

CAN DESIGN THINKING BE USED TO IMPROVE HEALTHCARE IN LUSAKA PROVINCE, ZAMBIA?

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1. Background

‘Africa experiences 24% of the global burden of disease, while having only 2% of the global physician supply and spending that is less than 1% of global expenditures.’ [Scheffler et al. 2008]. Every day the equivalent of two jumbo jets full of women die in Childbirth; 99% of these deaths occur in the developing world [WHO 2012]. For every death, 20 more women are left with debilitating conditions, such as obstetric fistula or other injuries to the vaginal tract [Jensen et al. 2008].

In the last 50 years, US\$2.3 trillion has been spent on foreign aid [Easterly 2006]; US\$1 trillion in Africa [Moyo 2009]. Despite this input, both Easterly and Moyo argue there has been little benefit. Easterly highlights that this enormous donation has not reduced childhood deaths from malaria by half, nor enabled poor families access to malaria nets at \$4 each. Hodges [2007] reported that although equipment capable of saving lives is available in developing countries, more than 50% is not in service. Studies have asked why this should be so high [Gratrad et al. 2007], [Dyer et al. 2009], [Malkin et al. 2011] the majority focussing on medical equipment donation. They suggest that it is not feasible to directly donate equipment from high to low-income settings without understanding how the receiving environment differs from that which it is designed for.

2. Aims

This study aims to understand whether the minimal effect which simple donation has on healthcare in Sub-Saharan Africa can be improved upon by the process of design thinking, through a case study in Zambia. Brown [2012] defines this as ‘a human-centred approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success’. The design thinking method used will focus on the benefits gained by an interdisciplinary approach to an ethnography-led, rapid prototype-based, iterative design process - evaluating its ability to discover problems or opportunities, enabling the generation and development of appropriate, transformative medical product solutions for Zambia. The study is part of the Zambia Wales Health Collaboration, a community link that supports the Chongwe community of Zambia in achieving the United Nation's Millennium Development Goals.

3. Previous Tgugctej

Peat [2008] discussed historical cases where ‘plan or policy is applied from outside by people who don't really understand all the subtleties of living and working within a particular context or community.’ He argues that things start to go wrong when people take action without a true understanding of the complexity of the situation they are dealing with. In response to this problem he proposes Gentle Action; minimal interventions, intelligently made which result in a major change or transformation.

Peat [2008] uses examples of Sirolli's personal experience of aid. Sirolli [1998] felt that inappropriate development caused more problem than it solved, for example, the American donation of solar ovens to African tribes who only cook at night. He also suggests that inappropriate novel technology can push borrowers in the developing world into debt. Schumacher [1973] argued that people are not best served by an assumption that advanced technology is best; rather the best is technology which suits the intended environment. Howitt et al. [2012] support Peat [2008], Sirolli [1998] and Schumacher [1973] in their attitude to hand-me-down technology where they emphasise that introduced technology must take account of funding staff and energy constraints as well. Howitt et al. argue for the development of frugal technology, defined as 'technology that is specifically developed to meet the needs of the world's poorest people' and 'one of the most important attributes is the involvement of users as co-designers.' Despite the benefits of this approach Howitt et al. highlight the difficulties of involving users where resources are poor. Imitation is cheaper than the development and testing of truly novel design and thus not readily afforded in resource-poor countries. Consequently, frugal technology will not necessarily develop in poor countries.

Discussing how to design for change, Brown [2009], of IDEO, argues that, we need new ideas and products capable of tackling the global challenges of health, poverty and education; new strategies which invoke a sense of purpose. His proposal is Design Thinking; an exploratory, iterative and non-linear process, based upon Human-Centred Design (HCD). HCD as defined by IDEO [2009] is a process which starts with the people they want to affect with their solution. Starting by examining their needs, dreams and behaviours.

The process starts with the acceptance of competing constraints, seen in three key points: Feasibility, what is functionally possible? Viability, what is likely to become part of a sustainable business model? Desirability, what makes sense to and for the people?

