

“A design team which produces a total, balanced, efficient design can help to produce a better environment.”

Sir Ove Arup, November 1968



“EuHPN Valuing the Future”

Copenhagen

Future hospitals – the drivers of change influencing future healthcare facilities

Phil Nedin

Wednesday 24th October 2012



Shaping our business through design



Altnagelvin hospital clinical block
Northern Ireland



Ysbyty Aneurin Bevan.
South Wales. UK.



Moorfields children's eye
hospital .London



Basildon Cardiothoracic
hospital. Essex UK



Medicover hospital Poland



Alfred ICU Melbourne Aus.



Kenema clinic Sierra Leone



Hospital Del Norte Madrid



Pembury hospital Kent. UK



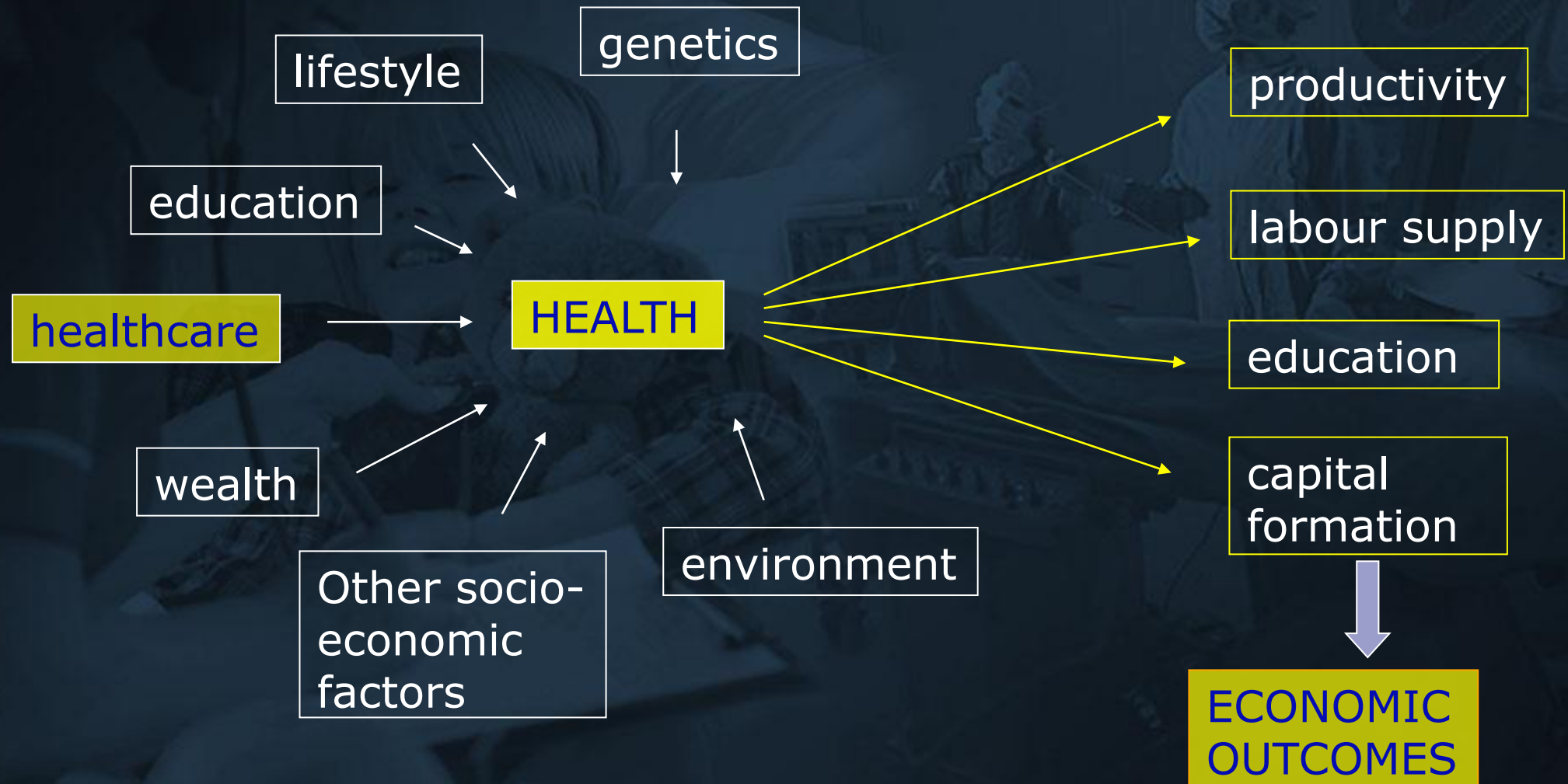
St Helens PFI hospital England

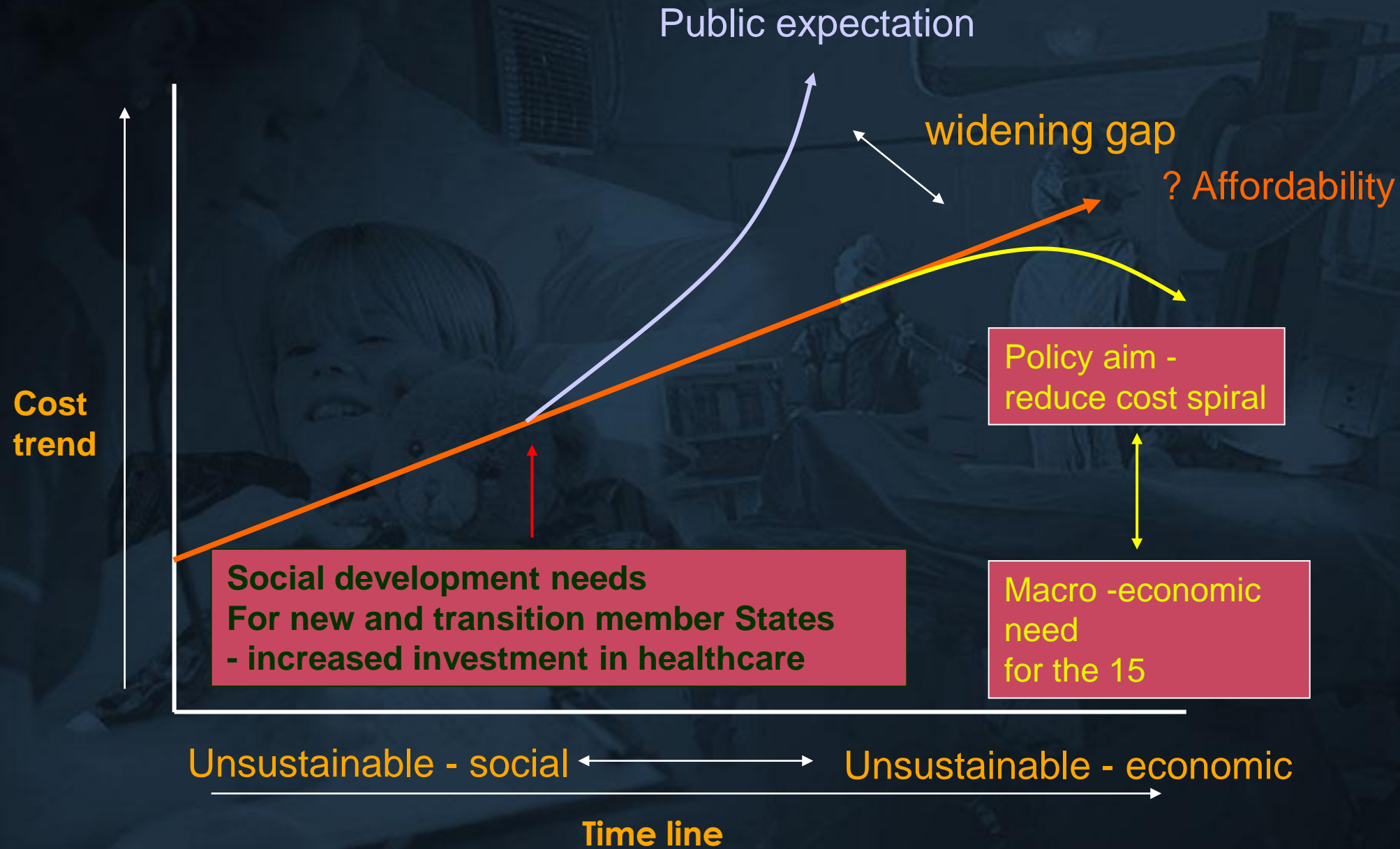


OASTSIH Aus.

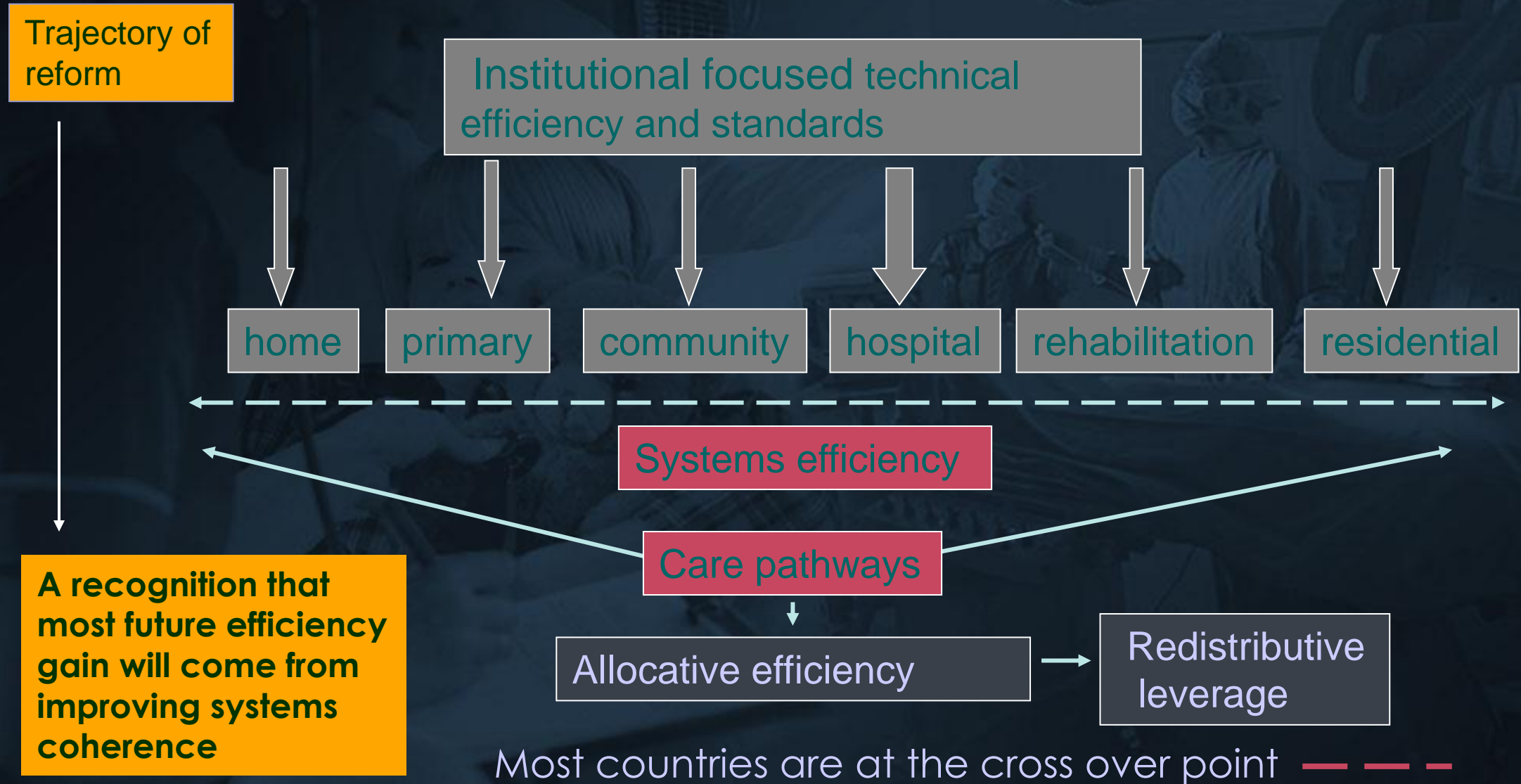


Kaiser - Antioch
USA





Facilitating reform in the mature healthcare markets whole systems efficiency – extending the provision of care



