A talk in four parts

1. Major global health problems

2. Areas where O.R. has made, is making or could make a contribution to global health

3. Gaps in O.R. for global health

4. Enabling an increased contribution to health and development through “real world” O.R.
Part 1

Major global health problems
The last two centuries saw unprecedented improvements in human health....
though recently progress has faltered in some regions.
The major global burdens of disease fall unequally and differently.

Premature mortality by broad cause and country-income group

<table>
<thead>
<tr>
<th>Low income</th>
<th>Middle income</th>
<th>High income</th>
</tr>
</thead>
<tbody>
<tr>
<td>234</td>
<td>103</td>
<td>55</td>
</tr>
</tbody>
</table>

Years of life lost (YLL) per 1000 population

- Communicable diseases, maternal and perinatal conditions and nutritional deficiencies
- Noncommunicable conditions
- Injuries

Source: WHO, World Health Statistics 2010 (figures are for 2004)
Life expectancy around the globe varies by a factor of 2.

Source: WHO Global Health Observatory 2010
Child mortality around the globe varies by a factor of 20 or more

Under-5 mortality rate (probability of dying by age 5) per 1000 live births, 2008

Source: WHO Global Health Observatory 2010
Maternal mortality around the globe varies by a factor of 100 or more.

Maternal mortality per 100,000 live births 2008

Source: Hogan et al, Lancet 375, 1609-1623, 8 May 2010
Non-communicable diseases form an increasing part of the global burden.
Smoking is a ticking timebomb for health in the developing world

The tobacco epidemic: A model
Long lag time between exposure and disease

% F deaths  % F smokers  % M deaths  % M smokers

% of smokers among adults % of all deaths caused by smoking

Time in years

Many developing countries

Western Europe

Lopez et al. Tobacco Control 1994;3:242
Most of the UN Millennium Development Goals focus on health

Eight goals were set in 2000 that all 191 United Nations member states agreed to try to achieve by 2015. Six are focused on health.

The health-related goals are:

**Goal 1:** Eradicate poverty and hunger *(by half)*

**Goal 4:** Reduce child mortality *(by two thirds)*

**Goal 5:** Improve maternal health.

**Goal 6:** Combat HIV/AIDS, malaria and other diseases.

**Goal 7:** Ensure environmental sustainability *(e.g. sustainable access to safe drinking water and basic sanitation.)*

**Goal 8:** Develop a global partnership for development *(e.g. working with pharmaceutical companies on access to affordable essential drugs in developing countries)*
Overall, there has been (mixed) progress on the Millennium health-related goals

Source: WHO Technical Briefing on Millennium Development Goals 2010

STOP PRESS!
Final UN progress report just published (6 July 2015) shows similarly patchy picture
A major initiative has been the creation of the Global Fund to Fight AIDS, TB and Malaria.
Though other diseases of the “bottom billion” have been comparatively neglected

A dozen or so parasitic and bacterial infections – including hookworm, filariasis, schistosomiasis, trachoma and onchocerciasis - constitute the group known as “neglected tropical diseases”.

Some estimate these have a higher global health burden than two of the three targets of the Global Fund - malaria and tuberculosis - yet they receive less than 1% of total development assistance for health.

Photo source: Imperial College London, Faculty of Medicine
Research in global health is also a neglected area – at least for low-income regions

International spread of infectious diseases or of resistance to drugs has rightly received a good deal of attention from researchers.

Less analytical attention appears to have been given to the other aspects of global health, particularly the problems of delivering health improvements to regions with few resources.
Areas where O.R. has made, is making or could make a contribution to global health
Operational Research is needed to help dispel the “fog of delivery” in global health

Improving global health requires increasing resources and making best use of what resources there are.

It has been estimated that the Millennium Goal of preventing two-thirds of global child deaths could be achieved if existing interventions were fully implemented.

Interventions that are efficacious in trial conditions are often much less effective in real world conditions where operational problems can be critical.

What resources will really be required? What assists or impedes delivery?

How can all the components work together to best effect? What impacts would various levels of implementation have?

This presents a global research challenge, not least to management science.
O.R.’s key role in “downstream” research can also inform “upstream” developments

Operational research is not an alternative to clinical and laboratory research, it is both an adjunct to and an ally of it, offering to add “real-world leverage” at low risk.

Although the immediate focus of operational research tends to be on “downstream” operations – typically service delivery – knowledge thereby gained can crucially feed back to inform “upstream” developments.
There has been – and is – useful operational research on global health issues

Project on **primary care operations research (PRICOR)** was established in 1981 by US AID. 49 studies were carried out in 32 countries on financing, staffing, distribution and organisation in community health programmes.