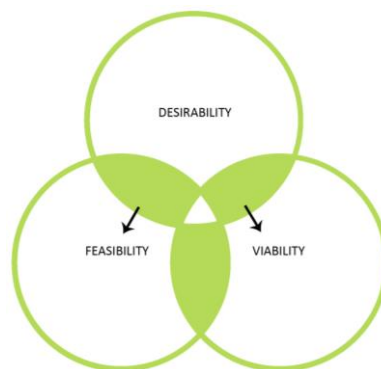


Figure 1. IDEO, 'Design Thinking', [IDEO 2009]

This process of design thinking is combined with the use of what Brown [2009] calls 'smart teams', interdisciplinary teams. Composed of people who are capable of working across disciplines, and who possess a depth of skill which enables them to provide a tangible contribution.

In 2009 IDEO developed a toolkit for researchers to help them understand community needs through human-centred design. This uses interdisciplinary teams combining three elements, hear, create, and deliver. 'Hear' involves qualitative research methods to listen with the aim of identifying users' needs, hopes and aspirations. These are analysed to ensure technical and organisational feasibility and financial viability. 'Create' involves iteratively translating what was heard into frameworks, opportunities, solutions and prototypes. 'Deliver' involves rapid cost modelling and implementation planning ready for product launch.

HCD has a number of similarities to Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA). RRA was developed as an economical and time efficient research method which is 'claimed to generate results of less apparent precision, but greater evidential value, than classic quantitative survey techniques' [IISD 2013]. RRA involves an interdisciplinary team spending time in location and having informal and open dialogues with people on different aspects of their lives. The objective of RRA [World Bank 2011] is for outsiders to gain qualitative insights into the daily lives of groups in rural areas. PRA expands upon RRA and was developed 'in response to the mechanistic and extractive

implementation of RRAs.’ [World Bank 2011]. The aim of PRA is to empower local people who develop a critical self-awareness, take responsibility and are thus able to plan and act. In PRA the information is owned by local people rather than professionals [Bhandari 2003].

4. Method and Focus

This study investigates the gains that can be made by following Peat [2008], Sirolli [1998] and Schumacher [1973], who argue that we should first listen and learn about environments, people and cultures before trying to help. The method used in this study evolves from Design Thinking’s Human-Centred Design and interdisciplinary approach, and incorporates RRA’s use of qualitative research methods.

We investigate whether this design thinking approach can help invoke new ideas and solutions by looking at problems and opportunities from different perspectives and with different knowledge - new ideas and solutions capable of managing the risks of developing solutions for unfamiliar environments through increased suitability.

The interdisciplinary team used for this study had individuals from medical, technical, design and commercial backgrounds with expertise in: Anaesthesia, Intensive Care and Pain Management, Information Ergonomics, Computer Embedded Products, Physicality in Design, User-Centered Design and Ethnography. All team members were involved in and contributed to each stage of the study from preparation to reflection and conclusions.

Ethnography is the main method we used to enable our process of HCD and ‘listening’ demonstrated in design thinking and RRA. Ethnography [Oxford Dictionary 2011] is ‘the study of humankind, especially societies and customs’. Mack et al. [2005] describe ethnography as ‘meaningful and culturally salient to the participant, unanticipated by the researcher, and rich and explanatory in nature.’ It provides researchers with an understanding of the needs and environmental conditions of people living in developing countries. This study investigates the benefits to be gained by the use of ethnography to identify unmet needs (needs that people cannot articulate explicitly) and its ability to help describe the use, usability and meaning of existing products and services - helping highlight possible new solutions.

The ethnographic research methods adopted for this study are similar to those used in RRA and include: observation, interviews, focus groups, discussions and user involvement. These methods were supported by a small toolkit to capture the required information: a camera, video recorder, note pad, and audio recorder. The study was split into three stages: preparation, participation and reflection.