A shift in approach

Current view	Evolving model of care
Geared towards acute conditions	Geared towards long-term conditions
Hospital-centred	Embedded in communities
Doctor-dependent	Team-based
Episodic care	Continuous care
Disjointed care	Integrated care
Reactive care	Preventative care
Patient as passive recipient	Patient as partner
Self-care infrequent	Self-care encouraged and facilitated
Carers undervalued	Carers supported as partners
Low-tech	High-tech

Sustainable Approach



Non Sustainable Approach

Healthcare drivers that shape our business



Robotics



The intelligent patient



Infection control



Drug development



Private finance



Surgical techniques



Alternatives



Therapeutic environments



Intelligent pills



DNA, RNA, Stem cell

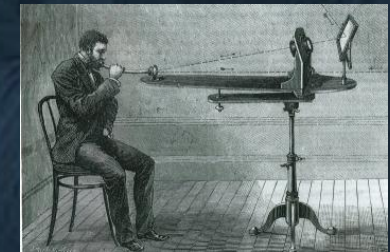
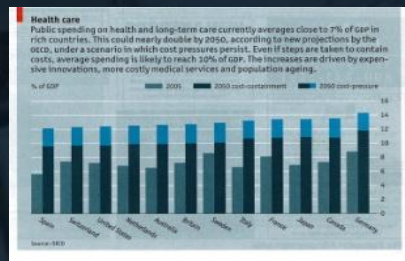


Photo acoustics



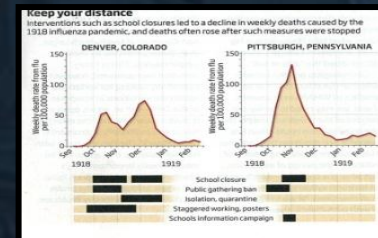
The elderly & chronic illness



Affordability



Home diagnostics



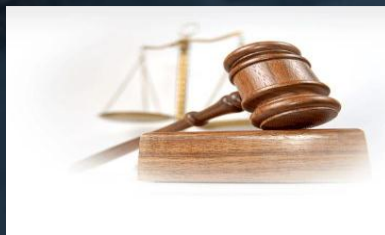
Pandemic risk



Artificial organs



Public health



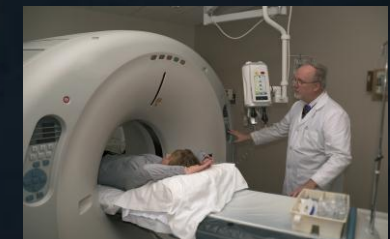
Government & Legislation



Global warming



ITC



Imaging

Healthcare drivers of change

Drivers that will change healthcare delivery



Robotics



The intelligent patient



Infection control



Drug development



Private finance



Surgical techniques



Alternative therapies



Therapeutic environments



Intelligent pills



DNA, RNA, stem cell



Nano technology



The elderly
& chronic illness



Affordability



Home diagnostics



Pandemic risk



Artificial organs



Public health



Government
& legislation



Global warming



ITC

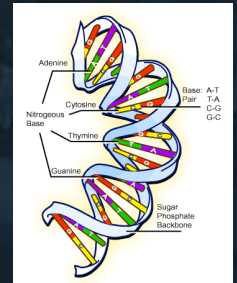
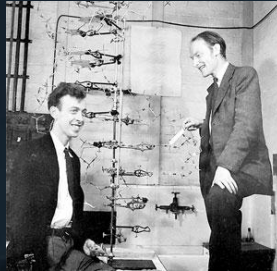


Imaging

Patient generation - gratitude

70 Years

NHS



Penicillin Mold Fungus

1942
Penicillin
produced

1948
NHS
created

1953 DNA
by Crick &
Watson

1960 FDA
approves
contraceptive
pill

1967 First
Heart
Transplant

1977
First Human
MRI scan

1981
HIV/AIDS
CDC
recognised

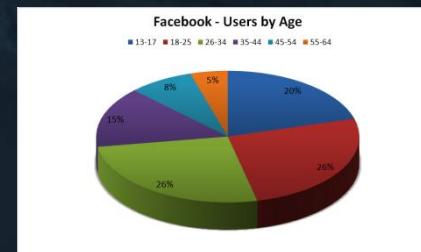
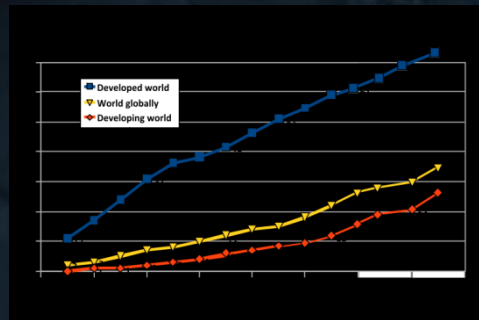
2002
Human
Genome
sequenced

The next stage of the therapeutic environment



Patient generation - expectation

24 Years



1983
Apple Mac

1991
2G mobile
phone

1995
Internet
commercialised

2000
Google
10 languages

2002
XBOX

2004
Facebook

2007
iPhone

2008
iPad

Patients of the future



Take
responsibility ?

The proposed cost of healthcare - 2013

Country	GDP/Head (US\$)	Health % GDP	Healthcare cost/head (US\$, € & £)			
USA	47,150	17.9	\$8,439.85		6,680.69 €	£5,297.02
Norway	85,390	9.5	\$8,112.05		6,420.17 €	£5,090.46
Denmark	56,240	11.4	\$6,411.36		5,076.68 €	£4,023.25
Netherlands	46,900	11.9	\$5,581.10		4,418.77 €	£3,502.56
France	39,450	11.9	\$4,694.55		3,719.21 €	£2,946.84
Sweden	48,900	9.6	\$4,694.40		3,716.74 €	£2,946.09
Germany	40,120	11.6	\$4,653.92		3,687.12 €	£2,907.87
Belgium	43,080	10.7	\$4,609.56		3,649.88 €	£2,893.05
Australia	50,750	8.7	\$4,415.25		3,495.23 €	£2,771.29
Ireland	46,170	9.2	\$4,237.64		3,355.10 €	£2,659.44
Finland	44,380	9.0	\$3,994.20		3,162.46 €	£2,506.84
UK	36,340	9.6	\$3,488.64		2,763.84 €	£2,189.87
New Zealand	32,370	10.1	\$3,269.37		2,587.71 €	£2,052.07
Italy	34,080	9.5	\$3,237.60		2,473.42 €	£1,992.88
Spain	30,550	9.5	\$2,902.25		2,299.34 €	£1,821.49
Greece	26,610	10.2	\$2,714.22		2,149.98 €	£1,703.77
Portugal	21,490	11.0	\$2,363.90		1,872.49 €	£1,483.86
Poland	12,290	7.5	\$921.75		730.13 €	£578.59
South Africa	7,280	8.9	\$647.92		512.87 €	£406.66
China	4,430	5.1	\$253.93		200.98 €	£159.37
India	1,410	4.1	\$57.81		45.76 €	£36.28

Cost information – information allows responsibility

- Overnight hospital stay
- Emergency admission
- MRI scan
- Normal birth
- Xray
- Gastric band procedure
- Stent procedure
- Renal dialysis
- Liver transplant
- Etc, etc, etc.

single room vs multi bed.



- Effective isolation
- Specific cleaning regime
- Privacy & dignity
- Improved patient environment
- Reduced patient travel
- Individual room stores/supplies



- Patient interaction
- Capital cost
- Staffing cost

Single rooms will be normal



The internet, social networking sites & wireless devices

The catalyst for new healthcare business models

Smart phones (Apple Apps store)

Access to medical records

Health monitoring – exercise, diet and vital signs

Health advice by phone (developing countries)

Medical education by phone and networking sites

Magic carpets for the elderly

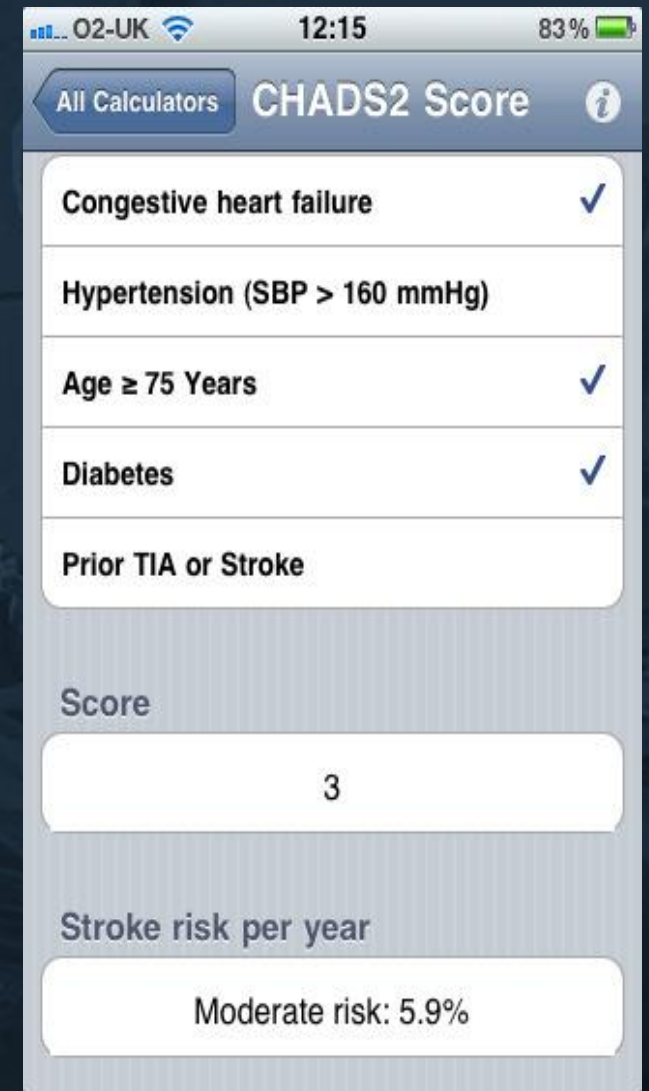
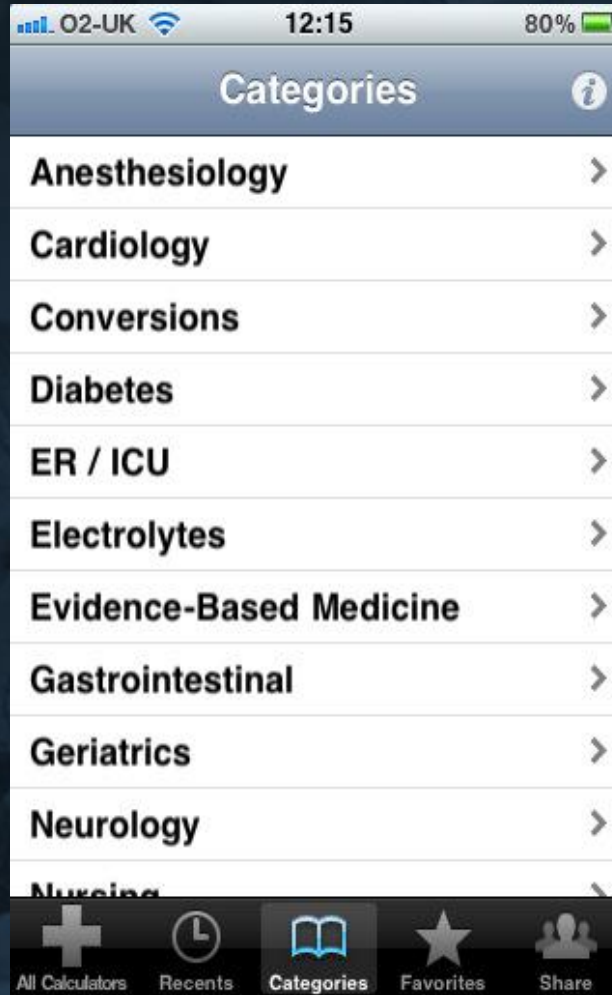
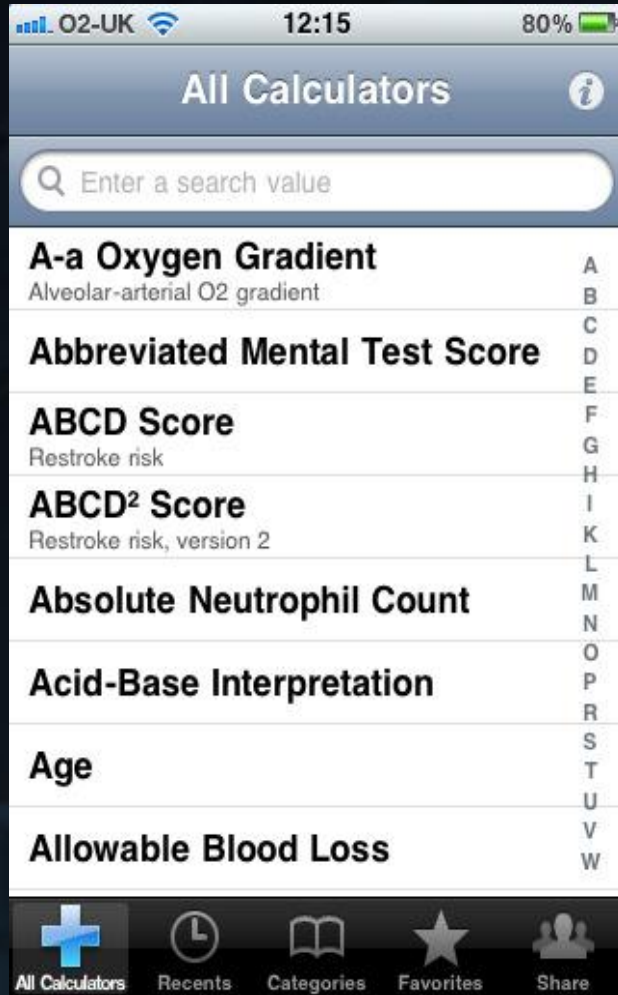
Medication reminders

Personal health coaching by phone

Social networks organised for common ailment support



The available APPS technology



Patient/doctor relationships



lifestyle developments!

