



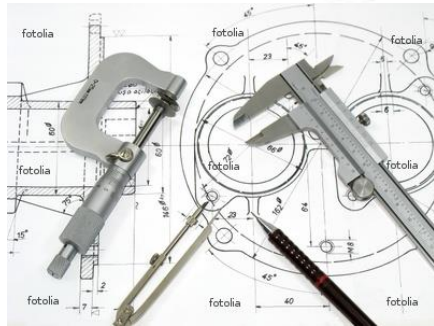
University of  
**Strathclyde**  
Engineering

**BIOMEDICAL ENGINEERING**  
Technology for Life

# Need, prevention, barriers and impact; a physical health technology perspective for low-income countries

*Dr Arjan Buis, Biomedical Engineering, University of Strathclyde*

# Biomedical Engineering



It combines the design and problem solving skills of engineering with medical and biological sciences to advance healthcare treatment, including diagnosis, monitoring, treatment and therapy



**Engineering**

**Medical & biological sciences.**

# Activity Scope (research)

Medical Imaging & Signal Processing

Biosensors

Tissue Engineering

Prosthetics & Orthotics

Modelling

Artificial Organs

Biomechanics

Artificial Intelligence

Synthetic Biology

Wound Dressings

Assistive Technologies

Drug Delivery

Diagnostics

Orthopaedic Implants

Biomaterials

Rehabilitation Engineering

Medical Devices

Neuroprosthetics

Sterilisation

Intensive Care Life Support

Haptic & Machine Interfaces

Battlefield Medicine

Biocompatibility

Neural Engineering

Medical Robotics



# Need

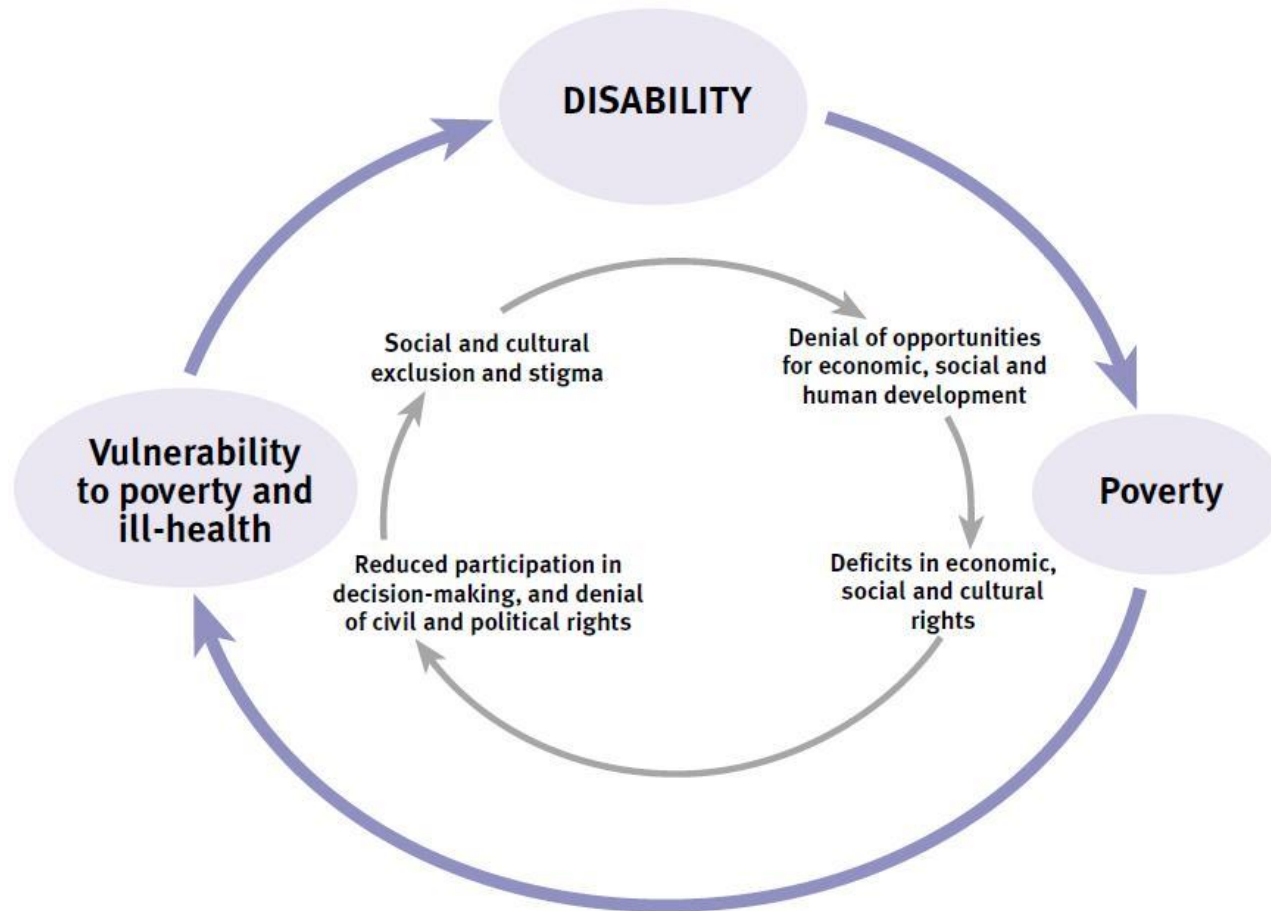
- It is estimated that 650 million people worldwide are disabled.
- This equates to approximately 10% of the world's population. Of those people, 80% currently live in low income countries (LICs).<sup>1</sup>
- The World Health Survey carried out in 2004 found, across 59 countries, the prevalence rate of disability in the adult population to be 15.6%, from 11.8% in High Income Countries to 18% in LICs. <sup>2</sup>
- LIC's account for 84% of the world's population and 90% of the total disease burden. <sup>3</sup> However, fewer than 3% of persons with disabilities in LIC's have access to required rehabilitation services.<sup>4</sup> Without access to the rehabilitation they require, those with disability may become entrenched in a cycle of poverty

