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Emerging Trends in Research and
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BRICS and South-South Cooperation in Medicine: Emerging Trends in Research and Entrepreneurial Collaborations

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Abstract: Though there is huge spectrum of South-South collaboration, led by the economies from the BRICS countries in the medical field there is a lack of studies examining the extent and characteristics of these collaborations and evaluating their benefits. The authors' research on South-South research and entrepreneurial collaboration in health biotechnology shows relatively strong involvement of the emerging economies BRICS, apart from some of the other economies such as Cuba, also actively pursues South-South collaboration. This collaboration is generally mutually beneficial for both participating countries, and aimed at shared health needs. As a result the collaboration does not necessarily consist of donor-recipient relationships but heavily reflect capacity-building efforts, where capacity in health biotechnology research and development was extended through South-South collaboration.

Key Words: BRICS, IBSA, South-South Cooperation, Health and Medicine

I. INTRODUCTION

Brazil, India, China and South Africa have launched major programmes for supplementing wider global efforts for tackling various health related challenges. In this context, the forthcoming BRICS Summit in New Delhi should facilitate further consolidation of various efforts launched by the BRICS members at individual and collective levels. At the Sanya BRICS Summit (2011), there was a clear emphasis on identifying health as an important area of cooperation within the grouping. This was followed by the Beijing Declaration adopted at the conference of Health Ministers

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from BRICS countries in July 2011. Apart from dealing with the specific health challenges in the South, it also called for greater participation of the developing world in the reforms process at the institutions like WHO and promoting BRICS as an appropriate forum for coordination, cooperation and consultation on the matters related to global public health.

These economies are now playing an important role within the global institutional landscape supporting health initiatives. South-South cooperation in this area is evolving at various levels, and there are growing efforts to consolidate this cooperation further with common global initiatives through global funds and the UN and other agencies. Brazil, China, India and South Africa together contributed nearly \$200 million to global health initiatives¹ alone during 2007-2008; this does not include the bilateral assistance in the same sector.² Some of these initiatives include the Global Alliance for Vaccines and Immunization (GAVI) and the Global Fund to Fight AIDS, Tuberculosis and Malaria.

At the global level the amount of the Development Assistance for Health (DAH)³ in the period from 2001 to 2007 has more than doubled, growing from \$10.9 billion in 2001 to \$21.8 billion in 2007.⁴ In the last few years, several other initiatives have also been undertaken to track DAH.⁵ However, there is no effort to map assistance from South in general and emerging economies or BRICS in particular. These flows from the South have supplemented the bilateral assistance contributions from the OECD and from development banks and UN agencies.

This paper presents some of the examples of South-South collaboration aimed at improving health in developing countries, describes some challenges, and evaluates the potential benefits of the collaborations, with the support of combined evidence based on a literature review and internet searches as well as the results of an empirical study recently carried out together with research groups in five developing countries. The study examined both South-South research collaborations carried out by researchers at universities or public research organisations, and entrepreneurial collaborations carried out by private-sector firms. Broad policy conclusions, relevant for forum like BRICS, are drawn at the end of the paper.

The following section deals with SSC initiatives in medicines. Section III brings out the effectiveness of SSC. The last section draws the conclusion.

II. FOCUS OF SOUTH-SOUTH COOPERATION INITIATIVES IN MEDICINE

Though there is huge spectrum of South-South collaboration initiatives in the medical field, few have been categorically mapped. Health professionals, researchers, and entrepreneurs are sharing diverse expertise, products and other resources with each other in order to promote health, build capacity, and foster economic development. This is despite the fact that health-related South-South collaboration can effectively help in achieving the Millennium Developmental Goals, such as reducing child mortality, improving maternal health, combating HIV/AIDs, malaria and other diseases, and developing global partnerships for development. South-South collaboration in medicine occurs in all regions of the developing world. There appears to be a relatively strong collaboration in health delivery focused on improving health in Africa, but systematic research is lacking that examines the extent and foci of South-South health delivery collaboration.

The increased overall resources from the BRICS are accompanied by substantial health gains in developing countries. For instance, mortality for children five years old and below has decreased by 30 per cent globally, from 12.4 million a year in 1990 to 8.8 million in 2008.⁶ Still, the need for health support continues to be great. Stark health inequities persist and access to health services in rural areas is highly inadequate. Approximately three million children die annually from diarrhoea and pneumonia.⁷ There are also unmet needs in maternal health, as, for example, up to half a million women die each year from complications of pregnancy and childbirth.⁸ African women suffer particularly in this regard, with 900 women in Africa dying per 100,000 live births, as compared to 27 per 100,000 women in Europe. Despite improved distribution of insecticide-treated bed-nets and anti-malarial therapeutics, malaria still continues to be a grave health problem, particularly in rural areas of Africa and South Asia.

Globally, the estimated number of cases of malaria in 2008 was 243 million, with 863 000 deaths⁹. There have been significant reductions in deaths due to other infectious diseases, such as tuberculosis and HIV/AIDS, but access to treatments continues to be challenging, particularly in rural areas of Africa. There are also needs for new solutions for the so-called neglected tropical diseases; it is estimated that more than 100 million people are affected by them each year.¹⁰ There are further needs to address the growing rates of non-communicable diseases and injuries in developing countries. These are estimated to have caused 33 million deaths in developing countries in 2004, and in the future are expected to be the largest cause of death in developing countries.¹¹ In order to deal with the non-communicable disease burden, there is a demand for low-cost therapeutics and innovative treatment options such as stem cell therapies.