- If eating habits met nutritional standards, 70,000 lives a year would be saved in the UK.
- Domino pizza & Kentucky fried chicken profits rose by 25% and 14% respectively in 2008 while McDonalds had their best trading ever year in the UK.
- Anorexia in girls under 16 in the UK has risen by 80% in the past decade.
- 23% of liver transplants in UK 2008 went to people with alcohol related disease – an increase from 14% in 2007.



- Smoking ban in public places – benefits apparent !
- Danish place a tax on saturated fats Oct 2011 – governments are watching!
- Mayor Bloomberg (NY) action on Fizzy drinks, smoking, fast food chain calorie counts and banned trans fats in restaurants.

NCD - Prevalence of Diabetes










	2000	2030 predicted
Worldwide	171,000,000	366,000,000
China	20,757,000	42,321,000
United States of America	17,702,000	30,312,000
United Kingdom of Great Britain & Northern Ireland	1,765,000	2,668,000

Source: World Health Organization

Estimated savings

david.muxworthy@alere.com

Ref: Data based on >1,000 NHS LTC patients monitored over 3 years

Area of Savings		Total	NHS Tariff	Gross Saved
COPD Admissions Prevented		472	£2,793.00	£1,318,296.00
Nurse Visits Saved		1,758	£30.00	£52,740.00
Mileage Saved		1,758	£8.00	£14,064.00
CHF Admissions Prevented		37	£2,987.00	£110,519.00
Nurse Visits Saved		205	£30.00	£6,150.00
Mileage Saved		205	£8.00	£1,640.00
Diabetes Admissions Saved		23	£2,112.00	£48,576.00
Nurse Visits Saved		160	£8.00	£1,280.00
Mileage Saved		160	£30.00	£4,800.00

Totals Gross Savings

£1,558,065.00

Formula: 20 Miles per journey @ £0.40 per mile

Nursing Time: 1.5 hours @ £20 per hour

1930's adverts promoting lifestyle

www.StrangeCosmos.com



Old hard way

New Schlitz way

Some day all beer cans will open this easy!

Now only Schlitz brings you—coast to coast—the world's easiest opening beer can! The new aluminum Softop can! **real gusto—real easy!**

The Beer that made Milwaukee Famous... simply because it tastes so good!

© 1933 Schlitz Brewing Co., Milwaukee, Wis., Brooklyn, N.Y., San Francisco, Cal., Boston, Chicago, St. Louis, Mo.

According to repeated nationwide surveys,

More Doctors Smoke CAMELS than any other cigarette!

Doctors in every branch of medicine were asked, "What cigarette do you smoke?" The brand named most was Camel!

You'll enjoy Camels for the same reason so many doctors enjoy them. Camels have real, cool nicotine, pack after pack, and a flavor unmatched by any other cigarette. Make this simple test: smoke only Camels for 30 days and see how well Camels please your taste. How well they soothe your throat as your steady smoke. You'll see how enjoyable a cigarette can be!

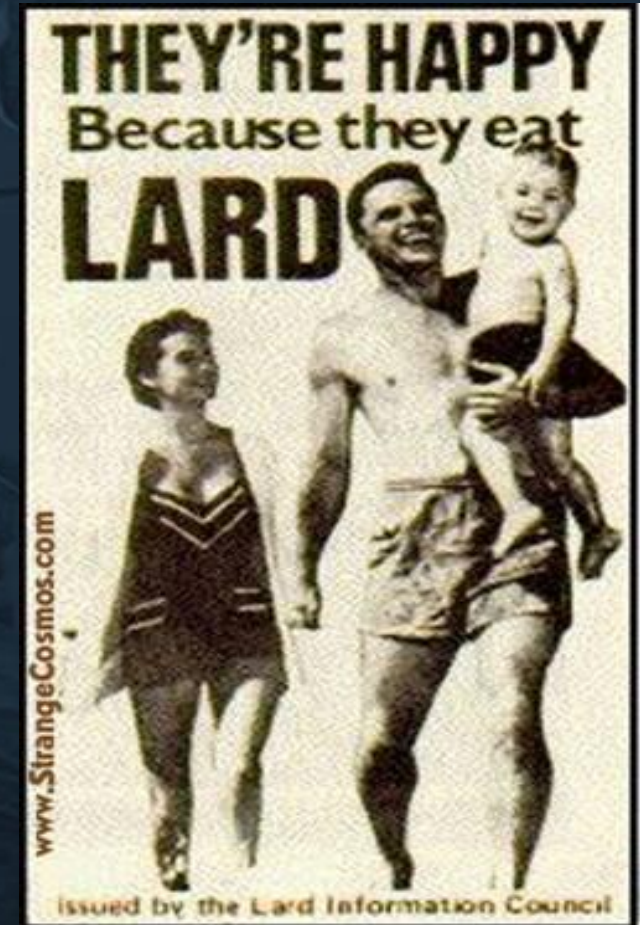
THE DOCTORS' CHOICE IS AMERICA'S CHOICE!



For 30 days, test Camels in your "T-Zone" (T for Throat, T for Taste).

www.StrangeCosmos.com

THEY'RE HAPPY
Because they eat
LARD



www.StrangeCosmos.com

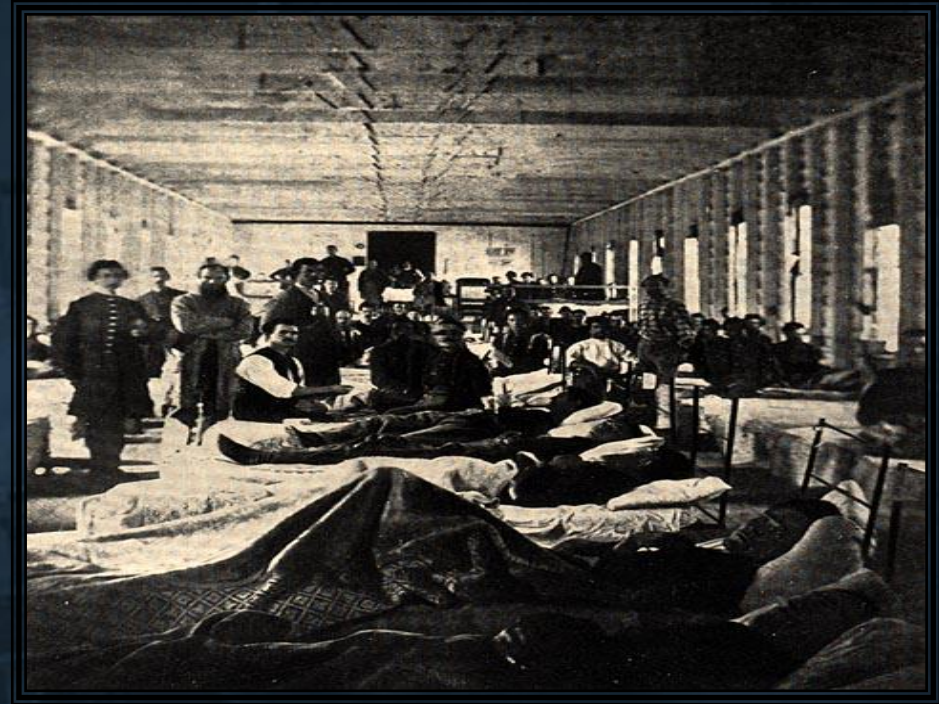
Issued by the Lard Information Council

Legislation v's the nanny state

Macro Nutrients ?

COMMON REMEDIES | Late 19th Century

6. Lead
5. Mercury
4. Bloodletting
3. Castor Oil
2. Opium
1. Coca Cola



Civil War Hospital c.1860s

*“Nearly all men die of their medicines,
not of their diseases.” Moliere 1670*

Genetic developments!

The completed human genome is only 5 years old but genetic pathways have already been successful:

- Age related macular degeneration
- Inflammatory bowel disease
- Cardiovascular disease
- Type 2 diabetes
- Obesity
- Cancer therapies
- Stroke therapies
- Major genome centres are now able to sequence 1 human genome every day – the first one took many years

Drug developments

- The development of the Poly-pill to postpone cardiovascular disease!

Surgical developments

- Tumours to be illuminated with targeted dye to ensure first time removal!

Technical developments

- Proton beam for targeted radiation treatment – large scale
- iPhone apps – small scale

