

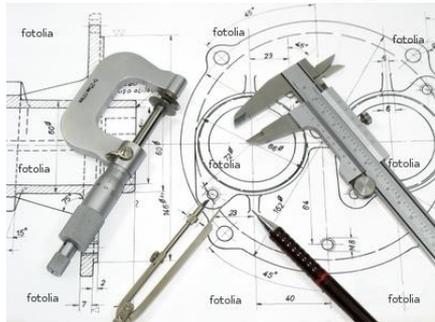
University of
Strathclyde
Engineering

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

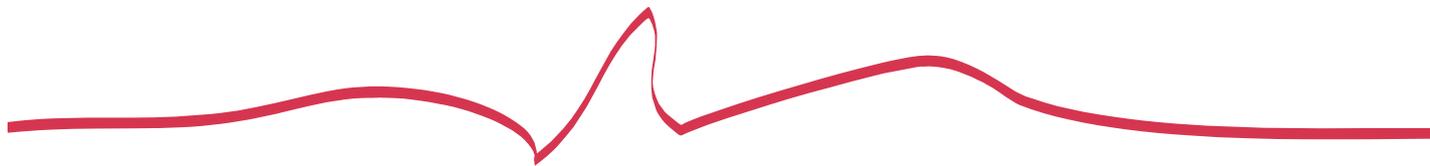


Engineering

Medical & biological
sciences.

Activity Scope (research)

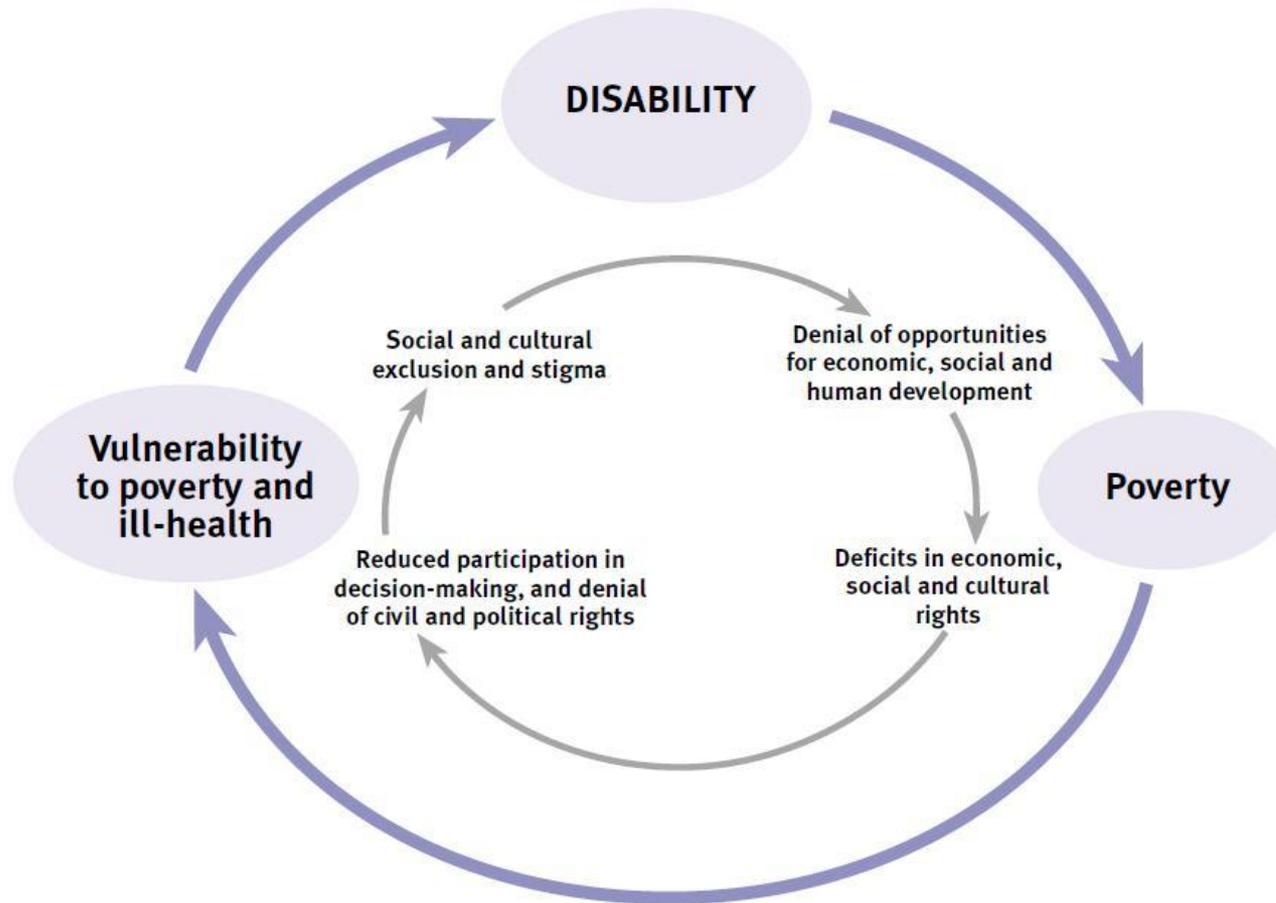
Medical Imaging & Signal Processing Biosensors
Tissue Engineering Prosthetics & Orthotics Modelling
Artificial Organs Biomechanics Artificial Intelligence
Synthetic Biology Wound Dressings Assistive Technologies
Drug Delivery Diagnostics Orthopaedic Implants
Biomaterials Rehabilitation Engineering Medical 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).¹
- 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. ²
- LIC's account for 84% of the world's population and 90% of the total disease burden. ³ However, fewer than 3% of persons with disabilities in LIC's have access to required rehabilitation services.⁴ 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-
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
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