Brazil, China, India and South Africa are increasingly active in initiatives to promote health through South-South collaboration. Typically, those initiatives are government-driven and often involve government-government collaborations.

Human resource development has attracted major attention in the canvass for South-South cooperation. **China** has organised development initiatives in Africa for the past 40 years and now has over 700 medical doctors practicing in Africa through bilateral arrangements. Through its Neighbouring Countries Economic Development Cooperation Agency (NEDA), **Thailand** has participated in dengue control by sending hundreds of medical doctors across Cambodia. The Thai Army also cooperates with Cambodian agencies at the Cambodian-Thai border in management of diseases such as malaria

Infrastructure and health system development are other popular areas of South-South collaboration in medicine. **Brazil** is, for instance, building pharmaceutical plants in Mozambique and Namibia to manufacture generic anti-retroviral medicines which are needed for these countries to deal with their HIV/Aids burden. It also has announced support of US\$ 80 million to rebuild the health system in Haiti after the 2010 catastrophic earthquake. It

will do this as a part of a triangular Brazil-Cuba-Haiti collaboration. **China** has built clinics and hospitals in some African countries such as Democratic Republic of Congo and Tunisia. It started those efforts in Congo in the 1970s, when it established a small clinic but has now expanded its operation to building large hospitals that amongst other things offer Chinese traditional medicine. **India**'s collaboration effort in health delivery is through the Pan-African e-network, launched in 2007, to deliver telemedicine services¹² in Africa, in addition to organising training sessions for local doctors through the e-network.

Increased absorption capacity by partner countries may help in extending South-South cooperation in advanced areas of medicine. It is critical to build manpower where it is most needed, and for this, the establishment of a national human resource development programme is vital. For instance, national efforts in Ethiopia were critical for supplementing Indian efforts in capacity building for medical doctors in handling complex surgeries. Ethiopia launched their Continuing Medical Education (CME) program for doctors in Ethiopia, which helped them gain knowledge on expert medical care and diagnosis. Seeing the benefits of the CME programme, the Care Hospital in Hyderabad, India, arranged regular sessions on various topics like adult cardiology, pediatrics, cardiology, radiology, pathology, neurology, and dermatology.

There are also efforts to build **health systems** across various developing countries. Under the India, Brazil, South Africa (IBSA) initiative, the **IBSA Fund** has been established. IBSA experts and national partners are jointly assessing how the Burundi health care system can be improved in the fight against HIV/AIDS, using models and experiences from IBSA countries¹³. The project aims to better the country's capacity to combat HIV/AIDS through technical cooperation and exchanges of experts that enhance the design of a national plan to prevent HIV transmission, promote safe practices and provide care for people living with HIV/AIDS.

The IBSA fund **rehabilitated and equipped** two health care centers in a remote area of the island of Sao Nicolau, Cape Verde, and is providing a water desalination plant that will produce safe drinking water for the

population of Sao Nicolau¹⁴. In the ambit of South-South Cooperation, the IBSA Fund is an interesting example of need-driven, locally-owned and managed support programme. The IBSA fund has already had some remarkable successes on the ground, and in 2006 it received the UN South-South Partnership Award.

Several leading developing countries have come forward to help other developing countries through **supporting international mechanisms**. **South Africa** committed \$20 million for the next 20 years at the GAVI Alliance (Global Alliance for Vaccines and Immunization), while **Brazil, China, India and South Africa** have committed more than \$40 million in total to support various activities of the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM). Apart from major cash support to various international initiatives like the Global Fund for addressing tropical diseases, these countries are also supporting production capacities in producing drugs, vaccines and diagnostic kits across many other developing countries.

Efforts by **regional organisations** are also expanding at a rapid pace among the developing countries. The Pan American Health Organisation (PAHO) has launched a major effort to manage dengue in the region. Plans are developed at the sub-regional levels. The Central American Sub-region has prepared their own version of the integrated strategy, along with Nicaragua and Venezuela. PAHO is also working with strategies developed by Guatemala, Honduras, El Salvador, Costa Rica, the Dominican Republic and Colombia. Similarly, a trilateral cooperation agreement between India, Bangladesh and Nepal with support from SAARC (South Asian Association for Regional Cooperation) and WHO support work on *kala azar* or Visceral Leishmaniasis (VL), the second most deadly parasitic disease in the world following malaria.¹⁵

There are **Southern NGOs** and individual experts who are developing new strategies to support the health sector in other developing countries. For instance, Bangladesh has an NGO, BRAC (formerly the Bangladeshi Rural Advancement Committee), the largest non-profit organisation in the developing world, which places a large emphasis on providing medical care to low-income populations. BRAC has evolved a holistic approach to

addressing poverty by providing micro-loans, education, health services, job creation and human rights education. It has delivered basic health services to 100 million people. It helped bring Bangladesh's immunisation rate from 2 per cent to 83 per cent, and reached 86 million people with its tuberculosis control programme.

Similarly, Aravind Eye Care System from India is an organisation that provides eye surgeries at cost-effective rates. It is one of the largest eye-care providers, performing nearly 300,000 eye surgeries each year, and 70 per cent of the cost is subsidised or free for the poor. Aravind has handled over 29 million outpatient visits and performed over 3.6 million surgeries. It has participated in establishing national eye care plans for India, Rwanda, and Eritrea, and is now working with Grameen Bank in Bangladesh. An important part of their strategy is to provide training to the local hospital staff in initial steps for eye surgeries and post-operative eye care.

