Editorial

Appropriate Technologies For Health And Disease: An Innovative Approach To Drive Sustainable Health Care Delivery.

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Preamble

The term "Appropriate Technology" emerged in the context of the 1973 energy crisis and the 1970s environmental movement. E. F Schumacher in his book "Small is beautiful- a study of Economics as if people mattered" introduced the term intermediate technology. The term was used in two primary contexts

i. Technology that most effectively meets people's needs in developing or limited resource settings
ii. Technology that is environmentally friendly and socially acceptable in the developed world.

Intermediate technology simply explains the technology that is between artisanal and industrial but simple, effective, cheap environmentally sound and sustainable with emphasis on local community ownership, management and maintenance.

Primary health care according to the Alma Ata Declaration is *"essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination"*

Health technologies, especially those dealing with medical devices, are crucial for the services offered in prevention, diagnosis, and treatment of illness, disease, and disability.

What is Appropriate Health Technology

Appropriate health technologies (AHT) are methods, procedures, techniques and equipment that are scientifically valid, adapted to local needs, acceptable to users and recipients, maintainable with local resources. Appropriate technologies are either new or adaptations of existing technologies of demonstrable effectiveness that can sustainably meet the varied conditions of developing countries and the unique needs of underserved communities. The criteria for adopting an Appropriate Health Technology include the following:

Effective - both in theory and practical use
Safe - and not easy to use incorrectly
Affordable - in initial and recurrent costs
Acceptable - to all who are affected by it
Sustainable - can be maintained, repaired or re-supplied.

It is therefore evident that health technologies developed for developed world countries may be inappropriate for use in resource- poor environments lacking physical infrastructure, trained health care providers or the means to buy and maintain complicated technologies. For instance appropriate technologies such as Oral Rehydration Solution (ORS) and Contraceptives faced significant obstacles to wide spread adoption.

Appropriate technologies are solutions that creatively integrate the need for new and culturally relevant technologies in addition to substantial behaviour change in order to reduce inequity between rich and poor countries. Therefore appropriate technology must be part of a health care Ecosystem

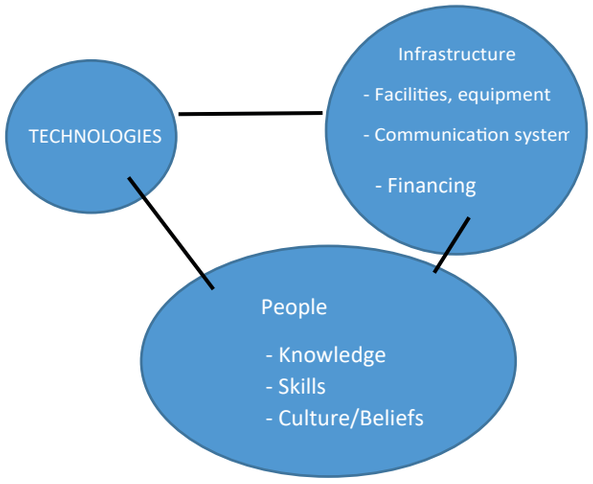

Figure 1: Appropriate Technology: Part of a Health Care Ecosystem

An 'appropriate' innovative technology is one that leads to improved access to essential health products and services; and/or leads to improved human health by providing affordable and accessible products for the population in need.

Health innovation systems therefore acknowledges the interrelationship between education, research and development (R & D), manufacture, domestic and export markets, intellectual property and regulatory policies.

For high income countries health innovative systems involve actors from multiple sectors and disciplines. Training and basic research are funded by the public sector through universities and government research institutions. Translational research and product development such as prototype productions or small-scale production are conducted by pharmaceutical or other companies or, depending on the national system, government institutions. In low-income countries, however, the health innovation system is often rudimentary and fragmented. The public sector provides most, if not all, funding and infrastructure for research. Although research is conducted in academic institutions, often there is little applicability to local health problems, due to the lack of capacity to conduct translational research and limited manufacturing capacity.

In developing countries, researchers and innovators face tremendous challenges, including the lack of technical training, research tools, financial resources, and up-to-date scientific information. These barriers impede activists from developing and implementing innovative and low cost technologies.

Innovative technologies for health care are very high in developed countries as medical technology is the second technology field with highest number of patents applications (Table 1).

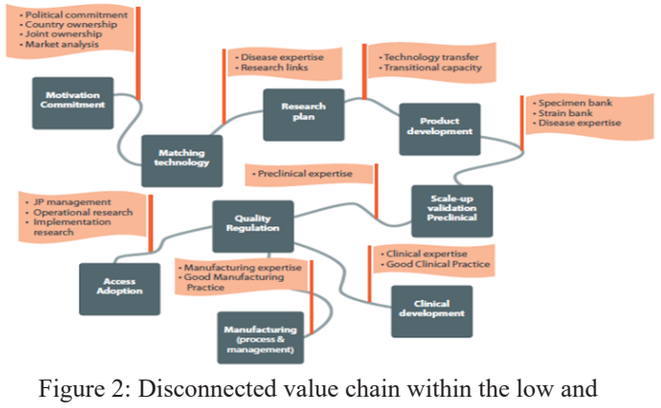

Figure 2: Disconnected value chain within the low and middle-income country health innovation system