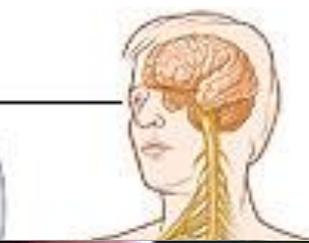
- It is estimated that amongst the disabled people living in LIC's the need for prostheses will have risen to 34 million by 2015.¹
- The need for orthotic intervention is thought to be even higher, ² but remains underreported as requirements are not as visible as are those of prosthetics.³

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.

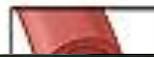
2. PUPULIN E. A personal view of prosthetics and orthotics. Prosthetics and Orthotics International, 2001;25: 93-95. Available from: <<http://informahealthcare.com/doi/pdf/10.1080/03093640108726580>>.

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>.





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

Diabetes
insulin
tolerance
mellitus
onset
insensitivity

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 3rd 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

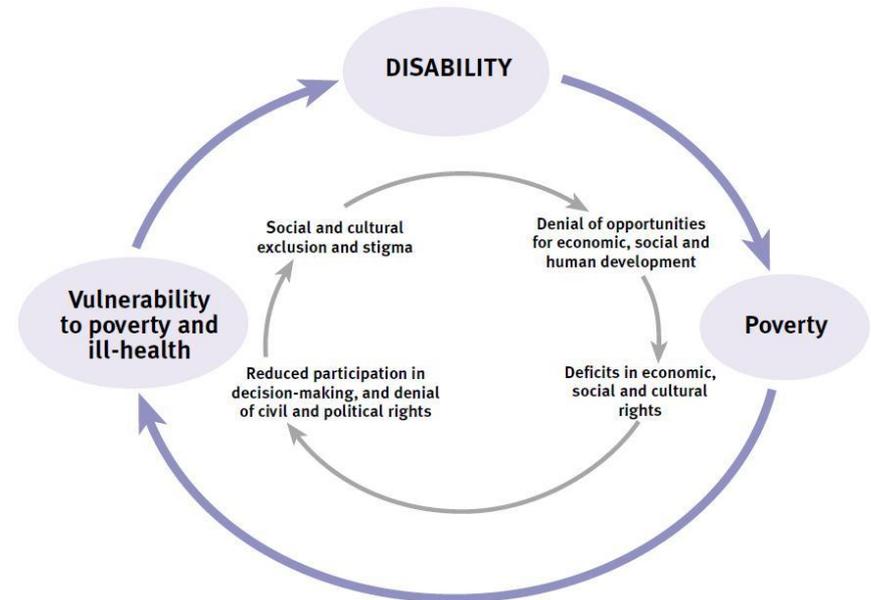
- Data regarding the burden of disability and service provision is incomplete
- Governmental level (central and local)
 - Funding (ring fenced)
- Human resources (clinicians)
- Geographical location of point of care
- Cultural
- Lack of appropriate components and/or service provision or both

Impact

- **Breaking the circle**

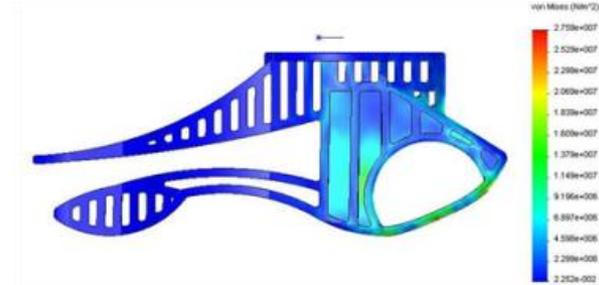
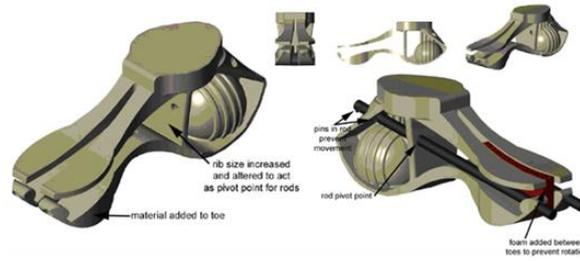
- Quality of life