II.I Research Initiatives in the Health Sector

It is not only in health delivery that developing countries work together. They have also, increasingly, been signing agreements that encourage scientific and technological collaboration, and joint research on shared health problems. Health research or the cutting edge field of biotechnology is commonly selected as priority areas for these collaborations. They are mostly carried out by public sector research personnel, either at universities or at public research organisations. The collaborations are both part of bilateral and multilateral initiatives to encourage closer linkages amongst researchers.

Multilateral initiatives have been, for example, organised by the IBSA collaboration, which started by promoting trade relations but has expanded to promote joint biomedical research, focusing on research cooperation in such fields as tuberculosis, malaria, HIV and AIDS, and biotechnology. Third World Academy of Sciences (TWAS), has an important initiative to promote health research as well as other research in the developing world. It is an autonomous, international organisation founded in 1983 that provides support for South-South collaboration in capacity-building and joint research and has had a substantial impact on encouraging South-South research collaboration.¹⁶

Scientometric analysis to examine South-South research collaboration, a scientometric analysis of health biotechnology publications was carried out. This involves analysis of publication levels over time and other characteristics of indexed publications. Universities and research institutes in developing countries typically emphasize publishing in peer-reviewed international journals as a way to disseminate their research. Therefore, examining patterns in health biotechnology publication can provide valuable insights into the characteristics of this type of research in developing countries.

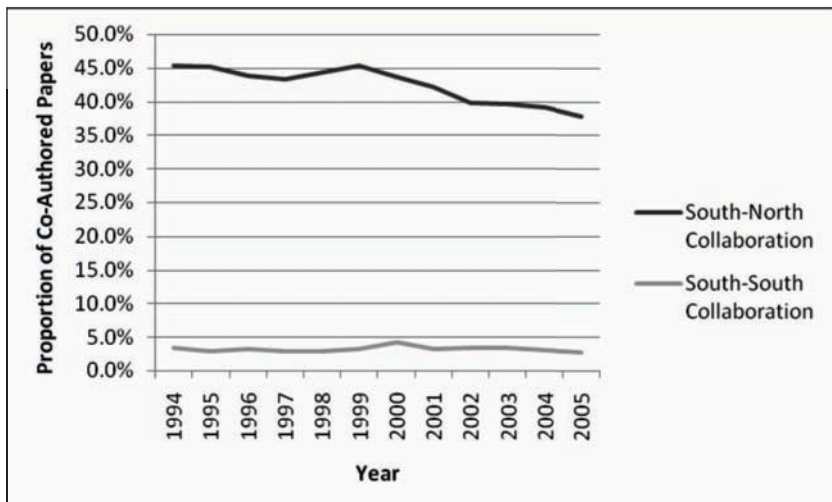
The Thomson Reuters' Science Citation Index Expanded™ database (SCI Expanded) was used, and a subset of all papers published in the 1994–2005 period that fell within the field of 'health biotechnology' was selected. Co-authored papers with addresses from more than one low- or middle-income country, also referred to as South-South co-authored papers were used as a proxy for South-South research collaboration. In comparison, papers published by researchers with addresses from both high-income and low- and or middle-income country were referred to as South-North co-authored papers.

Levels of South-South research collaborations. During the period 1994 to 2005, over 640,000 papers were published in health biotechnology worldwide. Of those, 8.2 per cent had authors from developing countries, whereas 93.3 per cent had authors from high-income countries.¹⁷ These two figures add up to more than 100 per cent because some of the publications have authors from both types of countries. It is obvious that a relatively small percentage of the papers in this field include authors from developing countries, and the knowledge production is still predominantly in the North.

In order to gauge South-South collaboration, the study calculated the proportion of South-South co-authored papers to examine how actively developing countries collaborated with each other in the health biotechnology sector (Figure 1). The data revealed that collaboration amongst developing countries is limited, with only around 3 per cent of their papers being South-South co-authored compared to about 40% being South-North co-authored.¹⁸ Furthermore, the extent of South-South co-authored papers remained largely

unchanged over the period examined. However, the proportion of South-North co-authored papers decreased slightly during the same time frame, from over 45 per cent of developing country papers to less than 38 per cent.¹⁹

Figure 1: Proportions of papers by authors in low and middle income countries in South-South versus South-North collaborations



Source: Thorsteinsdóttir *et al.* (2010).

Based on this analysis, it seems that despite emphasis by many developing countries' governments on signing South-South research collaboration agreements, where typically priority is placed on collaboration in health and/or on biotechnology research, levels of collaboration among developing countries are still low in general.

Aggregate results on the level of South-South collaboration may mask active research linkages between subsets of developing countries. Even though developing countries as a whole do not seem to be active in South-South research collaboration, some countries may be pursuing it more heavily than others. The patterns of collaboration at the country

level were therefore explored and data on countries that had over 100 South-South co-authored papers published between 1994 and 2005 were presented (Figure 2). Brazil has the highest number of South-South co-authored papers, with 423 publications during the period studied, and a steady increase in collaborative papers over the years. The collaboration between Brazil and Argentina is particularly intense and together they engage more frequently in South-South collaboration than any other developing countries. China has the second most collaboration with 287 South-South co-authored papers; Argentina is in third place with 248 papers; and India is in fourth place with 223 papers.

In some of the leading developing countries in the health biotechnology field, such as China and India, South-South collaboration measured by co-publications has tripled since the mid-1990s. As these are also the countries with the strongest economic growth in the last ten years, this may suggest a connection between South-South collaboration and economic growth, potentially boding well for future South-South collaborative activities in health biotechnology. It has still been only a few years since science-intensive South-South collaboration began to be emphasised by developing countries, so it may be too soon to observe an increase in South-South collaboration in general by developing countries. It will be of interest to repeat this exercise in a few years' time.