Diagnostic developments

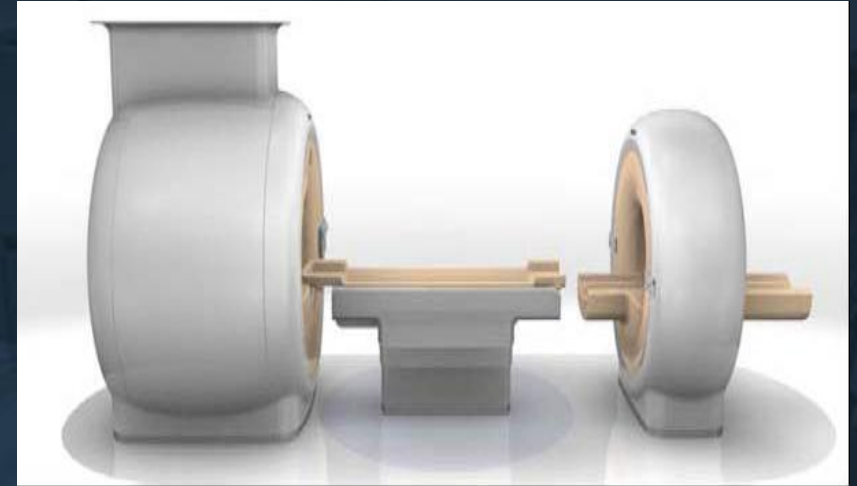
- Early lung cancer testing



Technology developments



Gamma knife



CT/MRI



Proton Beam



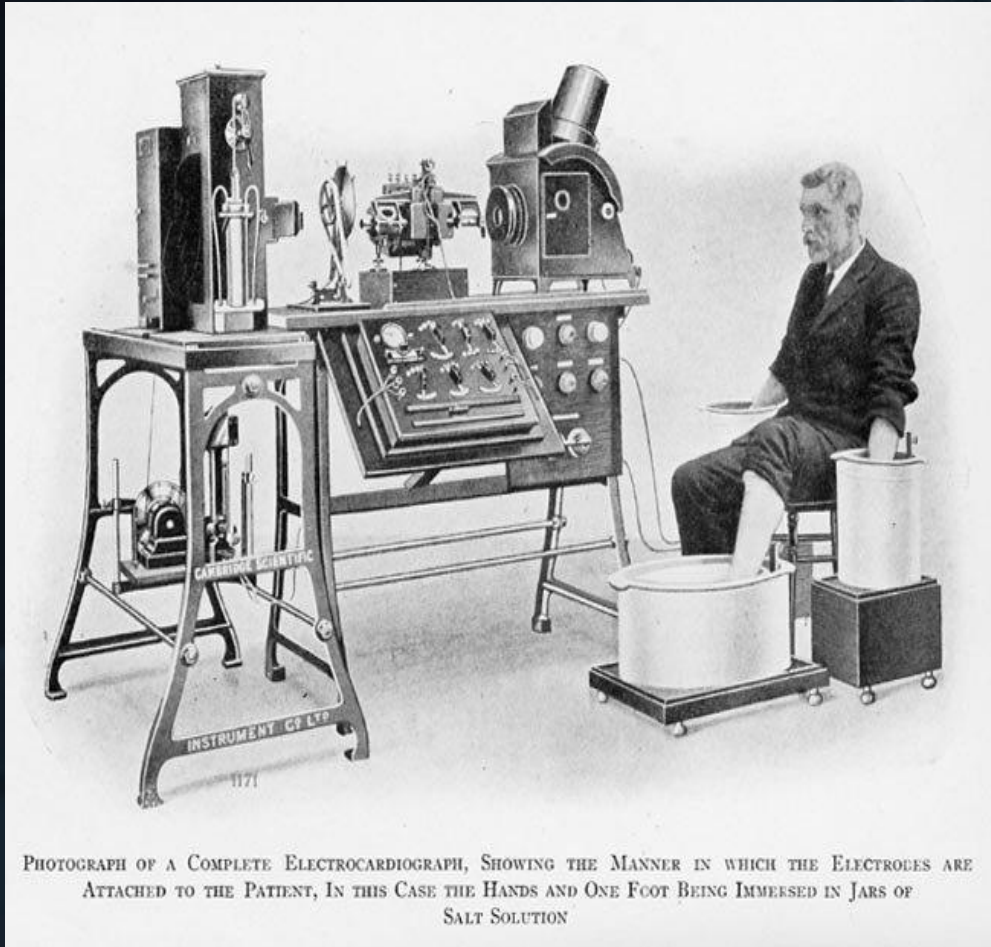
?

Where next

smaller.....smarter.....swifter



ECG development

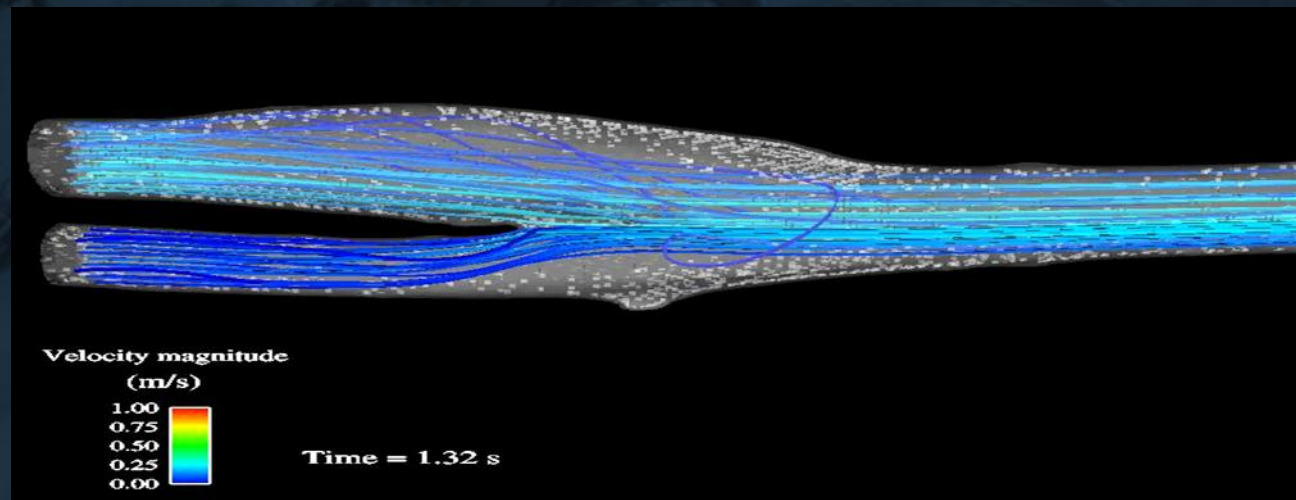


Experimental c1888



GE MAC 400 ECG - 2008

Molecular biology and nano-science will continue to revolutionise healthcare (prevention, diagnostics and treatment) in the next 10 years to levels that are unimaginable now.



Alzheimer's Disease – UK trend

- 700,000now
- 940,0002021
- 1,700,0002051
- 154% INCREASE OVER THE NEXT 45 YEARS!