1. EIDE AH and ODERUD, T. Assistive technology in low-income countries. In: MacLachlan M, Swartz L, eds. Disability & international development: Towards inclusive global health. New York: Springer, 2009. p. 149-158.

2. World Health Organization/World Bank, The World Report on Disability. WHO, Geneva, Switzerland, 2011 Available at [http://whqlibdoc.who.int/publications/2011/9789240685215\\_eng.pdf](http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf)

3. OLUNSANYA BO. Global health priorities for developing countries: some equity and ethical considerations. *J Natl Med Assoc.* 2008 ; 100 (10) :1212-1217.

4. BOYCE W. Adaptation of Community Based Rehabilitation in Areas of Armed Conflict. *Disability World: Asia Pacific Disability Rehabilitation Journal.* 2000 11: 17-20



Poverty and Disability, reproduced from the  
Department for International Development

# Disability



# Prosthetic examples





# Orthotic examples



# Need

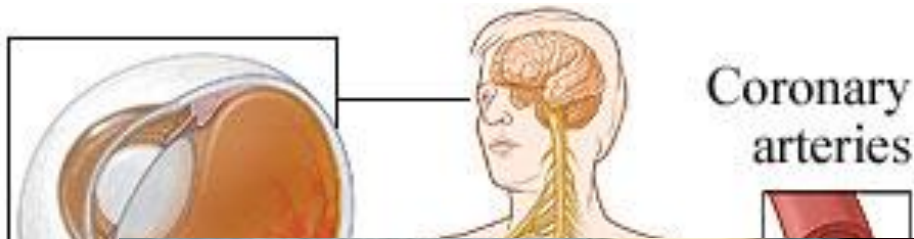
- It is estimated that amongst the disabled people living in LIC's the need for prostheses will have risen to 34 million by 2015.<sup>1</sup>
- The need for orthotic intervention is thought to be even higher, <sup>2</sup> but remains underreported as requirements are not as visible as are those of prosthetics.<sup>3</sup>

1. EIDE AH and ODERUD, T. Assistive technology in low-income countries. In: MacLachlan M, Swartz L, eds. Disability & international development: Towards inclusive global health. New York: Springer, 2009. p. 149-60.

2. PUPULIN E. A personal view of prosthetics and orthotics. Prosthetics and Orthotics International, 2001;25: 93-95. Available from: <<http://informahealthcare.com/doi/pdf/10.1080/03093640108726580>>.