Characteristics of the research collaboration. In terms of institutions involved, it is observed that almost all research collaboration were carried out by researchers at universities and research organisations but in some countries, such as China, hospitals also seem to be active in collaborations. Most of these organisations are public sector organizations. Developing countries however, vary in terms of how research-intensive their universities are, and to what extent they rely on public research institutes. For instance, India promotes the bulk of their research by public research institutions, and universities are often constrained to focus only on teaching. Universities in both Brazil and South Africa, on the other hand, focus heavily on research. It should also be noted that there is fluidity in the institutional structure, and the same person can belong to more than one type of organisation. It

is, for instance, typical for clinicians at hospitals also to have university appointments.

Developing countries have varying levels of involvement in subfields of health biotech. ‘Genetics & Heredity’ is by far the most common subfield of South-South health biotech collaboration. The same pattern is found in North-North collaboration. Collaboration in ‘Genetics & Heredity’ is dominated by the largest countries, with Brazil, China, India and South Africa all amongst the top collaborators. The high rate of South-South co-authored papers in genomics likely reflects the fact that international forces have stimulated collaboration in this field. China was, for example, the only developing country that took part in the Human Genome Project, and likely as a result, it is the only developing country that has collaborated the most in genomics. There are also cases where neighbouring countries, or countries in the same region, collaborate in ‘Genetics & Heredity’ with each other. For example, China collaborates with Mongolia in examining polymorphism in ethnic populations in Northern China²⁰ and South Africa collaborates with Zimbabwe and United Republic of Tanzania in examining a gene for drug-metabolizing enzymes in their populations.²¹ This can either reflect genetic research on a common lineage, or it can be an indication that some developing countries have populations which are valuable for research in genomics. But capacity is needed to harness this resource, something the leading developing countries in health biotech can provide. The relatively high rate of collaboration in ‘Genetics & Heredity’ is likely to reflect the emphasis on international collaboration that has been promoted within the Human Genome Project and other international initiatives taking place in genomics. A high rate of collaboration in ‘Genetics & Heredity’ also reflects the need to obtain samples from different populations around the globe, and to compare them when identifying the genetic causes of diseases.

South-South collaboration in ‘Tropical Medicine’ and ‘Parasitology’ is different from ‘Genetics & Heredity’, with countries such as Kenya, Columbia, Venezuela and Cameroon – generally weaker in health biotech – taking the lead with Brazil and Argentina. Therefore, depending on the subfield of health biotech, diverse patterns of collaboration may be found.

Brazil is an exception, as it is one of the main collaborators in all the subfields. It collaborates heavily in research on Chagas disease, with almost a quarter of its collaboration with Argentina focused on research into this tropical disease. In addition, Brazil collaborates on diseases such as malaria.

Two forces seem to have encouraged South-South collaboration in health biotech. On the one hand, there are the forces that have encouraged international genomics research in general, fuelled by the belief that in order to tackle the complex challenge of genomics and to accelerate biomedical research, a *global* view of genomics is required. On the other hand, there is a push for developing countries to work together on common health problems or common ancestry, where sharing expertise and resources can be a means of strengthening research. Neighbouring countries often share common ancestry and are thus well-positioned to collaborate with each other. Both genomics and tropical medicine and parasitology are highly relevant to health problems in developing countries. Genomics can provide input into research on both communicable and non-communicable diseases. Genomics research on the malaria genome can, for example, provide input into the development of diagnostics, therapeutics and vaccines to prevent the disease (Gardner *et al.* 2002). Research in tropical medicine and parasitology is needed to address the heavy burden of tropical diseases.

Case study research on health biotechnology collaborations in 13 low- and middle-income countries involving interviews with over 300 researchers, entrepreneurs and policy-makers confirmed that South-South research collaboration tends to be better adjusted to health needs in developing countries than are collaborations with high-income countries. Shared health needs were identified as being one of the major drivers for scientists to work with researchers in other developing countries.

An example of South-South collaboration on a shared health problem is the Latin American collaboration on developing a diagnostic for Chagas disease. It is caused by the protozoan *Trypanosoma cruzi*, and the disease is a major public health problem in Latin America. *Trypanosoma cruzi*, is transmitted by hematophagous insects that colonize dwellings in poorer rural

communities in Latin American countries. It is a potentially life-threatening illness that attacks the heart muscle. Scientists in Brazil, Argentina, Venezuela, El Salvador, Nicaragua, and Honduras have been working together to develop an ELISA diagnostic test to identify *Trypanosoma cruzi*. They have received support from different sources. These include the funding agencies CNPq and FAPESP in Brazil, bilateral programs such as CABBIO that supports cooperation between Brazilian and Argentinean research institutions to tackle regional health priorities, and international agencies such as the World Health Organization, Tropical Disease Research (WHO/TDR).

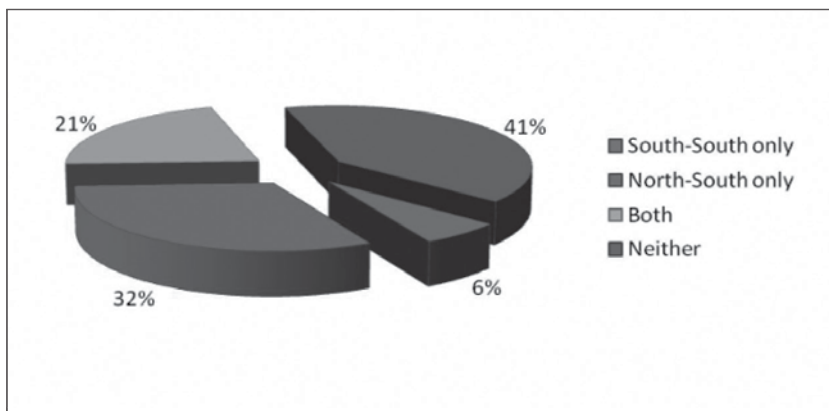
II.2 Entrepreneurial Collaboration

South-South entrepreneurial collaboration is considered in the context of this study to be any work jointly undertaken by firms and organisations in two or more developing countries that contributes to the production of knowledge, products or services. This definition is therefore broad, and involves all types of collaborative activity, from marketing to research and development.