- 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

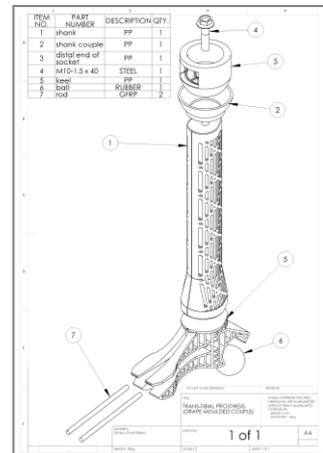
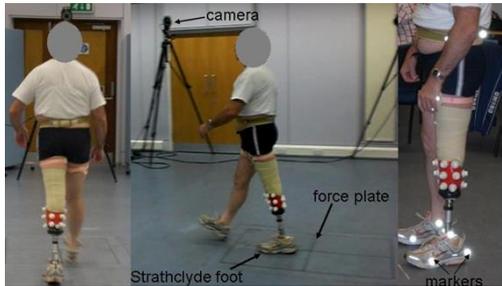
- Prototype design

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

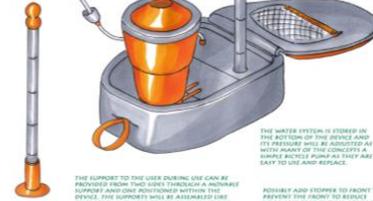
Implementation tools;

- o Surface matching
- o Volume matching

CONCEPT D

THE FOURTH AND FINAL CONCEPT ENCOMPASSES A NUMBER OF DIFFERENT CONCEPTS MAKING IT AN INTERESTING DESIGN. IT OFFERS A FAR MORE UNTRADITIONAL SHAPE AND BATTERIES THAN A SUITCASE. IT IS DESIGNED AROUND A BACKPACK, AS WITH ALL CONCEPTS THE DESIGN ENCOURAGES CLEAN CORNERS AND SMOOTH SHAPES FOR BOTH SAFETY AND AESTHETICS.

THE USE USED IN THIS CONCEPT IS A ROTATIONAL USER TO COVER CONTACT OF THE USER AS WELL AS THE UPWARD MOVEMENT OF THE LIMB AND BRACING OF THE POWER MECHANISM.



LAYOUT

THE CUTTING CHAMBER WILL FOLLOW INITIAL CONCEPT L AND BE COLLAPSED WITHIN THE CHAMBER FOR EASY REMOVAL OF THE LIMBS. IT WILL BE EASY TO ASSEMBLE AND DISASSEMBLE DURING TRANSPORTATION.

IT IS THE SUMMER CONCEPT DESIGN WHICH ANY OF THE JUNCTIONS FOR ADDITIONAL FEATURES BUT THIS IS TO ACHIEVE THE INCREASED PORTABILITY OF THE UNIT. THE SECOND HALF OF THE UNIT IS MUCH THINNER THAN IN OTHER CONCEPTS.

THE WATER SYSTEM IS ENDED ON THE BOTTOM OF THE DEVICE AND ITS PRESSURE WILL BE ADJUSTED AS WITH MANY OF THE CONCEPTS. A SIMPLE PUMP WILL BE USED TO EASY TO USE AND REPLACE.

THE SUPPORT TO THE USER DURING USE CAN BE PROVIDED FROM THE USER THROUGH A INCREASE SUPPORT AND ONE POSITIONED WITHIN THE DEVICE. THE SUPPORT WILL BE ASSEMBLED USE THE HOLES AND HELD TOGETHER BY SLIDING AS THEY ARE.

THE OUTER GAINING SHOULD BE MADE OF TENSILE AND POWERED BY A MOTOR WHICH WILL BE ON THE INSIDE OF THE MECHANISM.



THE UNIT CAN ALSO BE TOWED USING THE WHEELS AND HANDLES AS WELL AS CARRIED AS A BACKPACK.

THERE IS A BATTERY DESIGNED INTO THE BASE OF THE DEVICE TO MAKE IT CONSIDERABLE TO CARRY. HOWEVER AS THIS WILL BE ON THE FRONT DURING USE THERE ARE BATTERY PROTECTOR ON EITHER SIDE. THERE ARE INSULATED TUBES PREVENT THE BATTERY HEATING THAT PREVENT IT FROM DAMAGE.

THE OUTER GAINING SHOULD BE MADE OF TENSILE AND POWERED BY A MOTOR WHICH WILL BE ON THE INSIDE OF THE MECHANISM.

LORENZINI, M.

- Socket fit Criteria specification.

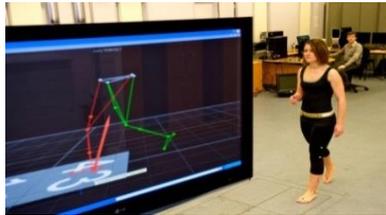
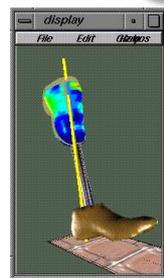
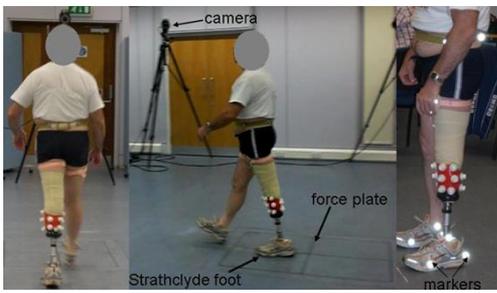
- Prototype design
- Concept development

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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