Multi-morbidity

50% of over 65's have two chronic conditions

50% of over 75's have three chronic conditions

Caring for our elderly

**Family lives
200 miles away**

**Poor vision
and hearing**

Lives alone

**Has diabetes
and arthritis**



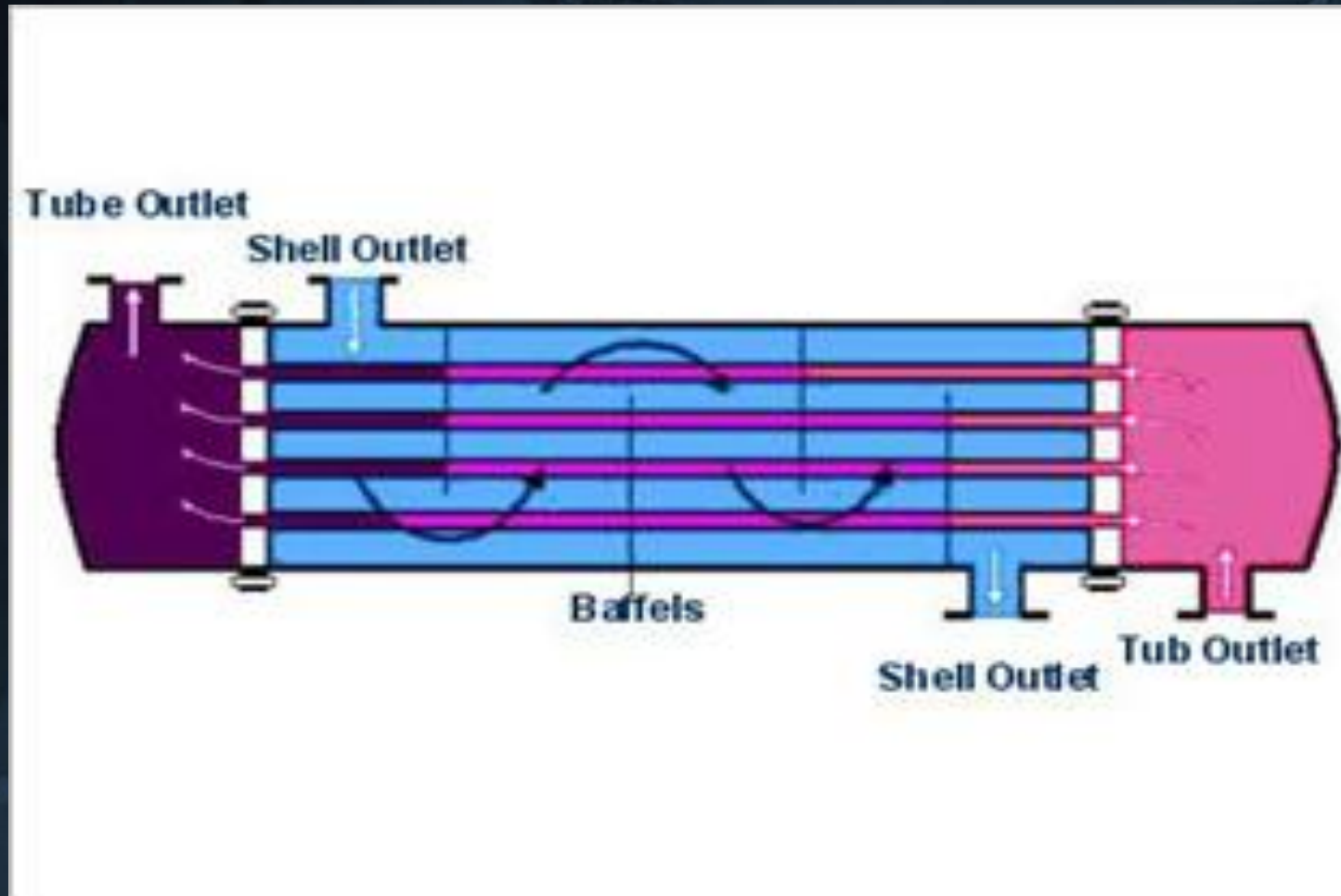
Low income

Own home

**Does not
qualify for
L.A. home
care
assistance**

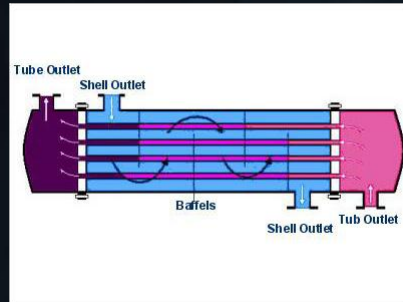
**Fiercely
independent**

The heat exchanger

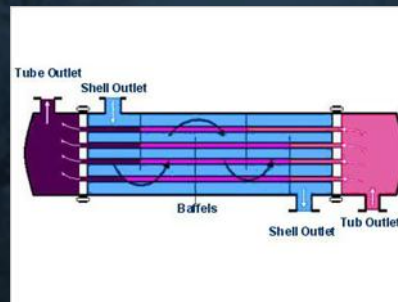


A vertically integrated system is required

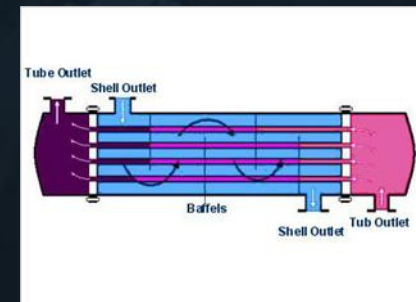
Prevention



Intervention

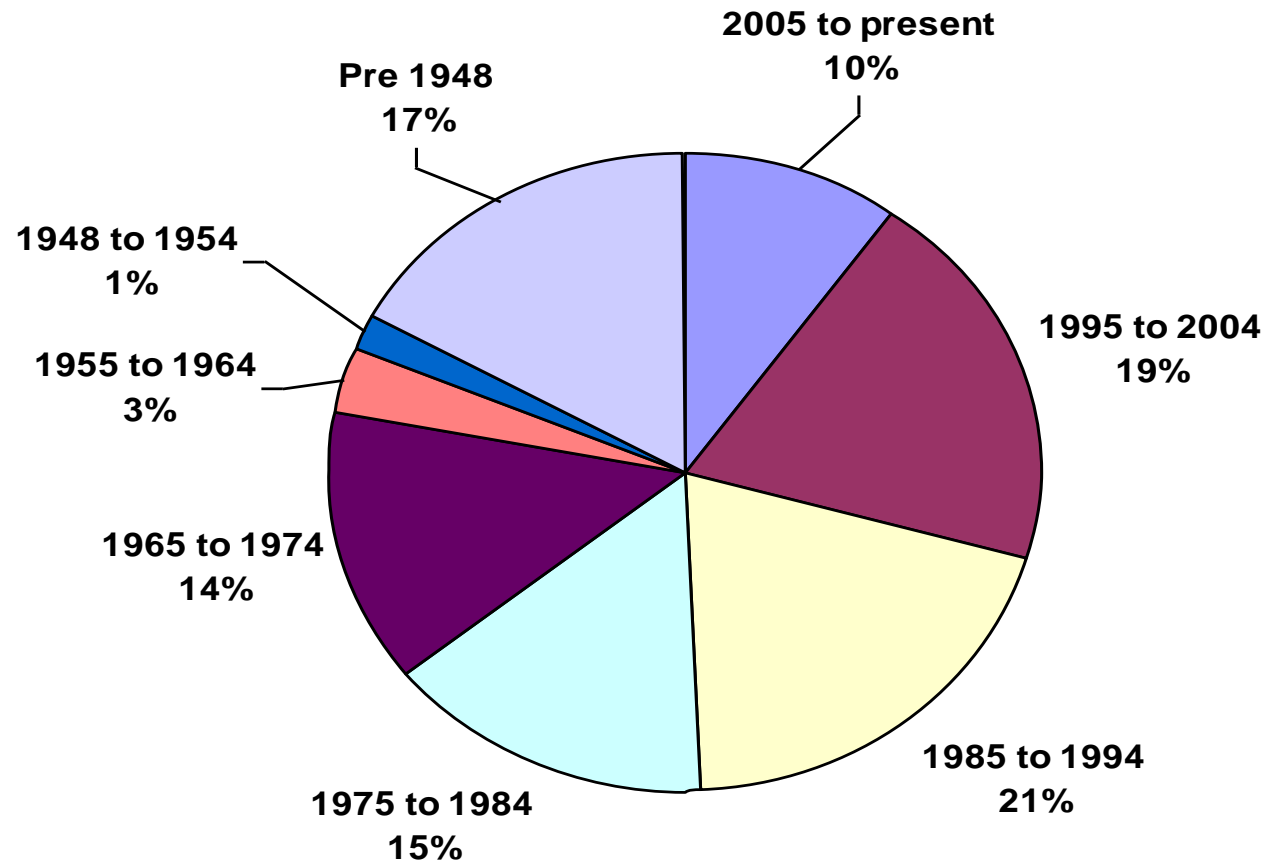


Care



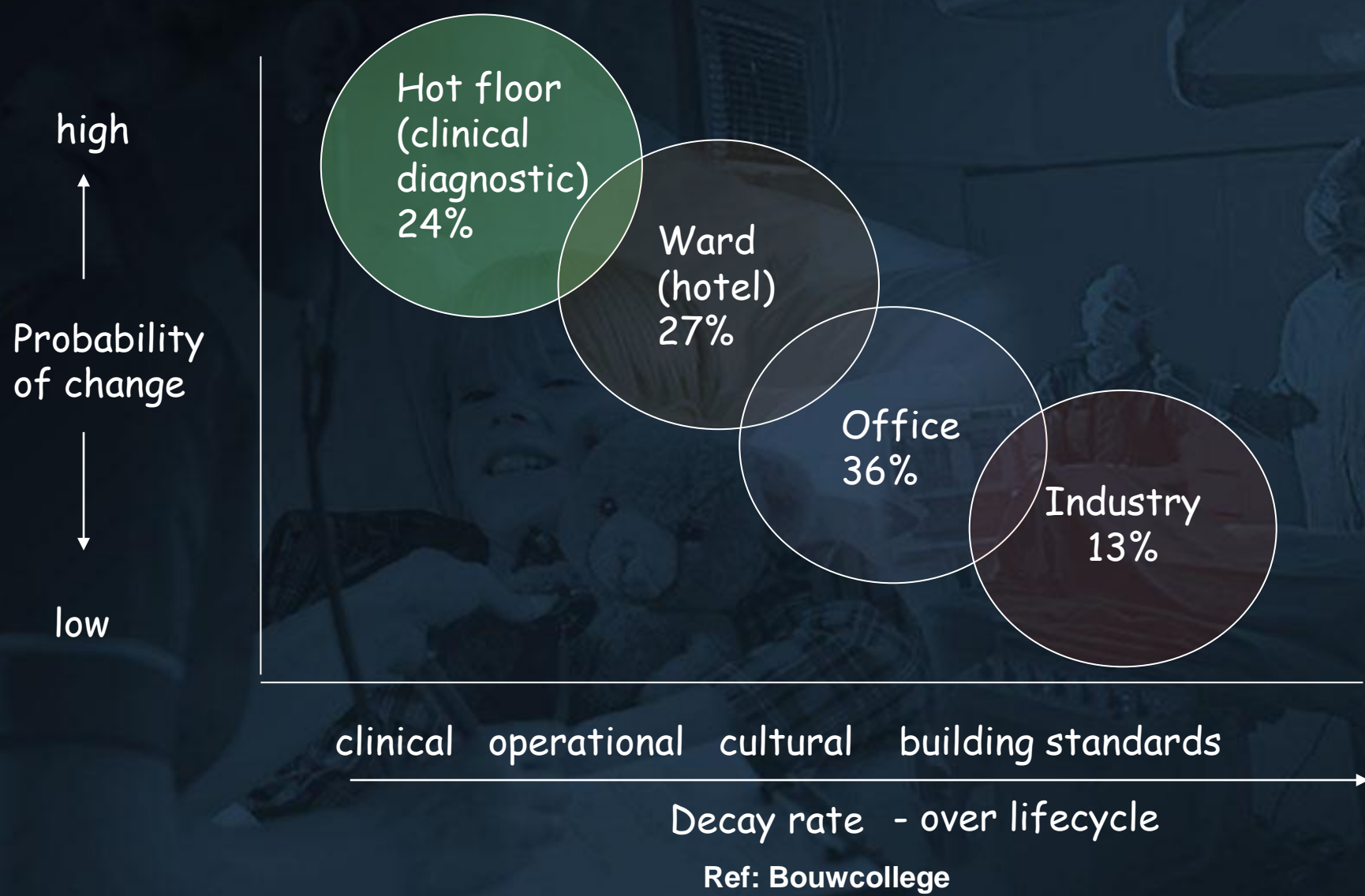
The existing estate – A major challenge

The Age Profile of the NHS Estate in England,
by date of construction

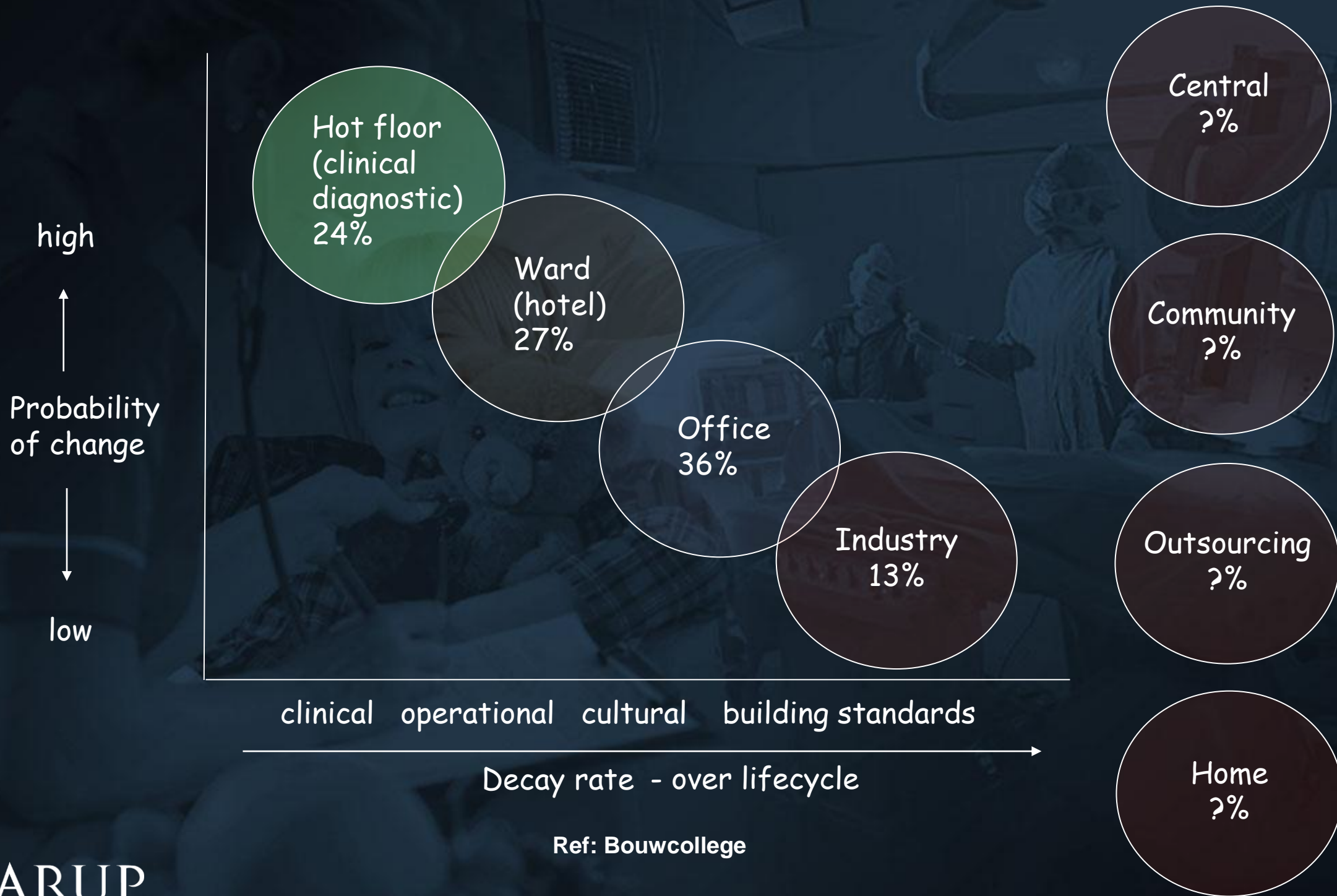


Source: ERIC (Estates Returns Information Collection) 2007-08 returns from the NHS

Flexibility in design



The changing face of healthcare provision



The existing estate – our starting position!



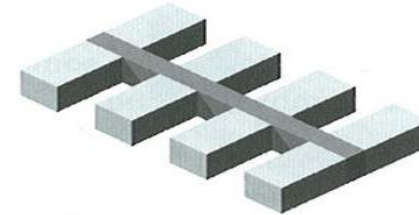
Typical models of the built estate

1. Linked pavilion or finger plan

The oldest typology and still in common use. The pavilions would often have clinical spaces on lower levels with wards above.

Examples

Woolwich Hospital and St Thomas's Hospital, London;
Hotel Dieu, Paris; many others worldwide

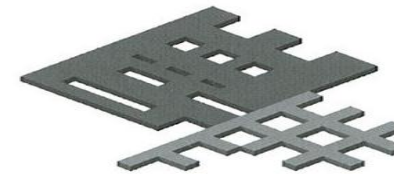


2. Low-rise multi-courtyard or checkerboard

This typology can offer a human scale in contrast to the institutional character that tends to overwhelm most hospital design. However it will tend to apply to the larger, non-urban sites or smaller hospitals.

Examples

Wexham Park Hospital; Venice Hospital (unrealized design by Le Corbusier); Homerton Hospital, London

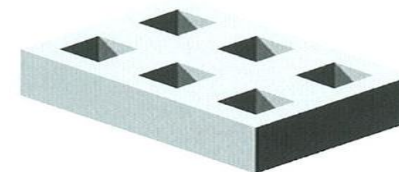


3. Monoblock

The classic compact and circulation efficient type. The small atria/lightwells can take many forms and the lower floors may have fewer, with deep planning for non-patient areas or operating theatres. There is a need for artificial ventilation and the opportunity to incorporate Interstitial Service Floors.

Examples

Greenwich Hospital, London (demolished); Boston City Hospital; McMaster University Hospital, Ontario



Typical models of the built estate

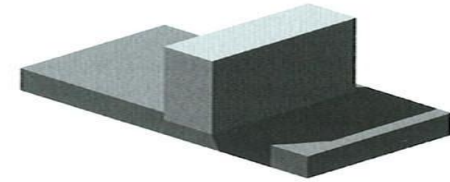
4a. Podium and slab/tower

(also 'Bundled' or 'Stacked' in US)

The wards are generally in the tower with the clinical and technical areas in the slab. This typology can be effective on urban sites with small footprints but the upper floors can be problematic in terms of travelling distance.

Examples

Bridgeport Hospital, Connecticut; Prince of Wales Hospital, Sydney; Royal Free Hospital, London; UCL Hospital (PFI), London

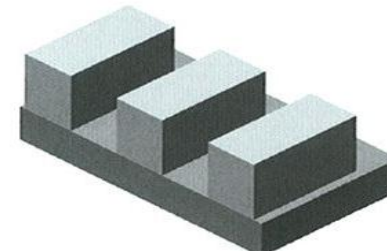


4b. Podium with two or more towers/ blocks over

This typology avoids some of the potential travel distance and scale problems of no. 4a above but will require a larger site.

Examples

Birmingham Hospitals (PFI)

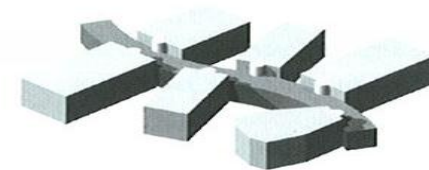


5. Street

The attraction of this type has lain in its flexibility and extendibility as well as the legibility that the street itself offers to patients.

