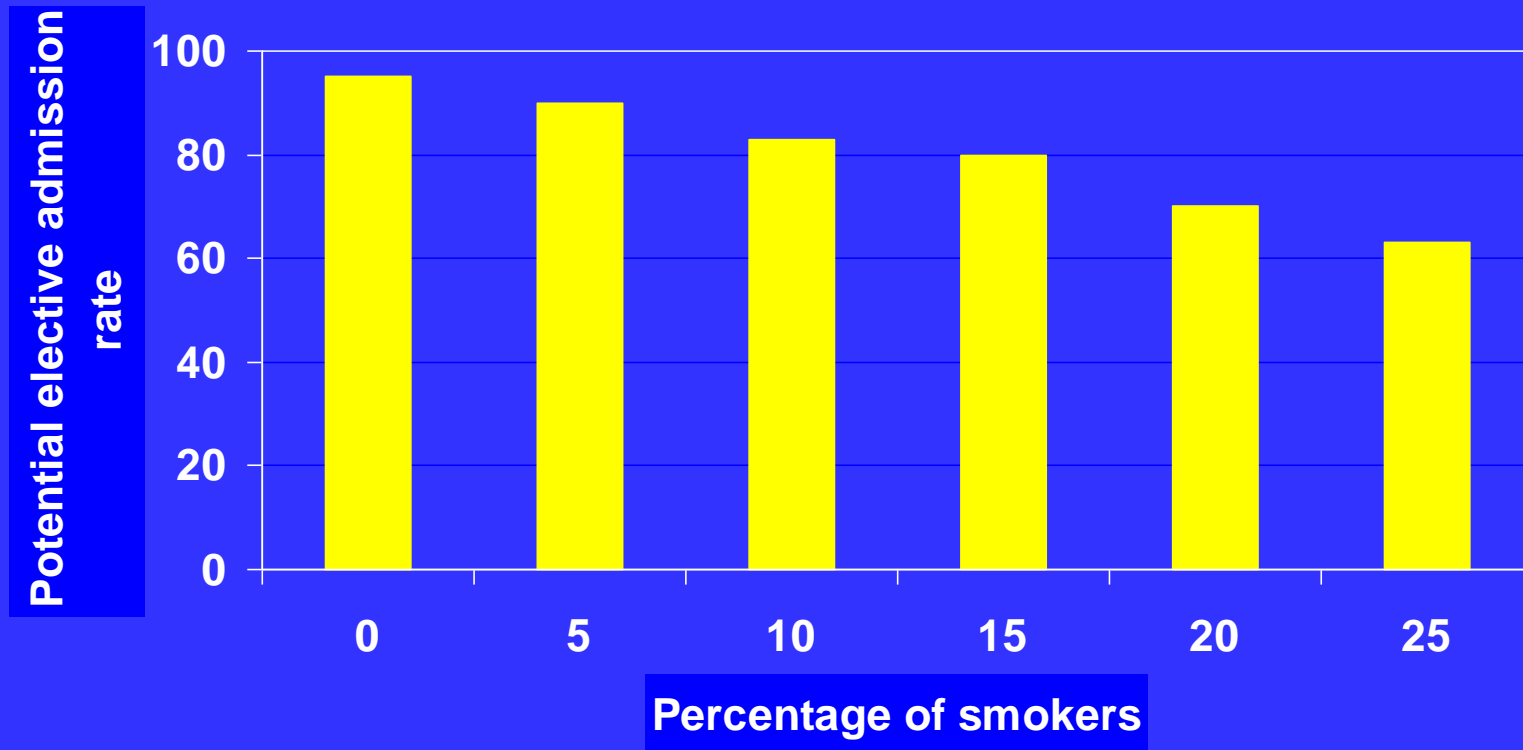
Evidence

- A ‘Choosing Health’ White Paper stated that (page 123)

“Giving up smoking before an operation leads to faster wound healing and a shorter hospital stay”
- A Danish report suggested giving up smoking 6-8 weeks before an operation leads to a drop in average length of stay from 13 days to 11 days.”