International Union Against Tuberculosis and Lung Disease led **operational research projects to develop the current global strategy for tuberculosis control** subsequently marketed by WHO as the ‘DOTS’ strategy.

Much **modelling work on HIV/AIDS**, including a special publication by the OR Society in 1994.

The Clinton Center for Strategic HIV Operations Research develops **decision support models for HIV treatment** and their application in resource-limited settings.
There is a wide range of future global health delivery challenges.

- Identifying problems and potential interventions
- Choosing interventions
- Introducing interventions
- Integrating interventions into health systems
- Scaling up interventions
- Evaluation
ORMS approaches can make a valuable contribution to global health delivery.

- Identifying problems and potential interventions
- Choosing interventions
- Introducing interventions
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- Evaluation

Scenario analysis and other “futures” methods can be brought to bear.

Modelling can assist rapid assessment of options for innovation in unconventional settings.

Combined or integrated interventions present major design and implementation challenges that systems thinking can inform and accelerate.

Requires forecasting demand, deciding location and size of facilities and setting staffing levels; all amenable to ORMS techniques such as simulation.
ORMS is already making some valuable contributions to global health delivery.

- Global monitoring and computer modelling by NASA alerted Kenyan authorities to an outbreak of an epidemic and led to local action that saved hundreds of lives.
- A simulation model for capacity planning at HIV clinics showed how the demand on public sector physicians for HIV services in Rwanda could be reduced by four-fifths.
- Scenario analysis has been used to investigate possible futures for scenarios for AIDS in Africa up to 2025.
- A system dynamics model of polio management showed that eradication was a better strategy than control.

Scenario analysis work showed how the performance of cervical cancer prevention programmes in developing countries critically depends on a range of factors at different levels of the health system.
This work won the prestigious Edelman award for 2014.

A system dynamics model of polio management showed that eradication was a better strategy than control.

Thompson KM and Duintjer Tebbens RJ
Part 3

Gaps in O.R. for global health
Five gaps in O.R. for global health

- Funding
- Methods
- Links
- Implementation
- Skills
The first gap

Funding
There is very limited funding support to operational research in global health

Global health research funding is heavily weighted toward “upstream” areas such as the development of new vaccines and drugs.

Only 3% of the funding from the US National Institutes of Health is for research on delivery and use.
... although there are signs of change......

The Global Fund to Fight AIDS, TB and Malaria allows 5-10% of each grant to be allocated for “monitoring, evaluation and operations research”

Two of the three UK Department for International Development’s Research Strategy priority areas for development research in health focus on operational issues, including “operational research to make health programmes more effective”
but there could still be a spending shortfall of a billion dollars.

The Global Fund spends much less than its guideline budget of 5-10% for operational and related research – a shortfall of at least $100m.

More generally a WHO report estimated that just 0.02% of total health expenditure in low and middle income countries is devoted to such research.

A goal of even 0.3% (one-tenth the percentage budgeted by Global Fund projects) would imply a need for an additional annual spend of some $1bn for operational and related research for global health.
There are several types of funding problems for operational research for global health

Operational research is (rightly) seen as part of strengthening health systems, but this is not seen as job of research funders, while resource-limited countries often do not (or cannot) prioritise it.

Research funding often needs to fund not only the research but also the system improvements to enable the research. This is of course costly.

Little of the research funding for global health is going to researchers working in low-income countries. (Particularly ironic for operational research).

It is also difficult for global health researchers based in the industrialised world to access funds – the Global Fund provides support to and through countries rather than support to NGOs.
The second gap in O.R. for global health
Analytical tools are under-used in research on global health delivery.

Operational research can be almost any improvement-oriented investigation into a programme’s operations.

Operational research tends to focus on illuminating problems through the use of modelling and related analytical techniques.
ORMS tools are not mentioned in the current guidance on operations research in global health!
O.R. provides a broad spectrum of “hard” and “soft” analytical tools of which global health work could make more use.
These tools have **systems thinking** at their core.