Examples

Wythenshawe Hospital, Manchester; Northwick Park Hospital, London; Westmead Hospital, Sydney; Rikshospitalet, Oslo



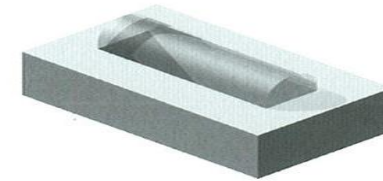
Typical models of the built estate

6. Atrium/galleria

Atria have become extremely common in open plan office buildings where daylight can penetrate working floors from both sides. The cellular character of hospital buildings make atria a less obvious solution but there are a number of successful uses of this typology

Examples

New Children's Hospital, Sydney; Chelsea and Westminster Hospital, London; Hospital for Sick Children, Toronto; University of Maryland Homer Gudelsky Building

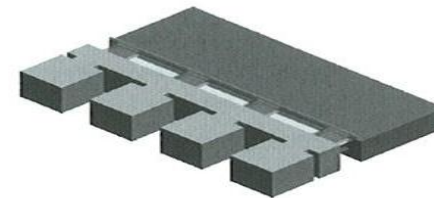


7. Unbundled

Unbundled is a pattern of segregation of the diagnostic and treatment functions on the one hand, and on the other the nursing functions along a shared circulation/support spine. 'Unbundled' is a North American term and the typology is dominant in current design there; but it is also used worldwide.

Examples

Norfolk and Norwich Hospital; many US examples

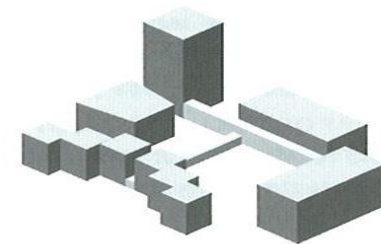


8. Campus

Individual buildings disposed around the site with or without enclosed circulation network.

Examples

Hospital sites that have been built up over the years with successive additions.



Flexible engineering services?



The real cost of refurbishment?

	Narrow Plan (2 Storey)	Narrow Plan (3 Storey)	Intermediate Plan	Deep Plan
Substructure	£2,082,540	£1,417,444	£1,408,147	£996,497
Superstructure	£2,379,005	£2,540,942	£2,612,866	£2,580,671
Roof	£1,865,548	£1,338,273	£1,195,924	£844,742
Façade	£4,678,560	£4,630,479	£4,882,135	£3,397,578
Internal finishes	£4,944,949	£4,931,111	£4,985,500	£5,004,332
Mechanical Services	£3,790,082	£3,762,333	£4,042,619	£4,740,210
Electrical Services (incl. lifts)	£4,150,357	£4,048,077	£4,106,319	£3,939,734
BWIC	£720,261	£617,680	£642,500	£617,680
Preliminaries and contingencies	£6,835,712	£5,942,914	£6,367,686	£5,999,323
Total	£31,447,315	£29,229,253	£30,243,696	28,128,205

What is the real value?

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Approx 13% saving due to a refurbishment!!

Optimising flexibility - #1



Refurbishment – A wise sustainable investment

- Refurbished in a phased manner whilst in occupation
- Single phase with decant – original use
- Single phase with decant - change of use
- Structural integrity – extended floor-plate
- Building engineering systems – impact on space and use
- Consider low energy/carbon solutions
- Consider the requirements for privacy and dignity
- Consider the needs of resilience due to climate change
- Non-viable spatial solution for future models of care - Demolish

FULLY COST THE OPTIONS

All healthcare estate sites should have a development control plan clearly defining the future for the building stock given the likely changes in the provision of healthcare – this is wise sustainable investment!

ORIGIN | HISTORICAL PERSPECTIVE – BRIGHAM AND WOMEN'S



F, E, D, C

Domestic Building

Pavilion A

Administration Building

Entrance Lodge

Outdoor Nurses' Building

GENERAL FACTS

The Hospital covers about 10 acres of land.
225 beds.

Fire-proof throughout.

Some of the chief objects have been to furnish the patients with the optimum amount of light and sunshine, and to make it possible for every patient to be easily moved out of doors.

By several systems, according to the requirements :

1. By the ordinary use of wall windows.
2. By windows in monitor roofs.
3. By accelerating heating coils in stacks.
4. By inlet fans.
5. By outlet fans.

Air Space in Typical Pavilions

2,400 cubic feet per patient.
This air can be changed five times each hour.

Flooring

Largely battleship linoleum cemented to granolithic, except the outside marginal eight feet of open wards on main floor, which space is wholly granolithic to allow of heating by hot water pipes in an enclosed space below this part of the floor.

Heating Wards

1. Hot water direct.
2. By warmed granolithic floors in bed space.
3. By fanning filtered air over hot water pipes into wards.

Plumbing

Single pipe system used throughout.

HOSPITAL GROWTH | A HOSPITAL MUST CHANGE IN ORDER TO REMAIN RELEVANT



New and expanded fields of knowledge created space needs that were difficult for the hospital to meet. “The character of the work done within the walls of an institution is vastly more important than the walls themselves. Even so, it must not be overlooked that if the work is good, it grows, and the time comes when walls must expand in correspondence.” – BWH 1937 Second Master Plan Report

HOSPITAL GROWTH | A HOSPITAL MUST CHANGE IN ORDER TO REMAIN RELEVANT

Hospital Growth Milestones:

1911 Hospital Opens

1937 Second Master Plan

1950's Research spurs New Construction

1969 to 1986 BWH triples in size.

1978 New 500 Bed Patient Tower opens

1994 Ctr for Women and Newborns opens

2008, Shapiro Cardiovascular Building opens.

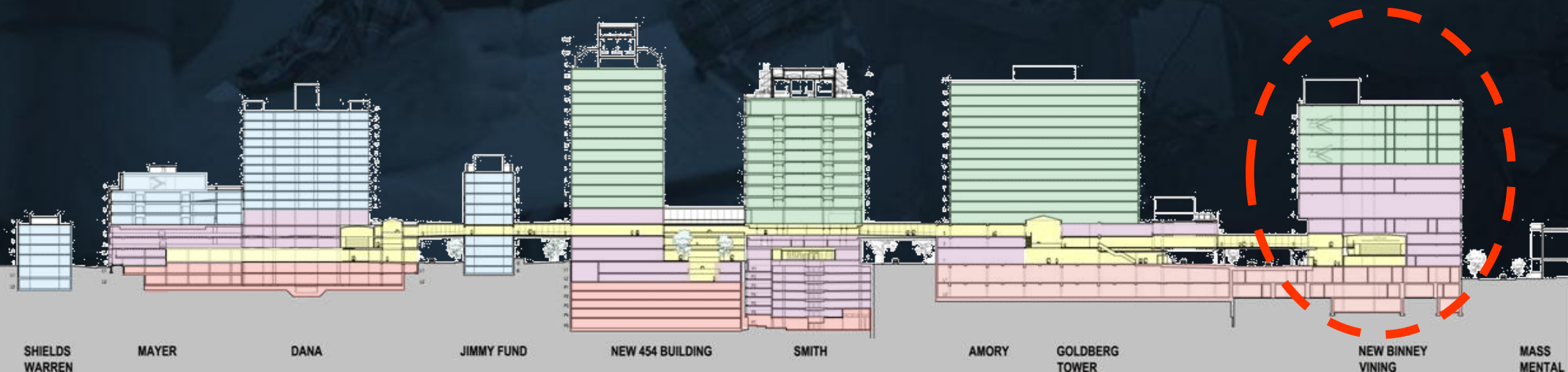
Today, over 2.4 million square feet on main hospital campus.



2008, The Hospital Today

THICK & THIN | HORIZONTAL INTEGRATION - VERTICAL FINGERS

- **Centers of Excellence**
 - Service Line / Disease Centric
 - Discrete Institutions
- **Accommodations**
 - Thematic Centers
 - Institutional Identity
 - Mixed Acuity
 - Bidirectional Bench to Bedside



Innovation taking a historical perspective – Crimea model - circa 1850

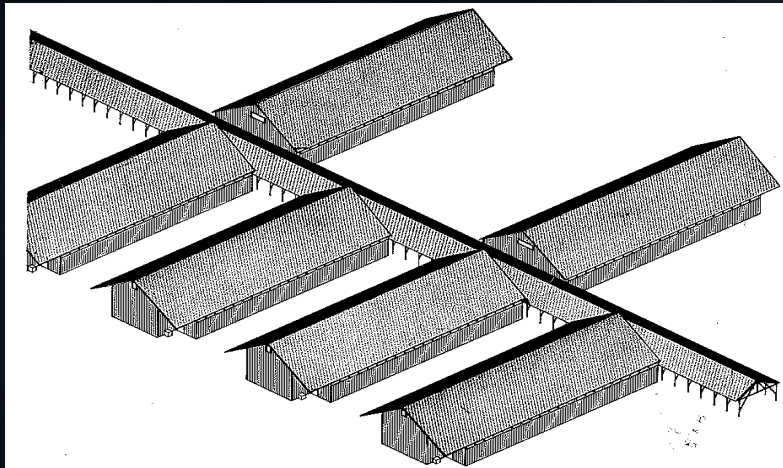


Fig. 11
Isometric drawing illustrating the linear organization of Brunel's standard ward units: pavilions either side of a connecting corridor, characteristic of indeterminate buildings. (Drawn by David Toppin)

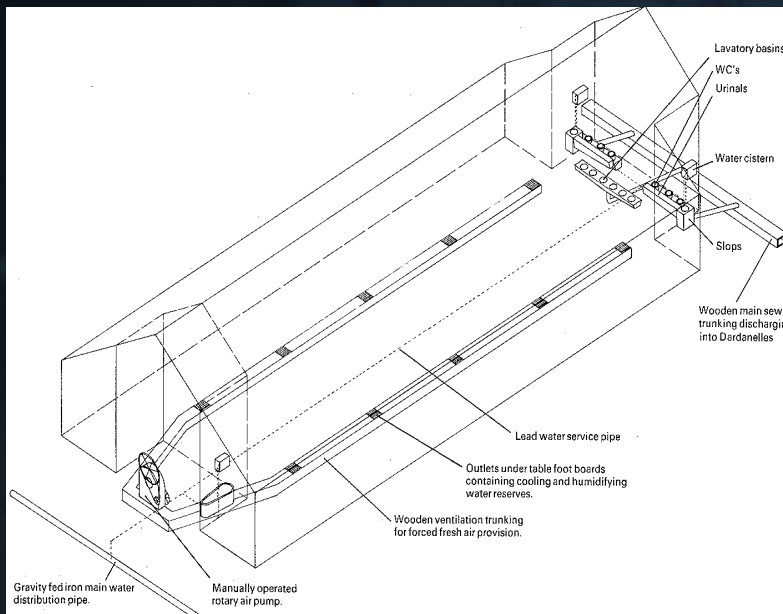


Fig. 12
Isometric drawing illustrating servicing systems in a standard ward unit. (Drawn by David Toppin)