1. **Preparation:** transfer of knowledge between group members to ensure all possessed a basic understanding of the study’s aims. This also enabled the sharing of technical knowledge from those with developing world experience to those without and from medical to non-medical and design to non-design backgrounds. This did not however involve setting out a rigid course of action for the study to follow. Removal of rigidity is essential to the process of design thinking and the ability to enable creativity.
2. **Participation:** refers to the field study itself. This part of the study involved the principal researcher joining a team of engineers, doctors and nurses from Mothers of Africa Charity, for a 10 day field trip to Zambia, to carry out ethnographic research. The study took place in three main locations in Lusaka Province Zambia: Lusaka, Chongwe Township, and Shiyala Village. These were chosen as each of their settings not only presents a different environment but also a different level of medical facility and services.
3. **Reflection:** the team members joined together to reflect on the field trip’s findings and discussed possible routes of exploration.

5. Findings

Key findings from the field study can be split into three linked groups: the places, the people and the problems. Differences were significant despite small geographic distances: Lusaka to Chongwe Township, 43.8km and Chongwe District to Shiyala Village 10.4km.



Figure 2. LMGH



Figure 3. CDH



Figure 4. Shiyala Health Post

Information recording methods differed between locations. Many observations were recorded by camera, pen and paper, while interviews, sounds, noises and conversations were best recorded by an unobtrusive audio recorder as the audio recorder was ignored during conversations, interviews and focus group and allowed for the more accurate capture of information. This information was reflected upon and later transcribed, without misinterpretation. The video recorder was the least used device in the toolkit. Many found it daunting although it was useful when speaking to specific clinicians who wanted to be heard.

Location one: Lusaka, the country's capital city covers c.375 km², with a population of c.1.74M [Central Statistical Office Zambia 2010], where differing levels of wealth are obvious. Half of Lusaka is a vibrant and fast-growing modern city, with shopping malls, restaurants, comprehensive roads and people dressed in westernized clothes, the other half has a reality hidden from holiday tourists. This part of the city consists of extensive unauthorized urban self-help housing (slums), lacking social and physical infrastructure like schools, disposal or health facilities, roads, water and electricity. In Lusaka our time was spent at Levy Mwanawasa General Hospital (LMGH) where we carried out observations, interviews and focus groups with doctors, hospital management and medical students.

In LMGH, a key interaction was with students who have been working as Nurses in different posts throughout the country. This group voiced recurring issues regarding medical care within the country including the lack of human resources, difficulties with supply chains and lack of appropriate resources, such as medical equipment. When talking about the supply of equipment and drugs, staff continually reiterated the difficulties they encounter with supply chains. Currently these supply chains are controlled by the Ministry of Health and are reliant on imports. The staff complained about a constant lack of resources such as drugs, face masks, spinal needles, gloves, gowns and hand washing solutions. As a result, facemasks are re-used, despite losing sterility after 20 minutes of use; spinal needles are substituted by a simple cannulae; and hands are ineffectively washed. Nationally, it is standard procedure to re-use much single-use equipment (excluding needles and cannulas).

The resource problem was emphasized by the School of Anesthesia staff: *'[lack of resources] is a massive problem for us. People budget what they can and often there are no facilities. Across the country, as I travel around, procedures are performed with no facemask, no gloves, and no gowns. spinal anaesthesia may be performed with the use of a cannula as the best way of performing it.'*

Medical staff in LMGH identified issues surrounding the donation of the hospital building itself. When donated by the Chinese Government, LMGH was equipped with new medical equipment and a year's supply of drugs. A year after the hospital opened, the anaesthesia machines are no longer usable, the drugs have run out, and are not available in Zambia. The new machines are in 'storage' and an old machine is in service. The impact of this is that despite having four theatres, it is only possible to use one, as they only have one working anaesthesia machine.



Figure 5, 6, 7. Inside LMGH theatres

The second key complaint highlighted by staff referred to the low levels of human-resource in the LMGH. When donating the hospital the Chinese Government tried to combat the problem of low staffing by the temporary input of eleven Chinese staff including five surgeons and one anesthetist. Unfortunately they didn't speak the same language as Zambian staff who expressed concerns regarding teamwork during theatre time and being unable to communicate with their colleagues. There was only one translator for the ten Chinese medically trained staff, clearly an inadequate situation.