A survey of health biotechnology/pharmaceutical firms in the leading developing countries in the field²² was conducted with the firms directly contacted and asked about their collaboration with other low- and middle-income countries. The survey covered every health biotechnology/indigenous pharmaceutical company identified in the leading developing countries in health biotechnology, Brazil, China, Cuba, Egypt, India and South Africa, with a total of 467 firms. The number of firms that responded was 288 firms, resulting in a 62 per cent response rate.

Level of the collaboration. The results of the study showed that 27 per cent of the firms that responded said they had an active collaboration with other developing countries (Figure 2). South-North collaboration is even more prevalent, with just over one in every two firms collaborating with at least one high-income country. Considering that the North is dominant in this field, it is not surprising to observe more South-North than South-South collaboration.

Figure 2: Proportion of health biotechnology firms in South-South and North-South collaborations



Source: Thorsteinsdóttir *et al.* (2010).

In total, Brazil and South Africa had the most number of South-South entrepreneurial collaborations, taking part in 63 and 61 collaborations respectively. Cuba had the greater number of collaborations per organisation with over 12 collaborations. It is notable that the strongest linkages appear to be between the leading developing countries in the health biotechnology field, which are mainly over relatively widespread geographical areas (Figure 3). Chinese firms collaborate relatively strongly with firms in Brazil and India, Indian firms have frequent collaborations with firms in South Africa, and Brazilian companies have close linkages with firms in Cuba. The only other pairs of countries with a relatively high level of South-South collaboration are Brazil and Argentina, and South Africa and Botswana. In addition, the results show a considerable number of regional collaborations between firms. Firms in South Africa, for example, have active linkages with other sub-Saharan countries, and groups in both Brazil and Cuba had active collaborations in Latin America. Thus, South-South collaborations serve to strengthen ties between leading developing countries in health biotechnology as well as strengthening regional ties.

The research showed that the collaborations typically involved the end-stage commercialization activities distribution (72 per cent of the collaborations) or marketing (34 per cent of the collaborations).²⁴ The firms collaborated primarily in order to reach each other markets. The countries with the smallest populations appeared to be most active in South-South collaboration, demonstrating their need to export their products.

As some developing countries have a track record in producing relatively affordable health products, South-South collaborations are able to distribute lower-cost health products among developing countries. An example is the collaboration between Brazil and Cuba to produce Meningitis A vaccine for Africa.²⁵ To combat a meningitis outbreak in 2007, the World Health Organisation (WHO) identified Bio-Manguinhos (Rio de Janeiro, Brazil), in collaboration with the Finlay Institute (Havana, Cuba), as the most suitable suppliers of a meningitis vaccine. The two firms relied on their respective strengths in the development and manufacturing process; neither firm alone would have been able to respond as quickly and efficiently to this request. Clearly, then, South-South collaboration can be harnessed to address a health threat when supported by demand and funding from an international organisation.

The survey indicated that there were few efforts in South-South collaborations aimed at developing new health products and other innovative activities. Partly this is because only a small number of the firms surveyed were involved in developing new health products and services. Instead, they were likely to have licensed technologies, typically from the North, and were mainly collaborating to expand their markets. There are also cases in which firms were licensing technologies from other developing countries.

Still, the research identified some important cases of South-South collaboration in developing diagnostics, therapeutics and vaccines.²⁶ For example, Cholera is a common problem in Bangladesh and eastern India. The International Centre for Diarrhoeal Disease Research (Dhaka, Bangladesh) has developed a vaccine candidate to prevent Cholera, and is collaborating with the Indian firm Biological E (Hyderabad, India). If the vaccine candidate proves effective and safe, the Indian firm will manufacture

the vaccine. The Kunming Institute of Botany (Kunming, China) and the Chinese firm SH-IDEA Pharmaceutical Company (Yuxi, China) are working with Thailand's Ministry of Public Health (Bangkok) on clinical trials of an HIV/AIDS treatment. The study is derived from research from the Kunming Institute of Botany based on Chinese traditional medicine and local biodiversity, but the clinical trials were carried out on Thai patients. China and Thailand are working together in developing therapeutics against HIV/AIDS based on Chinese biodiversity. A good example of South-South collaboration involving capacity-building is a collaboration between South Africa and India. East Coast Rapid Diagnostics (now split into Tulip South Africa and Life Assay, both of Durban, South Africa) is a joint venture between the publicly funded LIFE labs in South Africa and the firm Indian Tulip Group Diagnostics (Bambolim, India). As a part of this agreement, the Indian firm transfers several diagnostic technologies to South Africa, including rapid malaria diagnostic kits, together with substantial capacity and technical assistance. These diagnostic kits are stable at high temperatures and are thus suitable for application in Africa, where cooling can be hard to achieve.

According to the survey on South-South entrepreneurial collaboration, most of the firms engaged in joint research and development activities have also been involved in marketing collaborations. What appears to happen is that firms start their collaboration through joint commercialisation and then, as trust is built up between the partners, they start to consider joint developmental activities. As many of the collaborations are new, and developing countries' firms are increasing their emphasis on innovation, it can be expected to see more focus on research and other developmental activities in future South-South collaborations in health biotechnology.