3. STAATST. The rehabilitation of the amputee in the developing world: a review of the literature. Prosthetics and Orthotics International, 1996; 20: 45-50. Available from: <[http://www.oandplibrary.org/poi/pdf/1996\\_01\\_045.pdf](http://www.oandplibrary.org/poi/pdf/1996_01_045.pdf)>.





Coronary arteries

# Diabetes

Diabetes is a chronic condition where high blood sugar levels in the blood are caused by a lack of insulin or the body's inability to use insulin properly. Insulin is the hormone that regulates glucose in the blood. Diabetes is a chronic condition that can lead to serious complications.



Diabetes  
regulation  
insulin  
onset  
intensity  
tolerance  
mellitus  
referral  
incidence  
of  
diabetes

# Prevention



# Prevention

- Awareness, identification and recognition of diabetes. (health program)
  - medication/diet/ monitoring
  - prevention of injury.
  - education and footwear.
    - last resort prosthetic intervention

# Barriers

- To address rehabilitation issues a plethora of legislation has been produced. Despite this, varied levels of service provision exist in LIC's.  
(The Convention on the Rights of Persons with Disabilities (CRPD) became legally binding on the 3<sup>rd</sup> of May 2008)
- Entitlement to access rehabilitation services is emphasised in legislation. However, in countries where the gross national income is low ; rehabilitation services are rarely prioritised as primary health care understandably takes precedence.

Conversely, as primary health care initiatives achieve success, greater demand is created for rehabilitation services as more disabled people survive infancy.

# Barriers

- Data regarding the burden of disability and service provision is incomplete
- Governmental level (central and local)
  - Funding (ring fenced)
- Human resources (clinicians)
- Geographical location of point of care
- Cultural
- Lack of appropriate components and/or service provision or both



# Impact

- **Breaking the circle**

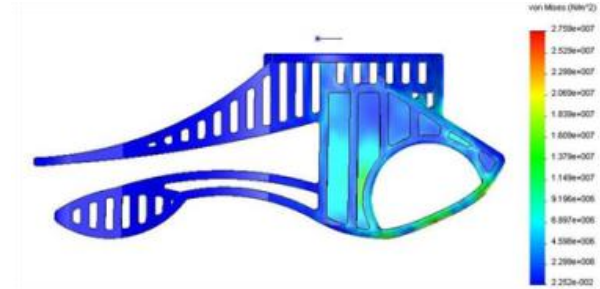
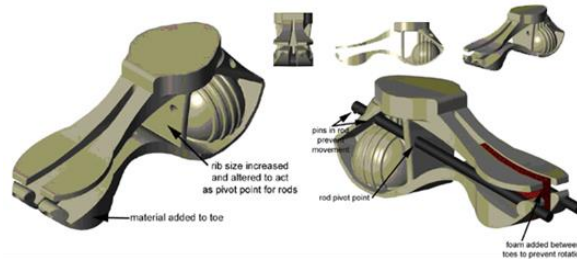
- Quality of life

- Creates a socio-economic opportunity, both on micro and macro level



# Service provision (the facts)

- Education
- Components
- Body/device interface
- Governmental priorities



- Product design specification.
- Concept development

Computer and Laboratory modelling

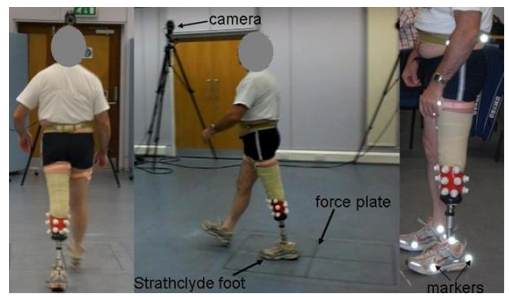
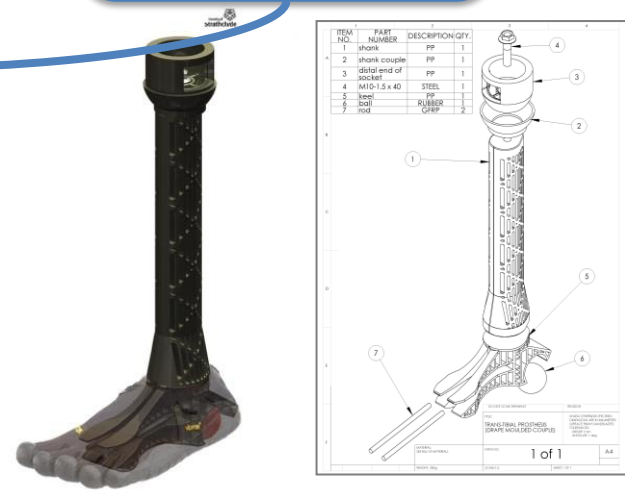
- Prototype design