Reference: Lancet 2002

Modelling how the percentage of smokers entering hospital results in a change in the potential elective admission rate



Percentage of smokers	0%	5%	10%	15%	20%	25%
Typical elective admission rate	95	90	85	80	70	65
Percentage of capacity saved	46.2%	38.5%	30.8%	23.1%	7.7%	0%

- **A 20% reduction in smoking prevalence will lead to 7.7% of capacity being saved.**
- **This is comparable to the growth in elective activity needed in a single year on the way to meeting the 18-week target.**

Evidence

“If all problematic drinkers were to reduce their drinking to within low risk levels A&E attendances are likely to fall by 30%”

“If 1 in 8 problematic drinkers were to reduce their drinking to within low risk levels A&E attendances are likely to fall by 4%”

Reference: Addiction 97; 279-292

Modelling the Impact of Alcohol Interventions on Attendances at a Typical A&E Department

	Baseline	30% Reduction in A&E attendances	4% Reduction in A&E attendances
Attendances (1)	70,000	49,000	67,200
Average Total A/E Journey time in minutes	108	91	102
% change in Journey time		16%	6%
% meeting 4 hour A&E target	97%	98.6%	98%

Impact.....

- *Selected as a case study for an Analytical pack for managers **Example Case Studies of use of Analysis -Operational Research***
- *Chosen to be presented at two high profile analyst days aimed at policy managers to **promote analysis**: the first of which was opened by the Head of the Government Civil Service*

Some Lessons for Success (1)

- Be Very **Pro-Active**
- React **quickly** when there is a need
- Flexible Use of **Existing** Models
- Incorporate **New** Research Evidence
- Make a **realistic** contribution to complex issues
- Link Analysis to **Action**
- Focus impact on the **organisation** not just individuals

Some Lessons for Success (2)

- Look for **some** short term wins
 - Use exemplar analyses
 - Decompose application into stages
 - Use workshops and presentations
 - Get **Senior** Management ‘Buy In’
 - From Public Health
 - Finance
 - Across the Department
- “Right people at the Right Time”**
- Look for **Simple** Messages that will Stick in Managers minds
 - **Innovate** and lay the ground for the future

Some Lessons for Success (3)

- Focus analysis on what Senior Policy Managers want-eg if they wanted **short term** returns
- Use **Generic** Solutions and Toolkits
- Look for, innovative, ways of increasing **visibility** of success
- Focus on the **decision makers**
- Continually reassess changing policies and individuals- avoid **complacency**

Contents

- Introduction
- Modelling
- Example Successful Applications *and their Impact*
- Two Selected Applications
 - Choice
 - Short Term Cost Savings from Prevention
- **Current Challenges**
- Future Opportunities
- Summary

BUT...

Application of health OR – lessons from *use of simulation in healthcare*

**-Review* (not just UK) of studies of simulation of
health clinics found**

1973-1977 8 studies ; 1993-1997 28 studies

*J B Jun, S H Jacobson and J R Swisher, A Application of discrete-event simulation in healthcare clinics: a survey, JORS, 50,109-123, 1999)

**-But (earlier) review* of 200 simulation projects in
health care found *only 16 (8%) reported successful
implementation***

*JCT Wilson, Implementation of computer simulation projects in health care, JORS, 32, 825-832, 1981

Some Special Issues of JORS and of HCMS

-“Meeting Health Challenges with OR”–
Journal of the Operational Research Society
February 2005 (eds Prof Ruth Davies and David
Bensley)