The examples above illustrate a focus on shared health needs in developing countries. Many of the examples discussed in this section reflect an emphasis on problems that developing countries primarily suffer from, such as cholera, malaria and Chagas disease. They have also showed that how Brazil and Cuba could, through their collaborations, provide countries in the Meningitis belt in Africa with a cost-effective meningitis vaccine. International organizations and philanthropic organizations engaged in

promoting health in developing countries should consider the potential of South-South collaborations for providing affordable health products. When firms in developing countries pool their respective strengths, they can be more cost-effective and sensitive to local health needs than firms in high-income countries. As a result, South-South collaborations may be able to provide health products that reach more poor people in the developing world.

In addition to the collaborations discussed above, there have been several formal South-South collaboration networks established in the health sector (Table 1).

Table 1: Formal Networks Involving South-South Health Collaborations

Network	Partners	Geography	Disease Foci
African Malaria Vaccine Testing Network (AMANET)	30 research institutions and universities in Africa	20 African countries	Malaria
Developing Country Vaccine Manufacturer's Network	Firms in developing countries: Bionet, Biological E, Fiocruz, Finlay Institute, LG Life Sciences, The Biovac Institute, Vabiotech, Panacea Biotech Limited, amongst others.	Global	Various, including TV, Meningitis, etc.
South-South Initiative in Tropical Diseases (TDR)	745 individuals: DEC researchers with expertise and capability to share and transfer technology	Global - Based out of Zimbabwe, seeking to work on diseases in Latin America, Africa and Asia	Infectious diseases such as Malaria
SANBio: South African Network for Biosciences	Private sector	Africa	Diseases of poverty
The Technological Network on HIV/AIDS	Representatives appointed by governments	Brazil, Argentina, Chile, Cuba, Nigeria, Russia, Ukraine, Thailand	HIV/AIDS

Table 1: continued...

Table 1: continued...

Developing Countries' Vaccine Regulator Network	Representatives from regulatory agencies	Brazil, China, Cuba, India, Indonesia, Republic of Korea, Russia, South Africa and Thailand.	Various
ANDI: African Network for Drugs and Drug Information	Public-private partnerships	Africa	Tropical diseases/ infectious diseases, such as Dengue Fever
Central Asia Regional Network for the Prevention and Control of Avian Influenza	Laboratories, regional centres, educational advocacy groups	Afghanistan, Azerbaijan, Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Uzbekistan	Avian influenza
SEAICRN: Infectious Diseases Clinical Research Network	Hospitals and research institutions	Thailand, Indonesia, Vietnam, Singapore	Human and avian influenza and other infectious diseases of public health importance
RNAS+ - Regional Network of Research, Surveillance and Control of Asian Schistosomiasis	Researchers	Cambodia, China, Indonesia, Lao PDR, Philippines	Schistosomiasis japonica
Regional Network for Schistosomiasis in Africa	Researchers	Africa, with collaboration with other similar networks in developing countries.	Schistosomiasis
ACTMalaria	Public health professionals	Bangladesh, Cambodia, PR China, Republic of Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Timor Leste, and Vietnam.	Malaria

Source: Author's compilation.

There is a variety of types of institutions involved in the formal South-South collaborations, ranging from researchers at public research institutions and universities, to private-sector manufacturers of vaccines and regulators of health products. The networks involved thus reflect the wide scope of activities in South-South collaborations, and the need to work together on diverse tasks.

While some of the formal networks have global interactions across Africa, Asia and Latin America, it appears to be more common that the collaborations are confined to a single continent. In addition, some of the networks are limited to countries with particular capacities. For instance, the Developing Country Vaccine Manufacturers' Network is confined to developing countries with capacities in manufacturing vaccines, and the Technological Network on HIV/AIDS is limited to countries that place a priority on having political will to control the HIV/AIDS pandemic through public health measures along with technological capacity in the pharmaceutical sector.

What is also noticeable in examining the formal collaboration networks is the strong focus on health problems that are specific to developing countries. Malaria, schistosomiasis and other infectious diseases in the tropics are frequent foci of these networks. The networks thus reflect the wish of developing countries to work together in addressing their shared health problems.

III. EFFECTIVENESS OF SOUTH-SOUTH COOPERATION

South-South collaborations in health shows great potential to contribute to improved health, capacity-building and innovation. By contributing their respective strengths, developing countries have the potential to enhance their research and development activities to lead to new health products and services aimed at their often dire health needs. South-South health collaboration can thus make a considerable contribution towards meeting the MDGs, and promote development in less-developed countries. Earlier dialogue on health needs of developing countries emphasised the importance of conducting research and development on so-called neglected tropical

diseases. As said above, the burden of diseases in developing countries is changing with low resource populations in developing countries increasingly suffering from non-communicable diseases. With increased smoking, lung cancer is, for example, on the rise. In addition to health solutions for the neglected tropical diseases, developing countries, also need affordable solutions for non-communicable diseases. As health needs in developing countries are diverse, it is challenging to judge the relevance of South-South collaboration to health prioritisation in developing countries.

South-South collaboration is also an important way to extend capacity in science-intensive fields, such as health research, to an increasing number of developing countries. Our case study on South-South collaboration involving 13 developing countries shows the importance of the capacity building role of South-South collaboration in health biotechnology.²⁷ What was noteworthy is that the contribution of South-South collaboration to capacity building was important both in countries that had extensive capacity in the health biotechnology field, such as the emerging economies, as well as countries that less competence in this area. For instance, in one case, Brazil and Cuba collaborated in order for Brazil to build local capacity in producing specific biotechnology therapeutics, interferon, and Erythropoietin.²⁸ The collaboration involved technology transfer from Cuba to Brazil and the driving force was the wish of the latter country to lower prices and reduce its dependency on imports.