**accepting uncertainty**

- brainstorming
  - behavioural simulation
    - scenario analysis
  - soft systems

**GROUP**

**qualitative**

- system dynamics
  - discrete event simulation
    - mathematical modelling
    - statistical analysis

**quantitative**

**individual**

**seeking certainty**
Spread systems thinking!

**Traditional thinking**

- **Static** – focus on particular events
- **Tree-by-tree** – focus on details
- **Linear** – focus on unidirectional causes

**Systems thinking**

- **Dynamic** – focus on patterns of behaviour over time
- **Forest** – focus on context
- **Loop** – focus on interactions between causes and events

Adapted from Richmond B. “The ‘thinking’ in systems thinking: seven essential skills.” Pegasus Communications 2000.
The need for systems thinking in global health is increasingly being recognised

“systems thinking has huge and untapped potential, first in deciphering the complexity of an entire health system, and then in applying this understanding to design and evaluate interventions that improve health and health equity.”

*Systems Thinking for Health Systems Strengthening.* 2009. WHO
A balanced approach would combine practicality with rigour.

Focus on practical problem solving:
- **Risk of “methodology lite” fieldwork with lack of rigour**
  - LOW
- **Use of appropriate tools in a search for real world solutions**
  - HIGH

Use of analytical techniques:
- **Risk of oversophisticated technique with lack of practical relevance**
  - LOW
- **HIGH**
The third gap
The global health research and the ORMS communities are largely separate.
It is important to publish not only in academic ORMS journals....
...but also in publications that our clients read

The fourth gap in O.R. for global health

Implementation
Success factors for operational research in global health have been identified

Recent article in the Lancet* highlighted factors for successful operational research in low-income countries:

- ensuring direct relevance to the programme
- partnering with local programmes
- building local research capacity
- developing trained researchers
- developing the research role of NGOs

Success factors identified by the PRICOR programme* some 25 years earlier:

- a systematic methodology for problem analysis, solution development and testing
- a flexible approach to choice of modelling approaches and analytical techniques
- promotion of utilisation of research findings through involvement of program managers and policy makers
- procedures for training host country staff in operations research


These are pretty similar to suggested key requirements for successful O.R. anywhere!

<table>
<thead>
<tr>
<th>Factors affecting success or failure of OR application</th>
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<tbody>
<tr>
<td><strong>Factors affecting project success</strong></td>
</tr>
<tr>
<td>Management support/involvement</td>
</tr>
<tr>
<td>Verifiable and useful results</td>
</tr>
<tr>
<td>Well organised/communicated/presented</td>
</tr>
<tr>
<td>Economic benefits/business results</td>
</tr>
<tr>
<td>Understanding true spirit of request</td>
</tr>
<tr>
<td>User support/involvement</td>
</tr>
<tr>
<td>Timeliness</td>
</tr>
<tr>
<td><strong>Factors leading to project failure</strong></td>
</tr>
<tr>
<td>Too technical/abstract approach</td>
</tr>
<tr>
<td>Customer not sold on the project</td>
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<tr>
<td>Poor communication</td>
</tr>
<tr>
<td>Poor problem definition/planning</td>
</tr>
<tr>
<td>Lack of professional competence</td>
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<tr>
<td>Over budget, not timely</td>
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OR Practice: survey results and reflections of practising INFORMS members

L. Abdel-Malek¹, C Wolf¹, F Johnson² and T Spencer III²

There is a common set of hurdles to overcome for success in O.R.
The fifth gap in O.R. for global health
Worldwide capacity building is a key enabler for operational research in global health

Nearly all work has stressed the importance of capacity strengthening and mentoring of researchers and investigators in the relevant countries.

“For example The International Union Against Tuberculosis and Lung Disease has adopted a process to:
• identify focal persons within a country’s health service who will lead and champion operational research
• engage them in a rigorous programme of training
• demand a product of published scientific articles and a process to track policy transfer
• provide the limited financial support needed to carry out the research

“The Millennium Development Goals will not be attained without new research addressing health system constraints as well as to build research capacity in less developed countries” WHO
A number of centres for operational research on global health have been established

- Centre for Operational Research established in 2009 by the International Union against Tuberculosis and Lung Disease
- Center for Strategic HIV Operations Research, Clinton Foundation
- Operational Research Unit of Medecins sans Frontieres, Luxemburg
- Schistosomiasis Consortium for Operational Research and Evaluation

The Global Health Delivery Project involving Harvard University and others, sees its work as being informed by management science, system science, and operations research.

There are also relevant operational research projects at various universities, such as, in the UK, London, Liverpool, Leeds, Southampton, Cardiff...