Every paper Required Evidence of Impact

**-“Contemporary Health Care Applications in
OR/MS”** Health Care Management Science
November 1994

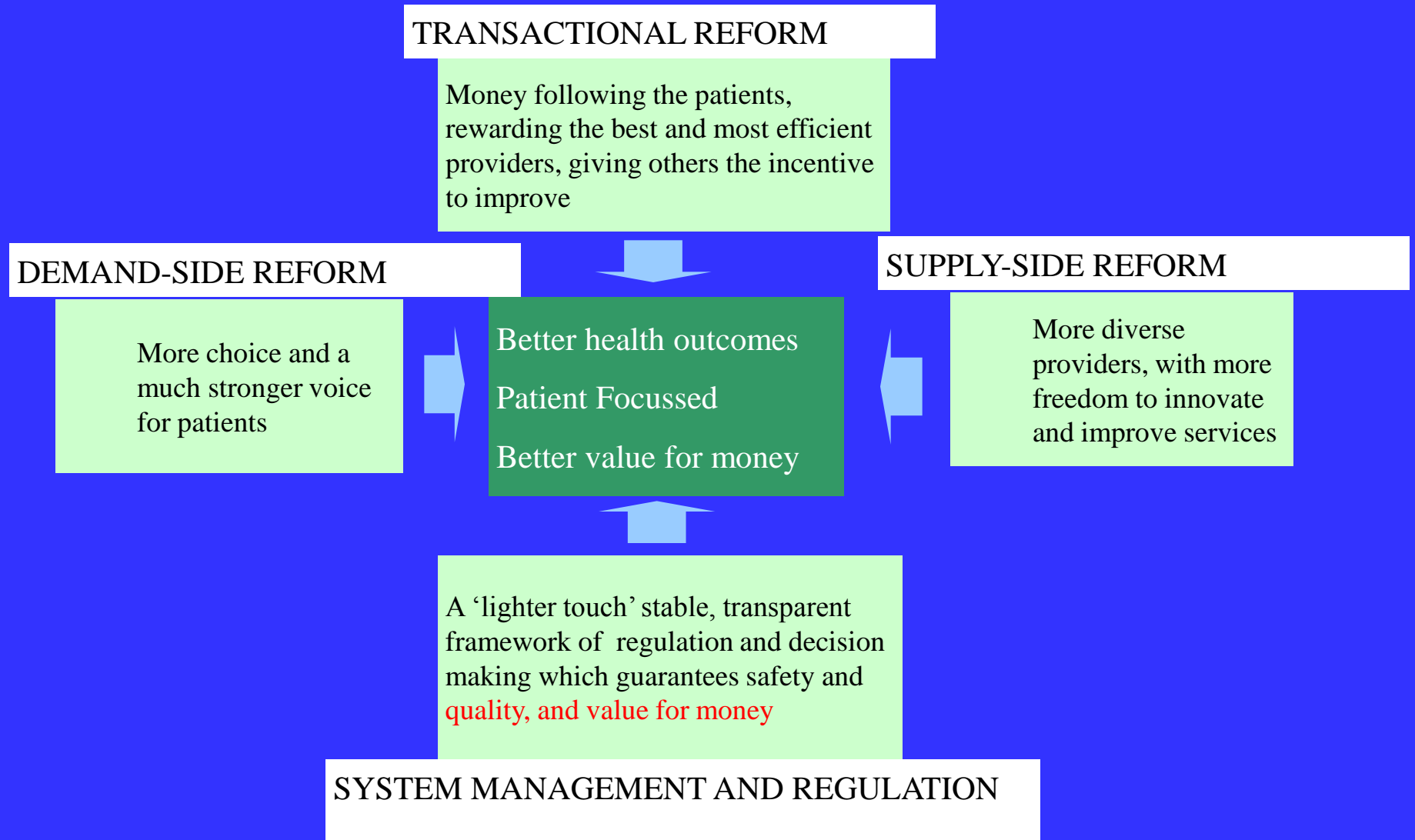
- **In July 2010 Announcement of arguably largest reorganisation of the Health and Health Care System proposed since 1948?**