Location two: Chongwe Township, is a thirty-minute drive down the Great East Road, population of 12,551 [Central Statistical Office Zambia 2010]. The town, although said to benefit from easy access to socio-economic amenities from Lusaka, is composed of a collection of shacks and market stalls. Only some have access to the limited electricity and water supply available in the town. Unlike Lusaka's urbanization, the streets are made of clay and dust; women walk carrying buckets of water on their heads; the streets are lined with people selling bowls of foodstuffs and live chickens; men cycle with bikes stacked with charcoal; and tiny children walk themselves to school in the dust.



Figure 8, 9, 10. Chongwe Township

The hospital in Chongwe, Chongwe District Hospital (CDH) is newly built. It is a small single story complex, with basic emergency room, male, female, maternity and paediatric wards, a small basic physiotherapy room and a building ready to hold theatres (unopened due to a lack of theatre staff). The hospital is affected by the extensive power cuts of Chongwe, which may last for an hour or the whole day. Whilst the majority of hospital workers speak good English, within the town the average person has very poor English. The team spent extensive time with staff, getting to know them, the hospital, the level of care available and the difficulties they encounter. This was achieved by undertaking extensive conversations, interviews and discussions in the hospital and its neighbouring environment.

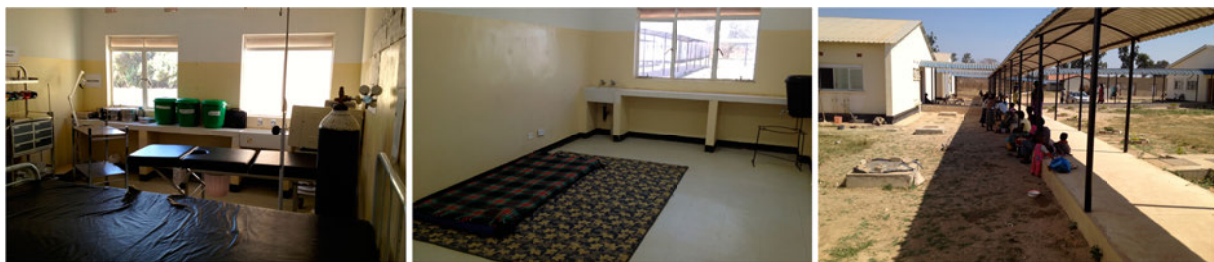


Figure 11. Emergency room Figure 12. Physiotherapy room Figure 13. Hospital grounds CDH

A number of recurring themes surfaced in Chongwe District. The first was with regard to medical supplies. Standard procedure required the re-use of most single-use equipment, excluding needles and cannulae: not because they didn't have replacements, but because they were unsure when they would be restocked. The hospital storeroom revealed the consequences of this practice: the majority of consumable equipment there was either past or close to its use-by-date. In addition, the hospital drug supply was almost non-existent; in particular analgesics were not available.



Figure 14, 15, 16. Storage of consumable medical equipment CDH

Electronic equipment is a problem. Hospital grounds have two rooms of expensive unused equipment donated without instructions or training, with unsuitable power voltage and missing components. An American ultrasound machine was found to be broken because of a local power surge.



Figure 17, 18, 19, 20. Equipment in Storage in CDH



Figure 21, 22, 23. Equipment after removal from storage CDH

Road traffic accidents (RTAs) are a major issue: everyone is advised against night driving. The Great East Road runs from Lusaka, through Chongwe, onto Malawi. Here the incidence of RTAs is extremely high. For example in August 2012, a bus carrying 34 passengers was involved in a RTA. 13 people died and 16 suffered serious injuries. In early 2013, a bus carrying 74 passengers was involved in a RTA. Over 50 passengers died and 10 had serious injuries.

