Medical Research & Innovation: unlocking its potential in health systems

Glenda Gray
SAMRC

14th October 2015
Anova’s 4th Annual HSS Symposium
Scope

• Burden of disease and its role in setting medical research priorities

• Evidence that introducing interventions impact on lives in RSA

• Innovation in the Health System: potential for impact

• Need for Health R&D in RSA
### SA MRC is committed to addressing the burden of disease that impacts health

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Deaths</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>180,870</td>
<td>29.4</td>
</tr>
<tr>
<td>Hypertensive heart disease</td>
<td>39,272</td>
<td>6.4</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>38,576</td>
<td>6.3</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>37,913</td>
<td>6.2</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>37,519</td>
<td>6.1</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>26,564</td>
<td>4.3</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>24,510</td>
<td>4.0</td>
</tr>
<tr>
<td>Interpersonal violence</td>
<td>20,155</td>
<td>3.3</td>
</tr>
<tr>
<td>Road injuries</td>
<td>18,166</td>
<td>3.0</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>13,667</td>
<td>2.2</td>
</tr>
<tr>
<td>COPD</td>
<td>11,458</td>
<td>1.9</td>
</tr>
<tr>
<td>Nephritis/nephrosis</td>
<td>9,130</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Top 12 causes</strong></td>
<td>457,800</td>
<td>74.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>615,788</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The quadruple burden of disease in South Africa: A cocktail of four colliding epidemics

- **Maternal, newborn & child health**
  - ~1% of global burden
  - 3-3 times > average for comparable countries

- **HIV/AIDS and TB**
  - 17% of HIV burden
  - 23 times > global average
  - 5% of TB burden
  - 7 times > global average

- **Non-communicable diseases**
  - <1% of global burden
  - 3-3 times > average developing countries

- **Violence and injury**
  - 1.3% global burden of injuries
  - 2 times global average for injuries
  - 5 times global average for homicides

Source: Lancet Series
## Leading causes of death, 2nd NBD Study for SA

<table>
<thead>
<tr>
<th>Year</th>
<th>Cause of Death</th>
<th>Deaths</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td><strong>HIV/AIDS</strong></td>
<td>60,336</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>Cerebrovascular disease</td>
<td>31,472</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>Interpersonal violence</td>
<td>30,569</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td><strong>Tuberculosis</strong></td>
<td>26,344</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Ischaemic heart disease</td>
<td>23,813</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Lower respiratory disease</td>
<td>21,908</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>Diarroheal diseases</td>
<td>18,737</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Hypertensive heart disease</td>
<td>15,771</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>Road injuries</td>
<td>15,159</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>11,321</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td><strong>Top 10 causes</strong></td>
<td>255,429</td>
<td>61.9</td>
</tr>
<tr>
<td></td>
<td><strong>Total deaths</strong></td>
<td>416,209</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Cause of Death</th>
<th>Deaths</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td><strong>HIV/AIDS</strong></td>
<td>153,661</td>
<td>29.1</td>
</tr>
<tr>
<td></td>
<td>Cerebrovascular disease</td>
<td>39,830</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Lower respiratory infections</td>
<td>25,977</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Ischaemic heart disease</td>
<td>24,969</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td><strong>Tuberculosis</strong></td>
<td>23,817</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>18,894</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Hypertensive heart disease</td>
<td>18,755</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Interpersonal violence</td>
<td>18,741</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Road injuries</td>
<td>17,597</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Diarroheal diseases</td>
<td>16,349</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td><strong>Top 10 causes</strong></td>
<td>358,589</td>
<td>67.8</td>
</tr>
<tr>
<td></td>
<td><strong>Total deaths</strong></td>
<td>528,946</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Children under 5 years, South Africa 2012

N=47,760

- Lower respiratory infection 12%
- Diarrheal disease 16%
- HIV/AIDS 19%
- Septicaemia 2%
- Meningitis 2%
- Tuberculosis 2%
- Other childhood conditions 7%
- Malnutrition 5%
- Neonatal deaths 26%
- Neonatal other 2%
- Pneumonia 1%
- Congenital abnormalities 3%
- Injuries 6%
- Malnutrition 5%