-

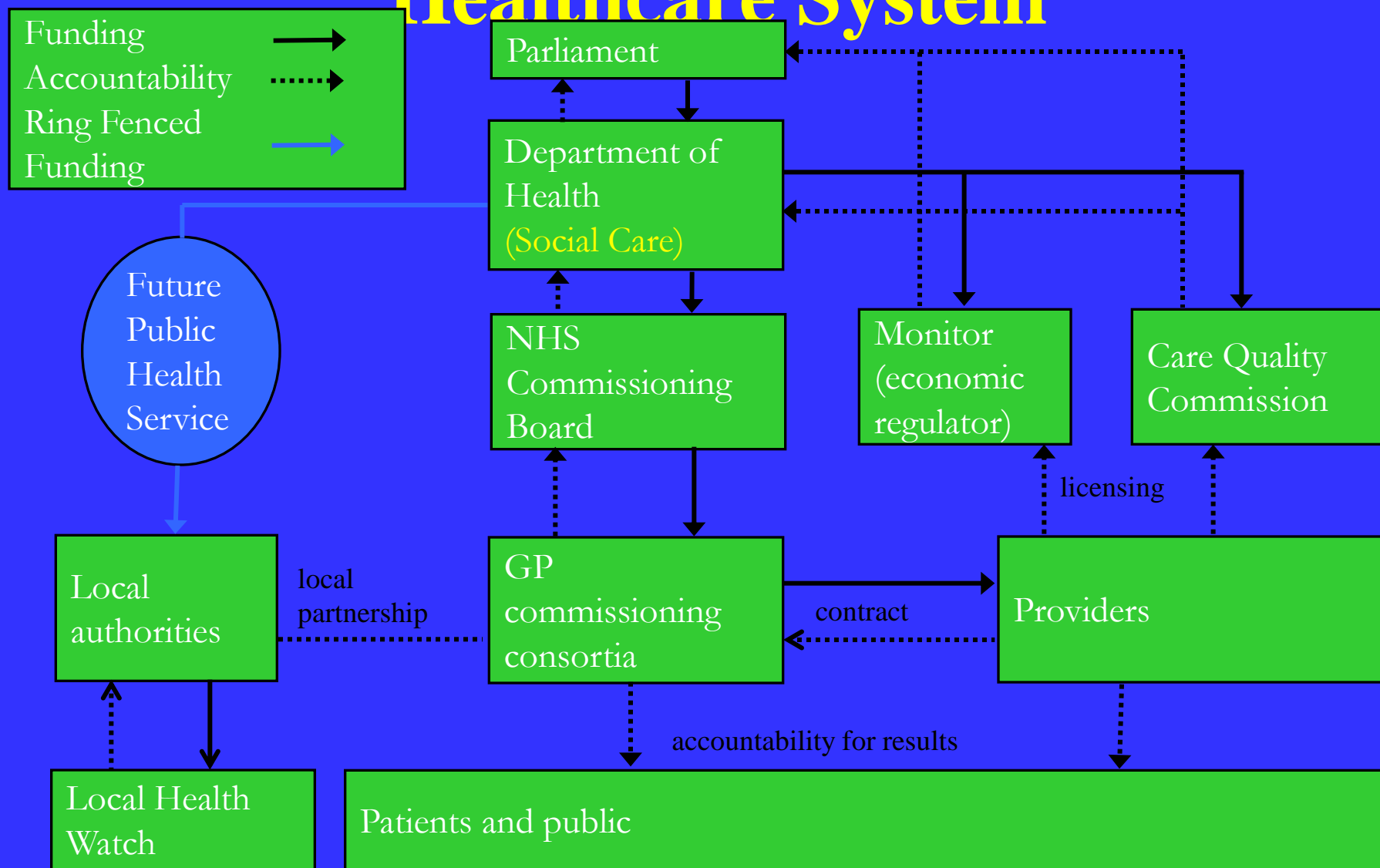
and

- **Massive Savings Required – ‘£20billion over 3years’**

NHS reform is aimed at being putting patients at the center with a strong focus on quality and patient outcomes and run with ownership and decision making in the hands of professionals and patients



Future Vision for the Health and Healthcare System



System Challenges (1)

- **Greater emphasis on local priorities and patients choice.**
 - System needs to be more flexible and reactive?
 - Need for early warning systems?
- **Incentives for implementing local Health Improvement**
- **Move to outcome measures**
 - Reduced connection between services commissioned, processes and outcome measures.
- **Move to Foundation Trusts, CCG's**
 - More competitive market?
 - Commercial approach including advertising?
 - More tailored service delivery.
- **Effect of Streamlined Regulation.**
- **Move to 'all Foundation Trust' Providers**
 - Reduced central command and control
 - Autonomous Units
 - How is central planning achieved?

System Challenges (2)

- **Whole System being redesigned**
 - Staged - not one big change
 - Shadow organisations
- **Managing the transition**
 - System needs to be more flexible and reactive?
 - Need for early warning systems?
- **Reduction in Costs and Staff**
 - Skill Mix of staff in the Future
 - Commercial approach including advertising?
 - More tailored service delivery

And

- **Commissioning Support**
 - Multiple, Fragmented, Competitive
 - Limit of £25 per head on Clinical Commissioning Groups
 - **“It was not in the long term interests of the NHS Commissioning Board to manage commissioning support” David Nicholson July 2011**

Some Specific Challenges

- **Reduce Emergency Admissions**
 - System needs to be more flexible and reactive?
 - Need for early warning systems?
- **Integration of Social and Health Care**
 - Reduced connection between services commissioned, processes and outcome measures.
- **Deliver Productivity Gains**
 - More competitive market?
 - Commercial approach including advertising?
 - More tailored service delivery.