CDH has neither the correct equipment nor sufficient staffing to deal with this patient intake. First responders on scene were local people or police. Chongwe has drivers not paramedics, and only two ambulances, donated by the Japanese Government, only one of which is in service. They are also not fit for purpose: *'The ambulances are very low to the ground, making them unsuitable for driving on the standard African roads that are full of potholes and large speed bumps; this is especially a problem in rural areas where the roads are very poor or non-existent. Another problem with them is the fact that they are only able to take one patient at a time. A maximum capacity of one means that if there is a multiple trauma accident patients must be brought to the health facilities one by one causing long delays in a patient's treatment.'* Consequently, injured patients are piled into police trucks for hospital transfer resulting in increased fatality. Survivors transferred to Lusaka have a 45 minute journey time.

Location three: Shiyala Village, is a 12 minute drive down the road, and the changes become even more evident. The tarmac road ends and we travel down a clay road. The village has partnered with

ABESU, a UK charity working alongside village women to build houses - adjoining hygienic toilets and a fresh water borehole with 100 houses. Despite this, living standards are very much lower than Chongwe Township and Lusaka with no electricity (except for a few houses with solar panels), no running water, no cars, many mud thatched roof huts, no shops and a half derelict non-funded school. Most people don't speak English and few read or write. The village has a small, very basic four room health post containing a consultation room, waiting room, ward (women only) and small pharmacy. It has no running water; a very small energy supply from a small government supplied solar panel (powering a light bulb); no fridge; and one staff member. With no fridge, no vaccines are stored and supplies are collected weekly when the nurse walks to CDH. Diabetic patients travel to CDH themselves to collect insulin.

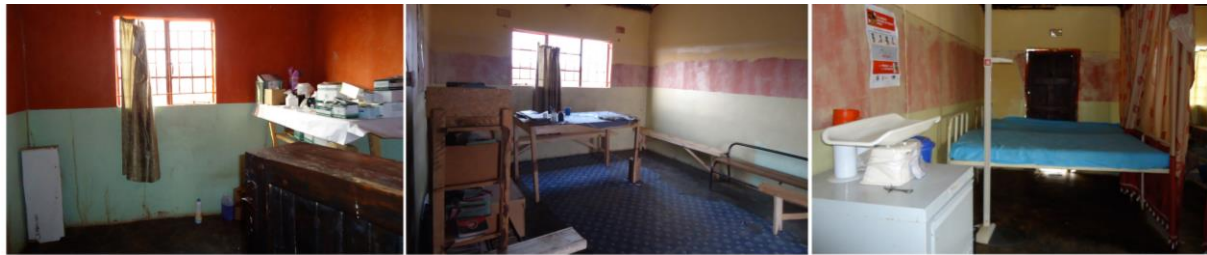


Figure 24. Pharmacy Figure 25. Waiting room Figure 26, 27. Ward in Shiyala health post

There are no disposal facilities like an incinerator or deep pit. Sharps are disposed of in a shallow ditch near the health post creating needle stick injury risk. Women take their placentae home after childbirth: it is unknown how these are disposed of with no toilet facilities.



Figure 28, 29, 30. Sharps disposal pit, Shiyala Village

Whilst the local community are encouraged to attend the health post, difficulties arise from the lack of equipment and drugs, its location and because it has only one ward which is reserved for childbirth. Sick patients cannot use the ward. Male patients walk to CDH. The health post is not stocked with any physical medical equipment, not even a consultation chair. There is also no stock of rehydration salts for diarrhoea or dysentery. Women give birth at night by candle light.

Due to the position of the health post in relation to the rural surrounding villages in its catchment area, the nurse encounters a number of problems with antenatal care and childbirth. Although women are encouraged to attend a health facility, because of both a lack of education and distance from the health post (it is often too far to walk), mothers get help from the local village women and give birth at home; a major contributor to maternal and neonatal mortality.

6. Discussion

In applying design thinking's qualitative research methods, the study identified a number of difficulties faced by researchers. Difficulties were encountered in Zambia due to a preference for older, educated, male researchers resulting in the younger, female, non-medical, researchers being presented with reduced access to people and places. During the recording stage of the study the team encountered difficulties with the use of video recorders. Despite being widely accepted within the UK, many Zambians found video recorders daunting, resulting in reluctance to provide information and withdrawal of participants.