Note however that these are all based in the industrialised world!
Enabling an increased contribution to health and development through “real world” O.R.
Some features of the (organisational) Real World

• Situations can be uncertain, complex and changing
• There is often a flood of data but a drought of knowledge
• It’s often not known what will work best, better, or at all
• Decision-makers are busy and not always very numerate
• Decisions are based on a mix of analysis and intuition
• People are looking for solutions to problems
- Situations can be uncertain, complex and changing - helping map and navigate in such environments
- There is often a flood of data but a drought of knowledge
- It’s often not known what will work best, better or at all
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We live in an often unpredictable world that we don’t understand very well

A turkey is fed for a 1000 days—every day confirms that the human race cares about its welfare "with increased statistical significance". On the 1001st day, the turkey has a surprise.
We need to watch for trends and for discontinuities - *white sails* and *black swans*

- **Health trends**
  - e.g. ageing population, obesity, telecare

- **Health discontinuities**
  - e.g. AIDS, Viagra, Avian Flu
Healthcare may be turned upside–down

20th Century Health Care?

21st Century Health Care?
We have a wide range of tools to help map and navigate complex, uncertain & changing systems

**accepting uncertainty**
- brainstorming
  - behavioural simulation
    - scenario analysis
    - soft systems

**GROUP**

**INDIVIDUAL**

**QUALITATIVE**

**QUANTITATIVE**

- system dynamics
  - discrete event simulation
  - mathematical modelling
  - statistical analysis

**seeking certainty**
“Soft O.R.” can help
.....as can the latest modelling ideas and tools....
…..and scenario analysis for futures thinking.
• Situations can be uncertain, complex and changing
• There is often a flood of data but a drought of knowledge - adding value to “big data” analytics
• It’s often not known what will work best, better or at all
• Decision-makers are busy and not always very numerate
• Decisions are based on a mix of analysis and intuition
• People are looking for solutions to problems
INFORMS has been in the vanguard of promoting analytics.
The OR Society now has an Analytics Section

IN THIS QUARTER’S ISSUE:

- Is predicting the future, fantasy or good mathematics?
- You’re so ‘data scientist’ and you don’t even know it!
- What’s next for Analytics?
- Mathematica Upgrade
- Artificial Intelligence Knows When People Tweet
- Data Farming

the Analytics Network

a section of the OR Society
Modelling adds value in data analytics

What happened? Descriptive Analytics

What could happen? Predictive Analytics

What’s best? Prescriptive Analytics

- Data Visualisation
- Simulation
- Regression modelling
- Systems modelling
- Optimisation
• Situations can be uncertain, complex and changing
• There is often a flood of data but drought of knowledge
• **It’s often not known what will work best, better or at all – encouraging and assisting evaluation**
• Decision-makers are busy and not always very numerate - communicating key insights
• Decisions are based on a mix of analysis and intuition
• People are looking for solutions to problems
A current example from my own work – evaluating the application of mobile phones for delivering essential healthcare information in low resource settings
Mobile phones have gone global

Mobile phone subscriptions 2001-11 for developed & developing countries

Households with internet access 2002-11 for developed & developing countries


Growth is particularly rapid for mobile broadband (internet) services. **Internet use on mobile phones in Africa is predicted to increase 20-fold over the next five years**, double the rate of growth in the rest of the world (Guardian, 6 June 2014)
The Afrobarometer survey gives key information about mobile phone use in many countries in Africa.

For example, over the past decade, mobile phone coverage has grown in Africa at staggering rates.

“In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa”
President Paul Kagame, President of Rwanda (Connect Africa Summit, October 2007).

“It’s hard to overstate how much mobile phones have changed the shape and form of life in Africa. Every stratum, every fiber of the fabric of life here has changed because of mobile phones”. Erik Hersman, Stanford Social Innovation Review, Spring 2013.

- In 1999, only 10 percent of the African population had mobile phone coverage, primarily in North and South Africa.

- By 2008, 60 percent of the population (477 million people) had mobile phone coverage.

Mobile phones are increasingly being used in health care around the whole globe.
But evaluation is patchy – as a first step criteria need to be established for evaluating mHealth applications in low resource settings

Applications need to pass through a filter funnel of success criteria e.g.

- Significance of the health problem(s)
- Appropriateness of the targeting
- Value of the information
- Ease of assimilation of the information
- Availability of the application
- Technological accessibility of the application

Ref: www.hifa2015.org/the-first-hifa-smart-goal-mobile-healthcare-information-for-all/
Allowing an assessment of the potential of different applications
Situations can be uncertain, complex and changing

There is often a flood of data but drought of knowledge

It’s often not known what will work best, better or at all

Decision-makers are busy and not always very numerate - communicating key insights

Decisions are based on a mix of analysis and intuition

People are looking for solutions to problems
Managers look for the 80/20

The Pareto Principle

20% of input (time, resources, effort) accounts for 80% of output (results, rewards)
Analysts need to look for 80/20 ways of improving their impact e.g. finding ways of communicating key analytical insights so that they get into managers’ heads!
WARNING!