Contents

- Introduction
- Modelling
- Example Successful Applications *and their Impact*
- Two Selected Applications
 - Choice
 - Short Term Cost Savings from Prevention
- Current Challenges
- **Future Opportunities**
- Summary

“Marvellous opportunities for closer cooperation between NHS and Universities” and “for developing Innovation and Research”

Prof Malcolm Grant

Chair NHS Commissioning

Board 9th Dec 2011

*Some Opportunities informed by a
Survey of 100 people who work in
or with the NHS and who described
what the changes meant for them*

Guardian Friday 16th March 2012

Opportunities 1

- *“Difficult to see wood from the trees and to understand the system”*
- Desperate need for more integration
- Improve health outcomes but with increased fragmentation
- Impact of Systems of care eg for Trauma: accident to hospital to discharge
- Impact of whole system eg cost savings for orthotics
- Impact of ‘cherry picking’
- Management of change

Opportunities 2

- **Money is the driver particularly in the short term- Rewards quick fixes**
- **Redesign/Sizing of specialist units**
- **Traditional in hospital redesign to produce cost savings eg ct scanning reduce scheduling bottlenecks**
- **Impact of flexible working eg in psychiatry treating only non routines**
- **Management of change**

Opportunities 3

- **Impact of Increased choice on capacity**
- **Impact of flexible working eg in psychiatry treating only non routines**
- **Need to win hearts and minds in primary and secondary care**
- **Clinicians and evidence based decision making**
- **Management of change**

Opportunities 4

- **Some CCG's may contract out of commissioning**
- **Training traditionally has suffered with independent providers**
- **Management of change**

Finally....

**Modelling *has demonstrated* a
track record of making *an*
impact at addressing some of the
challenges**

And Moreover

**OR has demonstrated it can be
successful *in 'Shaping Change'***

- **Peak load capacity planning (hospitals, walk in centres, NHS Direct)**

Impact: Understanding capacity requirements.

- **Modelling the impact of military casualties returning from Iraq.**

Impact: Policy colleagues feedback.

No hospital actually failed but:-

“Ministers had confidence that the plan would work”

“Best example of modelling with an immediate application and which impacted on decisions to be made in the short time available”.

- **Modelling the feasibility of introducing total booking systems into the NHS. Evaluation of pilot sites.**

Impact: Policy funded and implemented throughout NHS based largely upon the analysis.

- **Modelling the impact on Capacity of increasing the proportion of day cases.**

Impact: Contributed to capacity requirements for the 5 year Strategy Plan.

OR Shaped the Change

- **Assessments of a 100% 4 hour target for A/E departments.**
Impact: 100% target clinically and operationally inappropriate – reduced to 98% and met.
- **A Generic simulation model for analysing the flow of patients through A/E.**
Impact: Model used by A/E departments to identify bottlenecks.
- **Develop a high level stroke toolkit for best practice.**
Impact: Widely distributed for use throughout the NHS.
- **Modelling the impact on Capacity of establishing a Treatment Centre.**
Impact: Understanding capacity requirements.
- **Generic Modelling for achieving the 48 hour access target for GUM clinics.**
Impact : Model well received and continued support for it.

- **System Dynamics Model of a Chlamydia Screening Strategy.**
Impact: Understanding the long term implications of introducing screening.

- **Implications of Screening for Abdominal Aortic Aneurysms.**
Impact: Screening for males aged 65 recommended in principle subject to patient information and service configuration.

- **Short term incentives for implementing Public Health Interventions.**
 - Impact of brief interventions to problematic drinkers on A/E targets
 - Impact of pre-operative smoking cessation on waiting times**Impact:** Used to demonstrate short term effectiveness of prevention policies. Raised the credibility of public health with Treasury.

- **Whole Systems Analysis underpinning a strategic framework supporting self care.**
Impact: Evidence used to assess the benefits and implications of the policy and to provide significant funding for further expansion..

Contents

- Introduction
- Modelling
- Example Successful Applications *and their Impact*
- Two Selected Applications
 - Choice
 - Short Term Cost Savings from Prevention
- Current Challenges
- Future Opportunities
- **Summary**

*Huge **Opportunities** for **Successful** applications of Modelling, but also substantial **Challenges**, to make a real impact, in the changed Health Landscape.*

The End

Contact

e-mail: bensley.david@gmail.com

Tel: 01423 862638

Mob: 07790057638