Source: 2nd National Burden of Disease Study
Scope

• Burden of disease and its role in setting medical research priorities

• Evidence that introducing interventions impact on lives in RSA

• Innovation in the Health System: potential for impact

• Need for Health R&D in RSA
Every additional year of life expectancy raises the regions GDP by an estimated 4% (UNAIDS 2013)
Life expectancy by sex, South Africa

Source: Rapid Mortality Surveillance System
Childhood death rates, South Africa 1997 - 2012

Deaths per 1,000 live births

Source: 2nd National Burden of Disease Study
Age standardised death rates for cancers by sex, SA 1997 – 2010

Source: 2nd National Burden of Disease Study
**Maternal & Child Health**

The ESMOE-EOST scale-up programme has demonstrated an improvement in knowledge and skills of health care professionals and has been shown to reduce deaths of mothers and babies.
Comparison iMMR before and after saturation training (ST) in 8 districts

Before ST from 2011
RR 0.78, 95% CI 0.67-0.90

RR 0.80, 95% CI 0.65-0.992
Comparison of perinatal mortality rates before and after

≥ 1000g
RR 0.93 95% CI 0.91-0.95

≥ 2500 g
RR 0.91 95% CI 0.84-0.99
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### SAMRC funding in Innovation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>90M</td>
<td>210M</td>
</tr>
<tr>
<td>TB</td>
<td>37M</td>
<td>235M</td>
</tr>
<tr>
<td>Malaria</td>
<td>16M</td>
<td>20M</td>
</tr>
<tr>
<td>NCD</td>
<td>18M</td>
<td>135M</td>
</tr>
<tr>
<td>MCH</td>
<td>4.5M</td>
<td>75M</td>
</tr>
<tr>
<td>Ebola</td>
<td></td>
<td>10M</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>10M</td>
</tr>
<tr>
<td>TOTAL</td>
<td>165.5</td>
<td>695M</td>
</tr>
</tbody>
</table>
Flagship Program

• Sample projects

• Evaluating a new drug regimen for patients with multi-drug resistant TB – a randomised controlled trial

• Effectiveness of an alcohol-focused intervention in improving adherence to antiretroviral therapy (ART) and HIV treatment outcomes

• A multi-disciplinary approach to understand the causes and consequences of HIV transmission and drug resistance in hyper-epidemic setting in rural South Africa

• The impact of rape in women on HIV acquisition and retention linkages to care: a longitudinal study
Rapid diagnosis of tuberculosis in resource poor settings

- Advantages:
  - Unlike GeneXpert, this technology detects three unique *M.tb* genes in sputum
  - Pooled sensitivity of 73% and specificity of 95% - better than sputum microscopy
  - Differentiates between live and dead bacteria (prevents false positives)
  - Developed for point-of-care

- Disadvantages
  - Uses sputum

- Next Steps:
  - Develop an assay for drug resistance testing
  - Look for funding and commercial partner to develop working prototype (closed & automated system)
Rapid diagnosis of tuberculosis in resource poor settings (cont.)

TB PROTEC (Part 1)

SERS DEVICE (Part 2)

Figure 1. TB-PROTEC, a new generation lateral flow assay-like POC biosensor. Sample pad, fluid channel, electrochemical sensor, micro processor and the digital display is outlined.
Urinary TB biomarkers (Part 3)

- Distinguish between active TB and non-TB, regardless of HIV status
- Detect TB in urine – helpful esp. for HIV+ people and children
- No isolation of intact pathogens or nucleic acid amplification required
Mobile Triage Solution
TRIAGE - The South African Triage Scale:
<table>
<thead>
<tr>
<th>High energy transfer (severe mechanism of injury)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortness of breath - acute</td>
</tr>
<tr>
<td>Level of consciousness reduced / confused</td>
</tr>
<tr>
<td>Coughing blood</td>
</tr>
<tr>
<td>Chest pain</td>
</tr>
<tr>
<td>Stabbed neck</td>
</tr>
<tr>
<td>Haemorrhage - uncontrolled (arterial bleed)</td>
</tr>
<tr>
<td>Seizure - post ictal</td>
</tr>
<tr>
<td>Focal neurology - acute (stroke)</td>
</tr>
</tbody>
</table>
VERY URGENT