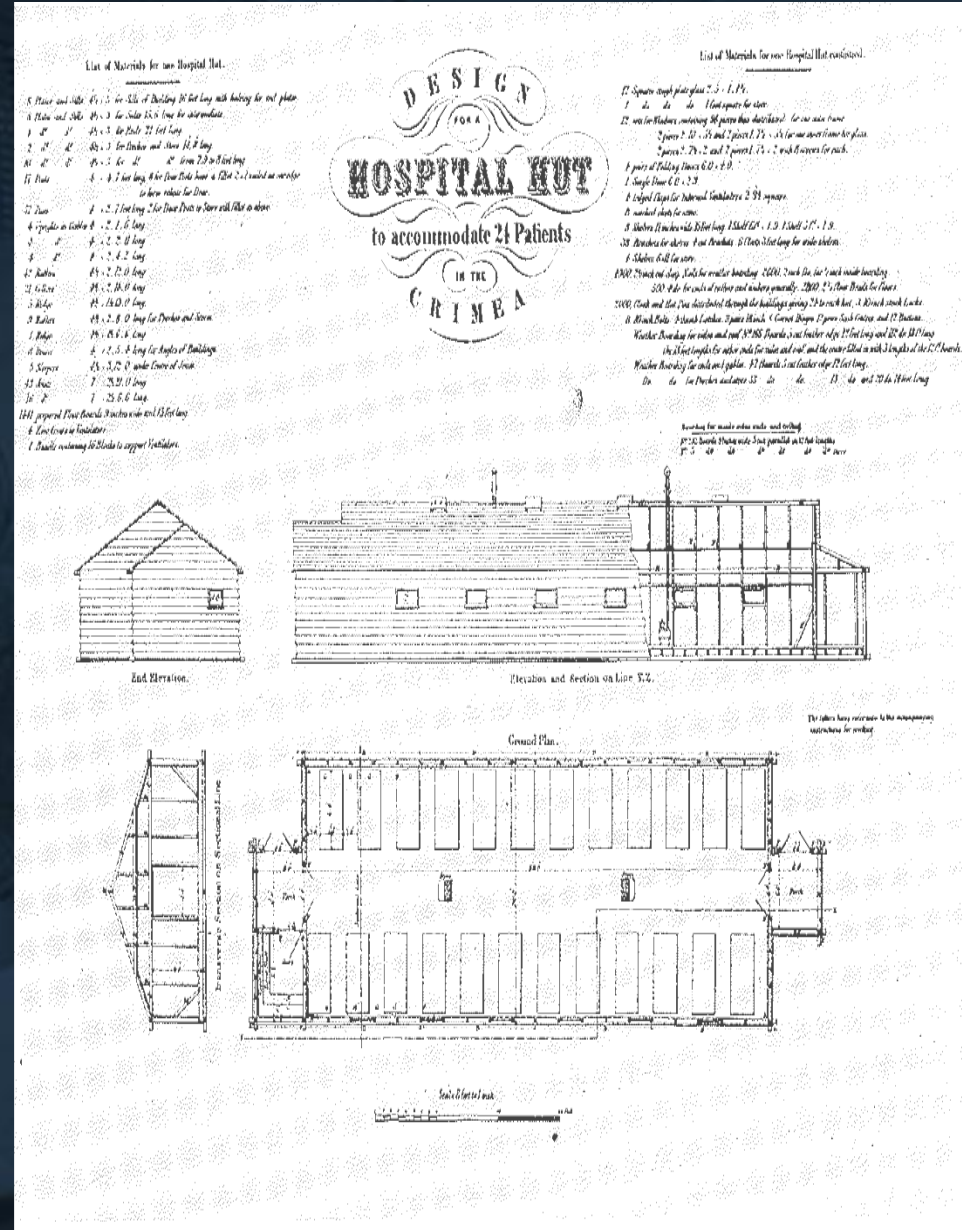


Fig. 9
Drawing of a hospital hut showing coding of components. (Reproduced by courtesy of the Public Record Office, London)

Fig. 10
Drawing of Brunel's ward building. (Reproduced from Dr. E. A. Parkes' report on the formation and general management of Renkioi Hospital, on the Dardanelles, (Turkey).)

Modular design, offsite construction, flexible façade, logistics and underfloor systems

Optimising flexibility - Planning in advance



If this were not a hospital then what could it be?

Narrow plan v's deep plan – Whole life costing

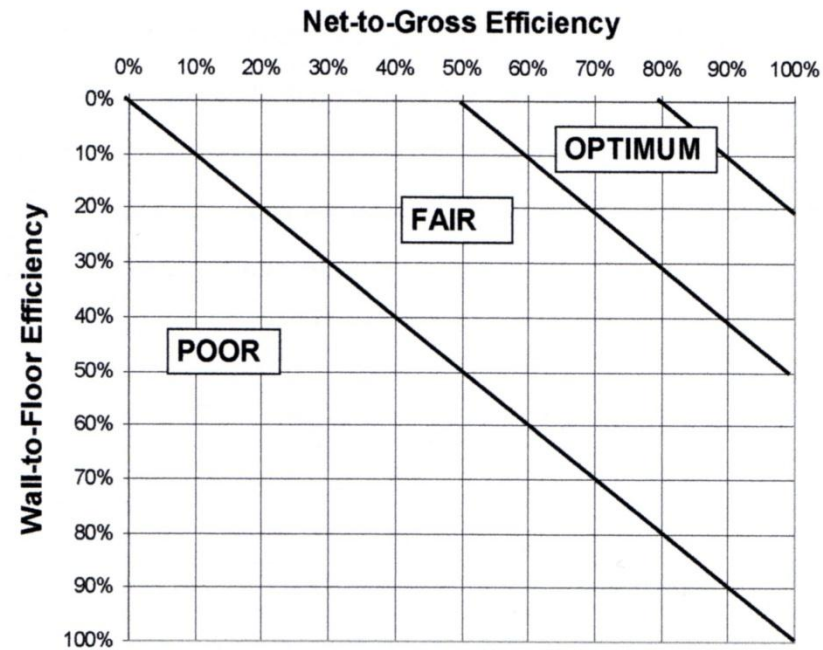
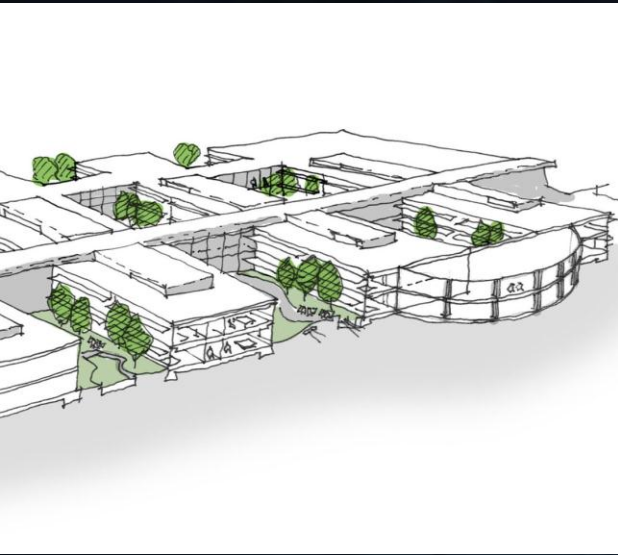
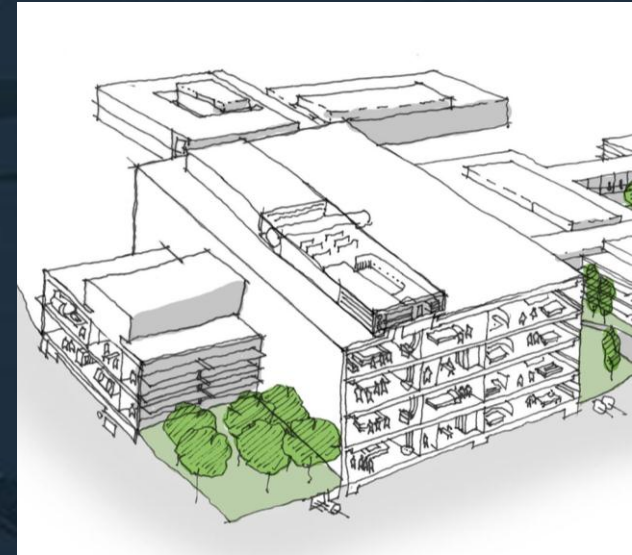


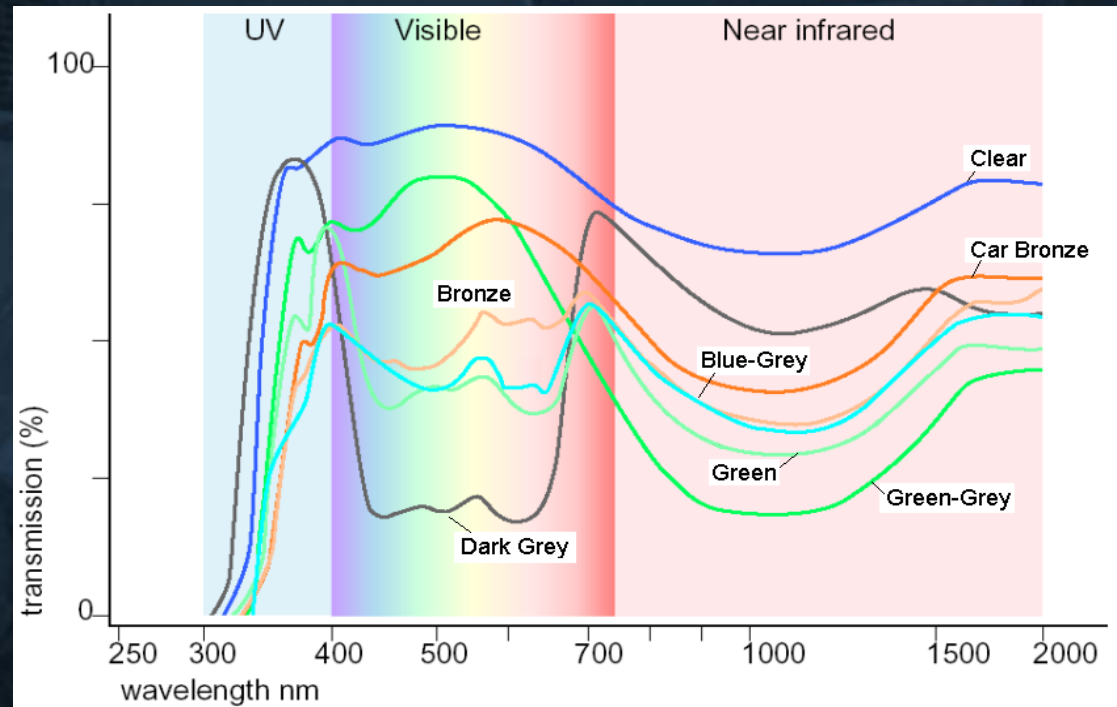
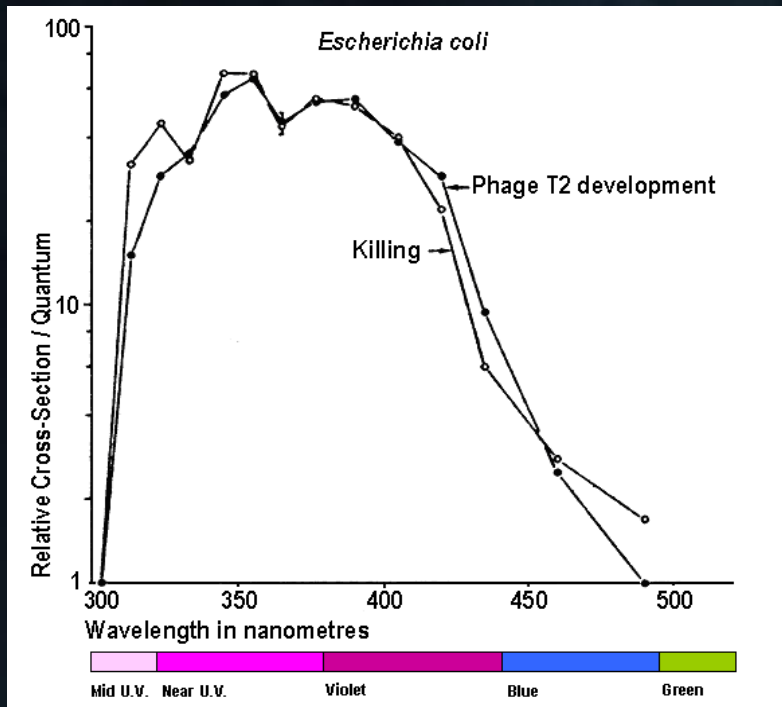
Figure 3.4 Graphical representation of Building Efficiency



- Departmental adjacencies = Clinical efficiencies
- Construction efficiency = Capital cost economies

MICROBES AND LIGHT SPECTRA

The spectra of light microbes are exposed to may influence their growth rates & viability



In many instances light wavelengths that may kill microbes can be screened or heavily filtered through coloured glazing systems. Serotonin released by the patient may be reduced through screening in the same way.

Arup research project involvement

Project 1

An Open-Source Searchable Database to Assess the Impact of Environmental Strategies on Health Outcomes

Project 2

Practical Resilience to Climate Change

Project 3

The Effect of Phase Change Materials on Building Thermal Performance

Project 4

Reinforce links with the Pathogen Control Engineering Institute (PaCE) based at Leed University

Project 5

Reducing the risk of infection through the introduction of single patient bedrooms

Project 6

Application of air disinfectant devices to enhance the respiratory transmission protection in hospital wards

Project 7

Areas of infection risk in healthcare facilities.