Poor mental models and measures can damage an organisation’s - and people’s - health.
The Third Generation Pill Scare Was A Result Of Confusion Between Relative And Absolute Risk

The papers screamed “new pill doubles risk of fatal thrombosis”

This mortality risk (possibly) had doubled - from about 2 per million women per year to about 4 per million

The scare has been estimated to have led to an extra 13,000 abortions in the UK alone
Risk are best understood through simple graphics

From http://understandinguncertainty.org/
Use of these ideas in a patient leaflet about prostate cancer screening

from *Risk Savvy* G. Gigerenzer 2013
Two books every manager, politician, journalist and analyst should read!
• Situations can be uncertain, complex and changing
• There is often a flood of data but a drought of knowledge
• It’s often not known what will work best, better or at all
• Decision-makers are busy and not always very numerate
• **Decisions are based on a mix of analysis and intuition – modelling behaviour**
• People are looking for solutions to problems
We are good at the “physics” of decision modelling

– but what about the psychology?
O.R. needs to do better at incorporating and integrating the “psychology” with the “physics” in models of human activity systems.
The capacity to model agent behaviour is growing
It is important to look at – and to model - how people actually behave!
Real decision making blends analysis and intuition.
Less can be More

Please evaluate all five items...
• Situations can be uncertain, complex and changing
• There is often a flood of data but a drought of knowledge
• It’s often not known what will work best, better or at all
• Decision-makers are busy and not always very numerate
• Decisions are based on a mix of analysis and intuition
• **People are looking for solutions to problems** – developing design thinking
O.R. is obviously about **analysis** but also involves **search** and **synthesis**

Where did A and B come from? Might there also be a C or D?

Simple choice A or B?

How do A or D and X, Y and Z fit together in space or time?
Search and synthesis are key tasks of design.
Analysis and synthesis should combine to form a double helix in O.R.
Four Ds (and one E) in O.R.

**Discovery**
- understanding situations
- diagnosing problems
- defining goals

**Design**
- identifying options
- developing solutions

**Decision**
- understanding likely results
- choosing options

**Delivery**
- Implementation
- collaboration
- project management

**Evaluation and learning**
“Design is not just what it looks like and feels like. Design is how it works.”

Steve Jobs

“Design is the art of gradually applying constraints until only one solution remains.” Unknown
“Design thinking” is penetrating business management
We all need to engage **both sides of the brain!**
**Left brain**


**Right brain**

Welcome to the joint workshop!

O.U. Centre, London.

13 February 2014
“Real world” O.R. – summary points

• Situations can be uncertain, complex and changing - *helping map and navigate in such environment*

• There is often a flood of data but It’s often not known what will work best, better or at all – *adding value to “big data” analytics*

• Decision-makers are busy and not always very numerate - *communicating key insights*

• Decisions are based on a mix of analysis and intuition – *modelling behaviour*

• People are looking for solutions to problems – *developing design thinking*
In “real world” O.R. the primary focus should be on addressing questions like....

• How well is this system performing? Why?
• What would count as an improvement? For whom?
• What changes might bring about improvements?
• How could we assess their likely success?
• How do we compellingly present our findings?
• How can desired changes be implemented?
• How will we know if there has been improvement?
In the health field there has recently arisen some relevant - but so far largely separate – thinking about “improvement science”

“The term improvement science recently emerged to identify a field of research focused on healthcare improvement. The primary goal of this scientific field is to determine which improvement strategies work as we strive to assure effective and safe patient care.”
O.R. *is* an **improvement** science!
Articulating the “science of better” requires “real world” O.R. to be:

not just about a bag of tools and techniques

but to be rigorously and systematically based on the theory and practice of system improvement.
A “systems improvement science” view helps weave the strands of “real world” O.R. into an integrated, coherent whole.
Some conclusions

Assuming that global health is a reasonably representative case, O.R. is making valuable contributions to development but there are many gaps and potential to contribute much more widely.

Major gaps relate to funding and connections and these need to be addressed; but others relate to methods, skills and implementation – requiring a strong emphasis on “real world “ O.R.

“Real world” O.R. involves not only “decision physics” but also problem structuring, behavioral science, design thinking and other elements needed for an articulated “science of better”.

O.R. for Development would gain from being, and being seen as, a broad “systems improvement science”.
O.R. as a coherent science of systems improvement

For the “real world”

For Development

Questions and Comments?