Patient:  
Date: 10/02/2014  
Time: 14:51

TEWIS: 0
Age: 21 Yr
Discrim: Chest pain
RR: 12/m
BP: 125/80
Temp: 95
Ketone: -
Diabetic: T
A/R/P/A: A
Paeds: Weight ---
O2sat: ---
Adrenaline
Atropine
Ketamine
Glucocorticoids

Please be aware: Do ECG and handover to SHCP because of Chest pain.

Additional Discriminator Information

Note:

South African Medical Research Council  
BUILDING A HEALTHY NATION THROUGH RESEARCH
KDH Pilot
Very Urgent

Triage Started: 27 Feb 2015 at 4:38:01 PM

Patient Details
Full Name: Yellow Face
Gender: Female
Age: 39 years, 0 months

Vitals
Respiratory Rate: 36 / min
Heart Rate: 100 / min
Blood Pressure: 125/ 85 mmHg
Temperature: 38.8°C
Glucose: --
Haemoglobin: --
SpO2: 99%

Pediatric Dosages
Calculated Weight: -- kg
Uncuffed ET Tube: -- kg
Dextrose: -- Ls/min
Fluid Bolus: -- ml
Ketamine Induction: -- mg
Adrenaline: -- ml
Atropine: -- ml
Glucose: -- ml

TEWS
TEWS: 6
Mobility Measurement: Walking
AVPU: --
Trauma: Yes

Additional Investigations
Shock Index: No
Diabetic: No
Suspected Pregnancy: No
Pregnant: No
Ketone: --

Urine Dipsticks
Blood: --
Leucocytes: --
Protein: --

Ketones: --
Glucose: --
Nitrate: --

Discriminator
Seizure - post ictal
A patient that had a seizure and is still not fully alert (i.e. confused, only responding to a verbal stimulus, painful stimulus or

Alerts
Please give paracetamol 1 g orally stat because of high temperature. (Don’t forget to document in the notes)
<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Age</th>
<th>Gender</th>
<th>Condition</th>
<th>TEWS</th>
<th>Time in System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown Female</td>
<td>2 yrs</td>
<td>Female</td>
<td>Child has facial or inhalation burn</td>
<td>0</td>
<td>0 hours 29 mins</td>
</tr>
<tr>
<td>Jane Doe</td>
<td>22 yrs</td>
<td>Female</td>
<td>Shortness of breath - acute</td>
<td>4</td>
<td>0 hours 28 mins</td>
</tr>
<tr>
<td>Gary Maartins</td>
<td>22 yrs</td>
<td>Male</td>
<td>Dislocation of finger OR toe</td>
<td>3</td>
<td>0 hours 13 mins</td>
</tr>
<tr>
<td>Aphiwe Jones</td>
<td>26 yrs</td>
<td>Male</td>
<td></td>
<td>0</td>
<td>0 hours 11 mins</td>
</tr>
<tr>
<td>Laura Jones</td>
<td>16 yrs</td>
<td>Female</td>
<td></td>
<td>0</td>
<td>0 hours 8 mins</td>
</tr>
<tr>
<td>Joshua Door</td>
<td>35 yrs</td>
<td>Male</td>
<td></td>
<td>0</td>
<td>0 hours 8 mins</td>
</tr>
<tr>
<td>Tasneem Henry</td>
<td>46 yrs</td>
<td>Female</td>
<td></td>
<td>0</td>
<td>0 hours 6 mins</td>
</tr>
<tr>
<td>William Kili</td>
<td>56 yrs</td>
<td>Male</td>
<td>Dislocation of larger joint (not finger or toe)</td>
<td>2</td>
<td>0 hours 26 mins</td>
</tr>
<tr>
<td>Alice Coombs</td>
<td>36 yrs</td>
<td>Female</td>
<td></td>
<td>3</td>
<td>0 hours 9 mins</td>
</tr>
</tbody>
</table>
Analytics
Blood and nutritional conditions
Cardiovascular conditions
Central nervous system conditions
Dental and oral conditions
Ear, nose and throat conditions
Endocrine conditions
Eye conditions
Family planning
Gastro-intestinal conditions
Human immunodeficiency virus and
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<table>
<thead>
<tr>
<th></th>
<th>Disease burden in Africa, millions of disability-adjusted life years</th>
<th>Basic research, number of articles</th>
<th>Clinical trials, number of trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>46.7</td>
<td>2,501</td>
<td>212</td>
</tr>
<tr>
<td>Lower-respiratory infection</td>
<td>42.2</td>
<td>299</td>
<td>20</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>32.2</td>
<td>293</td>
<td>6</td>
</tr>
<tr>
<td>Malaria</td>
<td>30.9</td>
<td>1,844</td>
<td>205</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>10.8</td>
<td>894</td>
<td>44</td>
</tr>
<tr>
<td>Neoplasms (tumors)</td>
<td>6.2</td>
<td>485</td>
<td>188</td>
</tr>
<tr>
<td>Meningitis</td>
<td>5.3</td>
<td>206</td>
<td>6</td>
</tr>
<tr>
<td>Lymphatic filariasis</td>
<td>2.3</td>
<td>59</td>
<td>1</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>1.6</td>
<td>126</td>
<td>8</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>1.5</td>
<td>322</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>346.9</strong></td>
<td><strong>31,729</strong></td>
<td><strong>1,627</strong></td>
</tr>
</tbody>
</table>