African countries were frequently the recipients of the capacity building efforts. These included entrepreneurial collaboration between China and Egypt, for example, where Egypt built capacity in local production of recombinant insulin based on technology transfer from China.²⁹ As a result Egypt has a reliable domestic source of insulin that is cheaper than the imported product. Economic and political turmoil can heighten the importance of self sufficiency in essential medicines.

There are also capacity building initiatives within Africa in health biotechnology. South African researchers are, for instance, involved in a number of capacity building initiatives with Kenya and Zambia.³⁰ The

capacity building focused both on strengthening research capacity in Kenya and Zambia as well as capacity for clinical trials. At times international organizations played a role in supporting the African collaboration. The International Centre for Genetic Engineering and Biotechnology (ICGEB), for example, has started to do so. It is an international network that is a part of the UN system with three main components (in Trieste, Italy; Delhi, India; and Cape Town, South Africa) and 39 affiliated institutions (one in each member country) that form a south-south network. The Cape Town office was inaugurated in 2007 and intends to play a significant role in research and training activities relevant for improving both infectious and chronic diseases in Africa. Africans need to work together to address their health problems and it was emphasised that it was of mutual importance for the African countries to build capacity widely on the continent in order to strengthen their abilities to manage disease outbreaks..

Many developing countries have been building up expertise in health research, and through South-South collaboration they can reduce gaps that exist among various countries. For example, in the case of China-India collaboration on the mitochondrial DNA of the Indian population, it was important for Indian scientists to gain access to sequencing infrastructure and expertise in China.³¹ As mentioned above China was the only developing country to take part in the Human Genome Project, and has a great sequencing capacity as a result. So instead of duplicating efforts and building expertise and infrastructure in a wide range of health biotech subfields, it can be valuable to focus on specific niche areas and collaborate with neighboring countries or other global players to gain access to complementary knowledge.

From the above there are clearly multiple benefits of South-South collaboration in medicine. There are several challenges that can hamper the collaboration as follows.

III.1 Need to Enhance Dedicated Resources

South-South collaboration is seriously hampered by a lack of dedicated resources. South-South collaboration in medicine can be criticised for not being taken seriously to the extent that resources are not allocated towards

it. The interviews³² conducted for this study confirmed a consensus that financial resources were lacking for collaboration on research.

In general, resources for South-North collaborations were more easily available and typically provided by high income countries. The availability of resources therefore provided a stronger impetus for South-North than South-South collaborations.³³ While South-North collaboration in the health field is certainly of great importance to developing countries, many interviewees stressed that there was a risk that it diverted emphasis away from developing countries' needs.

Even though biotechnology is on many South-South collaboration agendas, the study could identify only two funds that are dedicated to fund biotechnology collaborations, the CABBIO (Centro Brasileiro Argentino de Biotecnologia) fund between Brazil and Argentina and the IBSA Trust Fund.

The fact that CABBIO dedicated funds exist and have existed since 1986, has significantly promoted collaboration between the two countries. As a result, Brazil and Argentina now have the largest number of co-publications between any two developing countries. This, therefore, demonstrates that governments can stimulate South-South collaboration by investing resources in the collaboration.

The IBSA Trust Fund was established in 2004 for promoting joint research in health biotechnology focused on AIDS and other diseases. As it is rather recent in origin it has not had much impact on South-South research collaboration so far.

III.2 Overcoming IP Barriers

The BRICS readers have committed themselves to the idea of greater interdependence and its appreciation in global policy making between public health, innovation and intellectual property right. The Beijing Declaration calls for continued commitment to the 2008 WHO Declaration on Global, Strategy and Plan of Action on Public Health, Innovation and Intellectual Property.

The best example of South-South cooperation to positively influence access to medicine through relevant changes in the global trade architecture comes from the efforts of developing countries, which achieved flexibilities in the rules on IPR. Many developing countries governments have explored flexibilities as provided in the TRIPs which includes compulsory licensing, parallel importation and waiver granted to least developed countries until 2016 for becoming TRIPs compliant. The developing countries together have played an important role in the evolution of Doha Ministerial Declaration on the TRIPs Agreement and Public Health and the WTO General Council Decision in 2003 which eventually paved way for balance between ‘rights’ and ‘Access’ to essential mechanisms.

This provision had hampered the ability of countries that were unable to produce pharmaceutical products from importing cheaper generics from countries where pharmaceuticals are patented, according to trade officials. The problem here was finding sources of supply if the non-predominant part of production under a CL would be inadequate to supply another market/s. It was at the Doha Meeting of the WTO in August 2003 that the WTO agreed to grant flexibility to poorer countries, having no domestic capability to produce, from the provisions of the TRIPs agreement. Despite long and intense negotiations, members could not reach consensus on the ‘expeditious solution’ by the 31 December 2012 deadline. It was on December 6, 2005, just before the WTO Hong Kong Ministerial Conference, that WTO members agreed to adopt a protocol of amendment to the TRIPs that already had to incorporate the August 2003 waiver decision into the body of the TRIPs agreement. Though, it is operational, it still awaits acceptance by two-third of the WTO membership a fairly high standard in terms of entry into force of international treaties.³⁴