Table 1: Top eight technology fields by total of patent applications worldwide (WHO, 2010)

	Patent applications by year of filing					
Technology field	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Electrical machinery, apparatuses, energy	101 276	98 673	101 959	114 426	121 350	537 684
Medical technology	108 106	107 072	105 554	99 868	99 195	519 795
Telecommunications	96 631	91 313	94 867	105 652	116 770	505 233
Audio-visual technology	90 401	84 928	91 405	106 765	108 900	482 399
Optics	85 113	84 236	86 565	94 868	103 400	454 182
Pharmaceuticals	69 355	69 160	66 050	68 650	74 254	347 469
Biotechnology	45 573	47 576	44 632	41 993	40 861	220 635
Microstructural technology and nanotechnology	3425	2770	2994	2967	3357	15 513

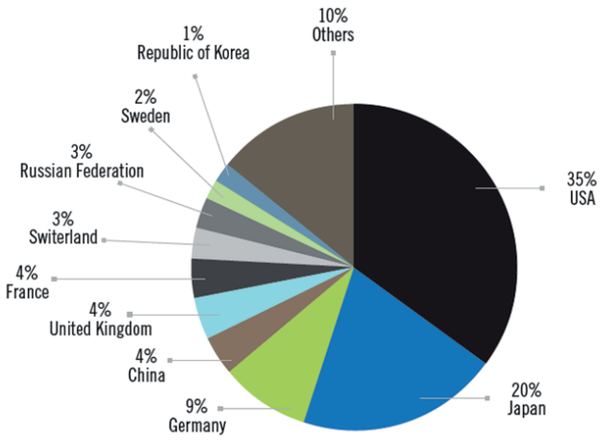

Figure 3: Top 10 countries with the highest number of patent applications in the field of medical technology (WHO, 2010)

Examples of Appropriate Technologies and Innovations that improved health

Insecticide treated Bednets (ITNs)

- The insecticide treated bed nets is an innovative combination of two different products namely bed nets and insecticides
- This led to the development of long lasting impregnated nets (LLIN) that provided two effective forms of vector control for 2-3 year life of the Net
- However an additional cost resulted to challenges in dissemination

Innovative Distribution Models

- Compulsory purchases
- Public Sector subsidies
- Free distribution to the most vulnerable population
- Public-private partnerships

Impacts of AHT (ITNs)

- Reduction in overall mortality by ± 20% in Africa
- For every 1,000 Children 1-59 months protected, 6 lives are saved per year
- 38% reduction in malaria parasitemia
- 28% reduction in risk of low birth weight
- 25 % reduction in adverse outcomes of pregnancy

Oral Rehydration Therapy

- Water-related diseases: a leading cause of death for ‹ age 5 children
- 20% of <age 5s die of diarrheal illness attributed to water sanitation related diseases
- About 1.8 million child deaths annually
- An often forgotten cause of diarrhoea is non hygienic food preparation

Figure 4: Oral rehydration therapy: Another successful appropriate innovative health technology

ORT Innovative Health Technology

- Introduced at the International Centre for diarrheal disease Research in Dhaka, Bangladesh
- One of the most important contributions to saving life
- Simple solution to prevent dehydration and electrolyte imbalance related to diarrhea
- Given by mouth to prevent and/or correct dehydration caused by diarrhoea
- Can be initiated at home and might prevent need for medical services
- Composition
  - Commercial packs are available
  - Can be made at home

DRACUNCULIASIS (Guinea worm) Eradication

Dracunculiasis, also called **Guinea-worm disease** (**GWD**), is an infection by the Guinea worm. A person becomes infected when they drink water that contains water fleas infected with guinea worm larvae. In humans, the only known cause is *Dracunculus medinensis* **Control of Guinea worm**

Given the transmission cycle of the parasite and the absence of an effective vaccine, the interventions include:

(i) provision of a safe water supply,
(ii) filtration of one's drinking water to remove cyclops,
(iii) searching for patients with active cases and proper management of cases,
(iv) ensuring that patients avoid contact with ponds, and
(v) Killing or removing cyclops in ponds.

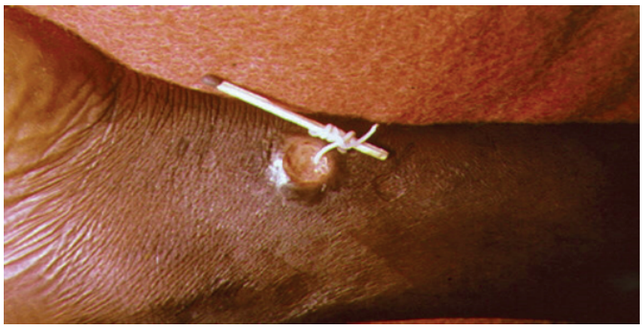

Figure 5: Using a matchstick to wind up and remove a guinea worm from the leg of a human

Figure 6: Filter Cloth and Pipe Filters: Appropriate technologies in eradication of Guinea worm in resource poor countries

LAPARASCOPY

Laparoscopy is a surgery that uses a thin, lighted tube put through a cut (incision) in the belly to look at the abdominal organs or the female pelvic organs. **Laparoscopy** is used to find problems such as cysts, adhesions, fibroids, and infection. Tissue samples can be taken for biopsy through the tube (laparoscope).