Project 8

Beyond Master Planning Beyond Estate strategy

Project 9

The impact of environmental space on delirium in ICU departments

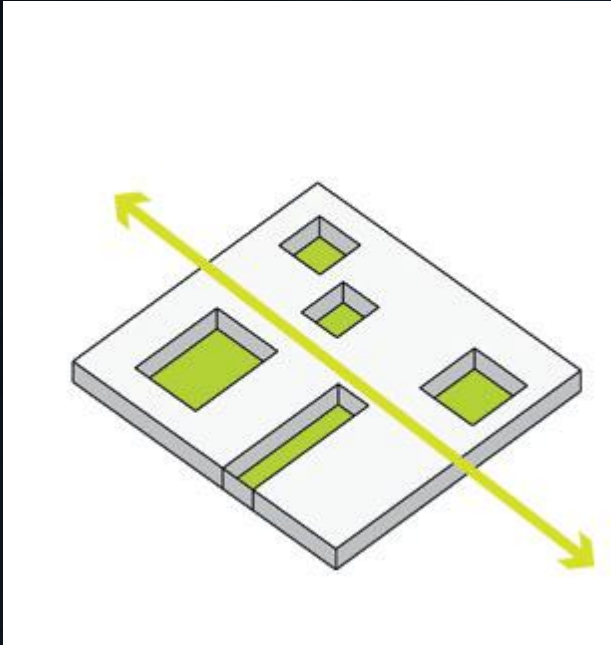
Project 10

The environment for elderly patients in the face of climate change

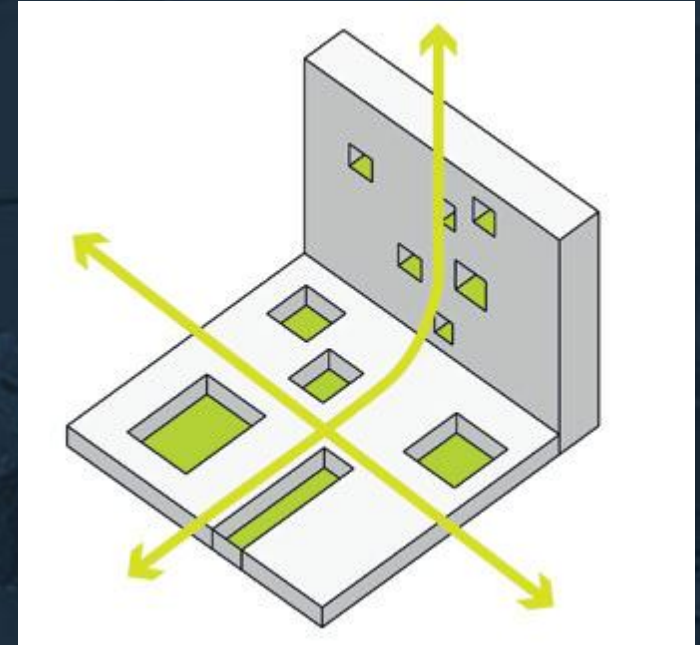
Project 11

The Optimisation of energy efficiency in existing healthcare facilities

Learning from China



World class
Primary care
JCI approved
Tower status
Chinese meds



从宋代城市到现代医院|
From SONG Dynasty to Modern
Hospital Design

Understanding the issues

- The importance of healthcare
- The low hanging fruit – multi faceted, multi discipline problems
- The financial burden – what does it really cost?
- The patient of the future – taking responsibility
- Changing disease burden – demographics and NCD's
- Marketing pressure - the nanny state, so what?
- Changing technology – smaller, smarter, swifter?
- Changing science – miracles in the making
- The existing estate – liability or opportunity
- Co-benefits – the single patient bedroom
- The long game – are politicians able to plan?
- Resistance to change

Questions

- Will the provision of healthcare be a driver of economic success?
- Are we giving the population the right information to enable them to be responsible for their health?
- Do we need government protection against the major food manufacturers?
- Are Trusts developing the their existing estate in line with their long term holistic clinical need – prevention, intervention and care.
- Are we designing the healthcare estate flexibly enough?
- Do we learn sufficient lessons from the existing healthcare estate?
- Are governments really able to take a long term strategic view of healthcare?

“A design team which produces a total, balanced, efficient design can help to produce a better environment.”

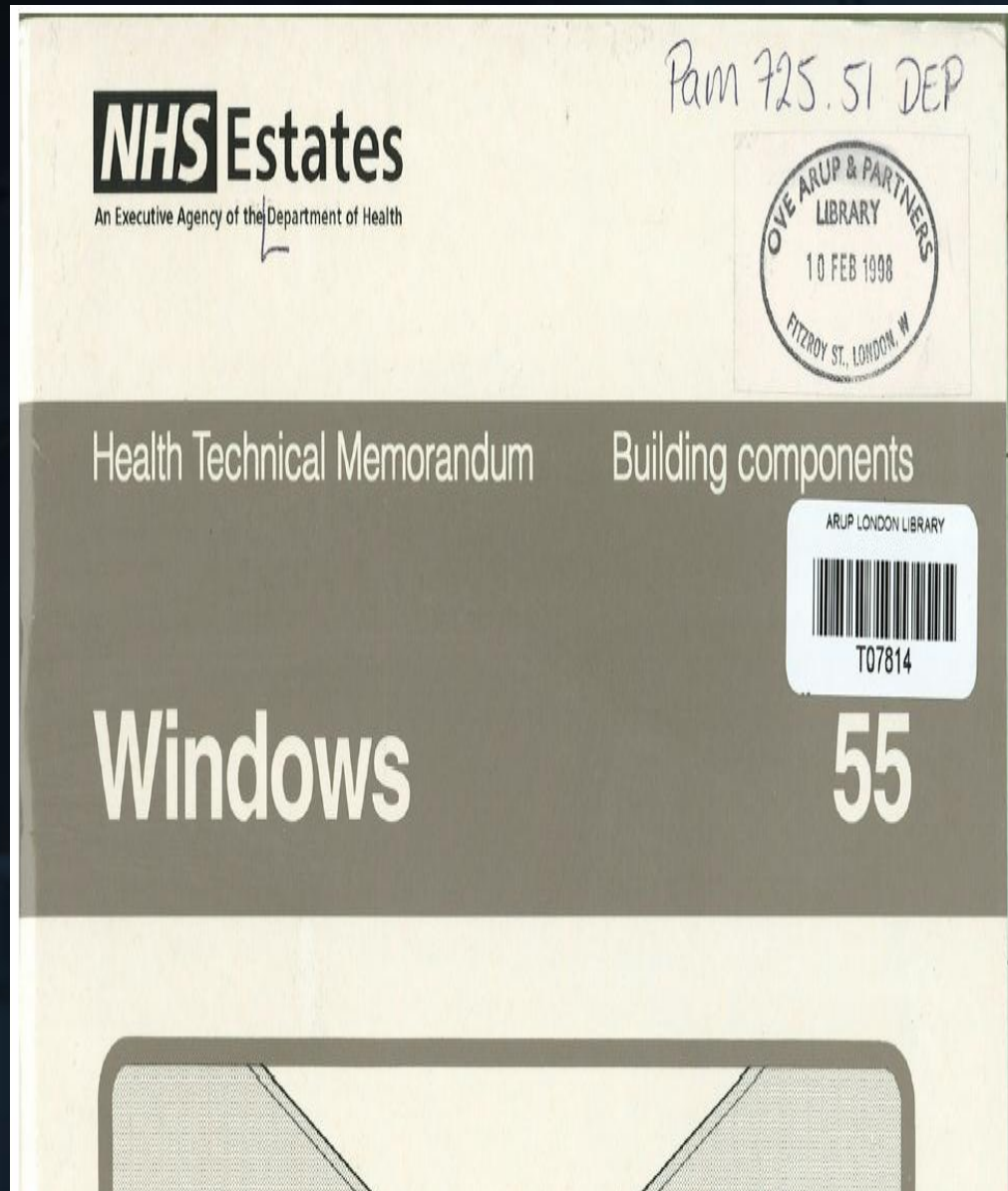
Sir Ove Arup, November 1968



Thank you

ARUP

Influencing Standards & guides



Natural lighting
Natural ventilation
View
Weather tightness
Energy conservation
Sound insulation
Security
Safety
Fire spread
Cleaning

Soaring hospital fuel costs could hit patient care

Jonathon Carr-Brown and Sarah-Kate Templeton

THE energy bills of some NHS hospitals have almost doubled as multinational oil and gas companies increase their prices to the health service by £120m a year.

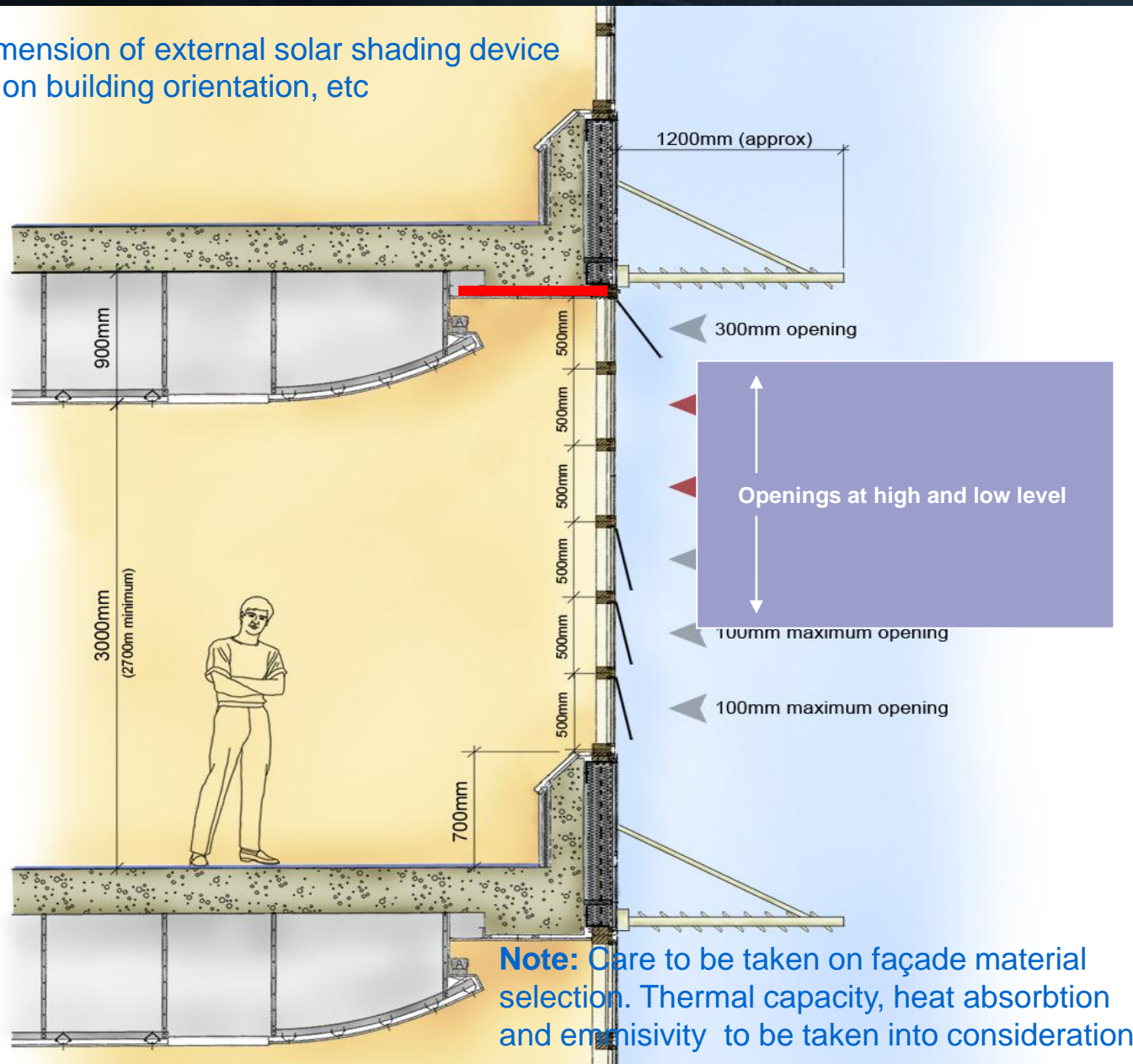
The Department of Health said this weekend that the

which represents health trusts, said: "These price increases could amount to several hundred thousand pounds for each hospital trust, which could be difficult to find in the middle of the year, given all the other financial commitments such as pay rises.

"Hospital trusts do not have a lot of money in reserve. They tend to spend money as they get

Exemplar window design

Note: Dimension of external solar shading device depends on building orientation, etc



Note: Care to be taken on façade material selection. Thermal capacity, heat absorption and emissivity to be taken into consideration