**Development of prosthetic components for low income countries.**

- User needs study
- Literature review on efficacy of existing devices

Clinical evaluation

Testing according to ISO standards





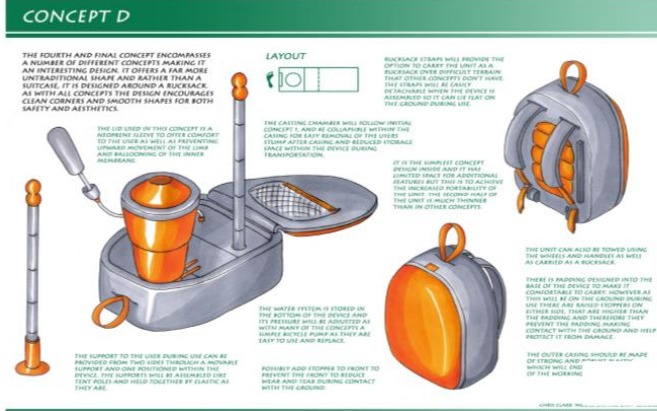


## Socket fit criteria:

- o As "stiff" as possible coupling
- o No tissue damage
- o Minimum discomfort

## Implementation tools;

- o Surface matching
- o Volume matching



- Socket fit Criteria specification.

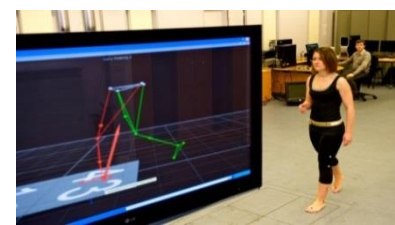
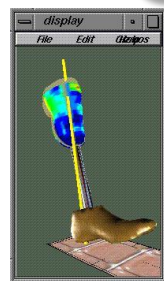
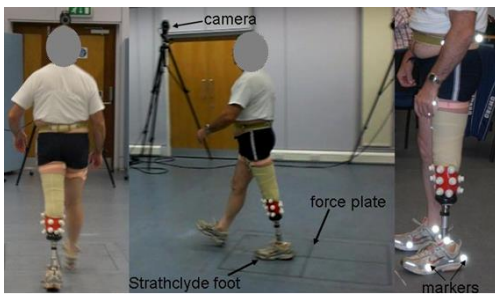
- Prototype design
- Concept development

**Development of an appropriate shape capturing system for low income countries.**

- User needs study
- Literature review on efficacy of existing devices

Clinical evaluation

Concept testing



# recommendations

- Data regarding the provision of rehabilitation care in LICs is unclear. To improve current service provision, increased knowledge of current service model provision and what is lacking is required. A detailed needs assessment must be carried out within individual LICs.
- The literature makes it clear that disability is intrinsically linked to poverty. The right to have access to rehabilitation services is now enshrined in legislation. This however, is only the beginning and there must be a concerted effort to ensure that legislation is implemented.
- It is important to recognise the economic benefits of prosthetic and orthotic provision and impress these benefits upon the governments and funding organisations of LICs.
- LICs are not a homogenous entity to which blanket policies or methods of prosthetic and orthotic service can be applied unilaterally. The regional issues must be considered and programmes should be tailored accordingly.

# recommendations

- There is a distinct slant in the literature towards appropriate technology rather than provision of service. A substantial body of research is needed to prove the efficacy of the methods of service provision, maximise the effective methods and to develop evidence based, sustainable services.
- To create sustainable individually tailored prosthetic and orthotic services, a work force of well-trained local clinicians must be employed.
- Although there is a obvious requirement for services, more specific data is necessary to create effective prosthetic and orthotic services. These services have the potential to reach impoverished disabled persons and may provide opportunity to break the cycle of poverty and disability.



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