In recent years, electronic tools have been developed to aid surgeons. Some of the features include:

- Visual magnification — use of a large viewing screen improves visibility
- Stabilization — Electromechanical damping of vibrations, due to machinery or shaky human hands
- Simulators — use of specialized virtual reality training tools to improve physicians' proficiency in surgery
- Reduced number of incisions Robotic surgery has been touted as a solution to underdeveloped nations, whereby a single central hospital can operate several remote machines at distant locations. The potential for robotic surgery has had strong military interest as well, with the intention of providing mobile medical care while keeping trained doctors safe from battle.

Advantages of Laparoscopic Surgery

Since the overall trauma to the skin and muscles is reduced, less post-operative pain and disability, a shorter hospital stay, and a quicker recovery period are major advantages that laparoscopic surgery offers when compared to traditional operations.

Another advantage is a reduced infection rate. This is because delicate tissues are not exposed to the air of the operating room over long periods of time. Video magnification also offers surgeons better exposure of the diseased organ and its surrounding vessels and nerves. As a result, delicate manoeuvers can be performed to protect these structures during the surgery.

Disadvantages of Laparoscopic Surgery

The disadvantages of laparoscopy include the expensive equipment involved in performing it. Not all hospital operating rooms can afford to offer it because of cost containment.

The other major issue is the need for surgeons to take special training in performing the many operations that are available by this means.

The need for additional training is because laparoscopic

surgeons leave the familiar territory of a three-dimensional operating field to working on a two-dimensional flat video display. The shift is a critical one, and requires some degree of practice moving around long laparoscopic instruments while handling delicate tissues. Despite these temporary disadvantages, with the proper training, surgeons are able to adapt to this means of operating.

Finally, laparoscopy cannot always be performed on everyone. Some patients with many prior operations may have so much scar tissue within the body that a safe operation cannot be done. In time, what disadvantages exist may be overcome with continued laparoscopic research and development.

Need for Appropriate Balance

Whereas improving the health of the poorest people in the developing world depends on the development of many varieties of health innovations such as new drugs, vaccines, devices and diagnostic tools as well as new techniques in process engineering and manufacturing, management approaches, software and policies in health systems and services; It is important to note that

i. Diffusing a new innovation requires understanding of the local environment.
ii. Innovative technology can be disruptive and trigger a backlash from incumbents.

There is therefore need for appropriate balance for instance

i. Health education is critical and an integral part to control the AIDS pandemic as is the use of condoms
ii. *Self-adjusting eye glasses which allows patients to be in full control of their prescriptions and to change the power of their glasses at will is not and can never be a substitute for comprehensive examination and treatment by medical and health care professionals.*

Challenges facing use of Appropriate Health Technologies in Resource Poor Environments.

i. **Lack of Infrastructure**: Most of the appropriate techniques require constant supply of electricity and use in controlled atmosphere and no subject to power fluctuations and use of standby generators. When government or health care professionals acquire sophisticated modern machines for improved health care delivery, the challenges of infrastructural deficit most times results to lack of optimal utilisation of the machines. A situation where patients must wait for designated time for switching on power generating plants is worrisome.
ii. **High Cost**: The cost of most modern equipment appropriate for efficient health care delivery developed and fabricated in the advanced countries are usually high. The cost of acquiring one machine can be higher than what can be used to develop a small cottage hospital in a developing country.
iii. **Lack of Man Power**: Sometimes when these machines are acquired, there is counterpart development of the appropriate manpower that can manage and maintain them. It is not just man power that can utilize them.
iv. **Poor maintenance and lack of replacement parts**: There is generally lack of technicians that maintain medical equipment in the developing countries in addition to the problem of lack of replaceable parts. In some instances when a machine breaks down, it will be abandoned for months until the spare parts arrive from abroad and replaced.

Conclusion

- Countries around the world are making significant investment to redesign and strengthen sustainable and efficient health system through using innovative technologies; with the goal of achieving better care, better health and lower cost of health care delivery. For us in Africa to be part of this innovative development, we must develop the capacity to invent, deploy and scale-up solutions that are sensitive and appropriate for both the Urban and rural communities.

- African entrepreneurs and Research scientists must be well positioned to address the needs of the

communities while considering the existing structural, cultural and political menaces – something that is often overlooked in aid-driven health programme.

We must encourage local innovators- for instance the use of rapid diagnostic blood tests to defeat malaria is largely limited in rural African communities due to its risky and complex diagnostic procedure. Instilling a culture of innovation must be a promising way to propel Africa in its efforts to eradicate diseases and improve health.

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