Despite these difficulties the use of design thinking's methodology also demonstrated a number of benefits. Smart teams provided an increased level of comprehension and understanding of the captured

information. Medical members of the team were able to provide medical insights and present comparisons between UK and Zambian medical practice - information not known to non-medics. Design thinking's broad selection of research methods also enabled the study to select an appropriate method of gathering information in accordance with its suitability for the environment and people. When gathering information from leading medical professionals, interviews were effective, however non-invasive methods such as observations and informal conversations provided greater insights when working with non-literate, non-educated members of the community.

The findings described here are a précis of the full findings, however this field study has enabled the identification of issues necessary to be taken into account when designing for the Zambian market including low levels of human resource and a lack of access to consumables and equipment. Major changes in people's environment occur over short distances. A product used in Lusaka would have access to a regular energy supply, running water and people with an understanding of technology. A product for Shiyala Village and Chongwe district must account for irregular or non-existent power and water, dust and poorer English literacy levels.

This study highlights problems surrounding donations, problems which could have been identified previously with initial observations, and avoided through the application of a process of design thinking which considers a solution's desirability, feasibility and viability. These problems include the anaesthesia machines - unusable due to the lack of consideration given to the accessibility of a drug supply. Machinery in Chongwe, donated from various organisations, has not been able to withstand variations in power supplies, resulting in machine breakage during power surges. Training manuals, guides and key components have not been supplied or are missing. The vehicles donated from Japan to Zambia are unsuitable for the local terrain. Zambia has roads with potholes, large speed bumps, clay roads or no roads at all.

Through taking a design thinking approach, of focusing on desirability, viability and feasibility and incorporating ideas from RRA it has been possible to analyse our findings and identify development opportunities, including some surrounding rural trauma and childbirth. Ethnographic research methods including observations, informal discussions and interviews, provided insights into areas that need particular attention including rural trauma and childbirth. During the analysis of the qualitative data collected consideration was also given to viability and feasibility factors. This enabled the identification of the need for key product attributes including: accessibility, affordability, usability and appropriateness. Developments must be low cost; be sustainable through a local supply chain; be environmentally suitable; have due consideration for energy and water supplies; be non-reliant on donation; and have a high level of usability - factors not necessarily taken into account when designing for the developed world and then donating the equipment.

7. Study limitations

Time restrictions were placed on the study in Zambia as a result of the study taking place alongside a charity expedition. Travel within Zambia was also limited as a result of poor road safety. In addition, language barriers placed limitations on the study (even though translators provided assistance) as only 1.7% of the Zambian population use English as their language of communication [CSO 2010].

8. Conclusions

This paper explores design thinking's ability to improve upon the minimal effects of simple donations. Peat [2008] suggests that 'most people who wish to 'help', end up imposing solutions of their own making upon situations they may not fully understand'. This can be clearly identified in the situation within Zambia. The Chinese government saw a need for better health service facilities and built a hospital. The hospital needed human resources, so they supplied their own doctors. The hospital needed medical equipment so they supplied machines and one year's supply of drugs. This however was a temporary solution as eventually the Chinese staff went home and the drugs ran out. Now the hospital boasts four theatres, but not the equipment nor the human resource to run them.

The findings in this paper demonstrate how through a process of design thinking and the use of ethnography in particular, gains can be made by an increased understanding of the environment being designed for. Replacing the existing process of imposing solutions without true understanding with a

process of hearing and learning, through ethnography, can enable an understanding of desirability, what makes sense for the people, feasibility, what is functionally possible and viability, what is likely to become part of a sustainable business model. It is inefficient to design products for the developed world and then simply export them to the developing world without researching their suitability.

9. Future work

Future work will involve the next stages of design thinking to 'create' and 'deliver', by taking the findings from this paper and using a rapid, prototype-based, iterative design process to develop a method of providing suitable trauma care in Zambia. The initial focus of the future work will be on providing design solutions in relation to road traffic incidents in Zambia. This will start with an interdisciplinary team developing a range of possible design solutions. Next, rapid prototypes will be iteratively developed and tested in-context in Zambia to try and achieve the aim of a desirable, feasible and viable solution.

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