Source: clinicaltrials.gov, US National Institutes of Health; Thomson Reuters Web of Science; World Health Organization (WHO); McKinsey analysis
Physicians Working

Africa with a population of 800 million trains 6000 medical doctors, the same as Europe with a population of 60 million
Science Growth
Table 7: Number of Web of Science Journal Publications by South Africans

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Publications</td>
<td>4,173</td>
<td>4,526</td>
<td>4,709</td>
<td>5,446</td>
<td>6,117</td>
<td>6,949</td>
<td>7,629</td>
<td>8,155</td>
<td>9,437</td>
<td>9,793</td>
</tr>
<tr>
<td>% of World Share</td>
<td>0.49</td>
<td>0.50</td>
<td>0.51</td>
<td>0.55</td>
<td>0.58</td>
<td>0.62</td>
<td>0.65</td>
<td>0.67</td>
<td>0.73</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Source: Thomson Reuters “InCites”

Figure 4: SA Scientific Publications in We
Scientific Productivity is a much better predictor of economic wealth and human development than any other variables.
**Insufficient Investment!**

Bulk of our R&D investments come from foreign sources therefore alignment between local R&D efforts and local priorities will remain difficult to achieve.

Need concerted efforts by government & local stakeholders including private sector, research community and influential individuals!
Need to create a sustainable health R&D structure in Africa, less than 10% of the funding of R&D comes from local money.

Current efforts aimed at treating African diseases depend on organisations outside Africa!
Local Ownership of the Health R&D process is a concern

The bulk of funding is external which translates directly to the under representation of Africans in organisations devoted to Africa’s health problems.

9-14% of Board Members of International Organisations are African.

A self sufficient Pan African R&D system is required to meaningfully address the health needs of Africans, but this requires commitment from our governments which has been lacking thus far.
What does the SAMRC as regards funding innovation in the R&D arena?

• Seek, fund and manage multi-disciplinary and multi-institutional product research, development and innovation projects from prototype to proof of concept

• Develop local and international partnerships to increase the likelihood of success and reduce costs to market

• Develop pathways to facilitate movement of new products and services from the laboratory to the marketplace

• Facilitate the transfer of research outputs into improved health outcomes and/or social benefits

• Enhance the capacity of South African science to improve the Health of the Nation
Tackling Africa’s Health Challenges offers us the opportunity not only to improve the well-being of citizens but also to initiate a virtuous cycle in which health investments boost economic productivity, providing resources for a further investment in health systems (Sachs & Malaney 2002)
Thank You!