III.3 Triangular Cooperation: Sustainability of Projects

Many of the health sector initiatives, under South-South collaboration in medicine, are in project mode, which pose several challenges in terms of management of health services once projects are over. Possibility of continuation of projects and predictability of magnitude of assistance remains a major issue of concern for recipient countries. This is valid for most of the health delivery initiatives described above where the emerging economies

and other developing countries (for instance, Cuba and Thailand) are contributors providing health services to developing countries suffering from dire health problems. Some initiatives, however, involve national efforts from the recipient countries and as a result they encourage further sustainability of the services. For instance, telemedicine collaboration between India and Ethiopia is aimed at providing expert services to 53 hospitals in rural settings in Ethiopia that have equipment such as ultra sound machines and electro-cardio-gram machines. Through the collaboration with India, patients in Ethiopia will receive online consultations with some of the best medical specialists of Ethiopia. National efforts in Ethiopia have established a continuing medical education program to train Ethiopian doctors. Indian hospitals are using the fiber optic based network set up for the telemedicine services to arrange training on various topics to the Ethiopian doctors. Instead of remaining primarily dependant on the services of the Indian doctors their service needs will slowly be diminished with increasing Ethiopian expertise.

The South-South entrepreneurial collaborations discussed above are also examples of collaboration that have built in sustainability. The firms collaborate because it is mutually beneficial to them. They may require help from governments, industrial associations, or international organisations to start the collaborations and build trust, but with time there have been examples where firms have used their respective strengths to develop affordable health products and services that are well aligned to the shared health needs in developing countries.

III.4 Need for Systemic Alignment

The research conducted for this study has shown that in some cases it can be a challenge for the collaboration to have impact. The collaboration may involve capacity-building but the new capacity may not contribute to either health improvements or economic development. For instance, the collaboration may involve providing research training for researching health problems in developing countries. Even though the training may be highly relevant to the health problems of the receiving country, the trainee may not have the facilities to continue his/her work after receiving training, as there is limited research infrastructure in the receiving country.

In order to appreciate the impact, it is important to look at South-South collaboration as interactions between two systems in different developing countries. If country 'A' provides training to country 'B', it is of key importance that the training is relevant to the priorities of country 'B', and the trainee has the systemic support to continue to work in the area. Instead of looking at the collaboration as isolated training, it is crucial to consider how the training fits into the health and innovation systems in both countries. By doing so, national ownership of the expertise is enhanced and the collaboration is better aligned with the priorities of both countries.

The importance of a systemic perspective is also clear in entrepreneurial collaborations. When firms in two countries are engaged in joint development of health products, the work can get delayed owing to regulatory systems in two countries. If the regulatory systems have the opportunity to collaborate, exchange information about each other's requirements, and align their processes, the development is likely to be less challenging. In the case of the Brazil-Cuba collaboration for Meningitis A vaccine in Africa, the fact that the World Health Organisation initiated the collaboration and supported it, allowed the regulatory systems in the two countries to collaborate. As a result, the collaboration was smoother and it was quickly able to produce a cost-effective vaccine that met health needs in Africa. Systemic alignment of entrepreneurial collaboration can thus be of key importance and lead to concrete health improvements.

III.5 Strengthening Triangular Cooperation

In addition to bilateral South-South collaboration, what is needed is a model of South-South-North collaboration, which harnesses the appropriate learning between developing countries and the technological and financial strengths of the North. There are limited instances where triangular South-South-North cooperation has taken place in the health sector. However, several promising opportunities exist for effective trilateral cooperation in the health sector. Triangulation was also a recurrent theme in the interviews conducted as part of this study with experts in 13 developing countries about South-South collaboration, and was heavily endorsed by them.

The limited instances of triangular cooperation are mostly in health care training; for example, Egypt and Japan have come together to train nine other African countries in molecular biology and disease control. Specific training is also being provided for nursing and hospital care. Similarly, training from Turkey is provided to seven African countries as part of capacity building in primary health care.

Awareness creation for health management is another area which has attracted trilateral funding. For instance, night blindness education by Tunisia in Niger is funded by the Islamic Development Bank as part of a blindness reduction campaign. Similarly, there is UNDP/UNICEF funded Thai-Zambia initiative on HIV/AIDS.

IV. CONCLUSIONS

As stark global health inequities persist, there is a great demand for better dissemination of existing solutions as well as for the development of new solutions tailored to the health needs of developing countries. South-South collaboration can have a substantial impact in fulfilling these demands. Some developing countries, such as China and India, have built up capacity for manufacturing affordable health products.³⁵ As these products cost less than alternatives from the high-income countries, the DAH can extend to more people in low and middle income countries. Developing countries have also been increasing their capacity to develop new-to-the world innovations.³⁶

Most of the health research in the world is focused on the problems of industrially advanced countries, and relatively very few health products are developed for the people in poorer parts of the world.³⁷ There are few incentives for private sector firms in industrially advanced countries to focus on the small market potentials of developing countries. However, research on the health biotechnology innovation in seven developing countries and private sector development in a number of countries has shown that some developing nations are successful in developing new and innovative biotechnology products for their populations.³⁸

The developing world is no longer entirely dependent upon industrialised countries to develop new health products for their health needs. The research described above shows that the health biotechnology sectors in developing countries are more likely to develop health products that fit the local patterns of disease and are affordable by the local population, compared to the sectors in industrially advanced countries. Therefore, supporting medical sciences in developing countries is a promising way to encourage the development of appropriate and affordable health products for those countries. South-South collaboration affords possibilities of mutual learning to address these problems. There is also a strong need in the developing countries to develop low-cost solutions, as large segments in these countries are poor. These shared needs, therefore, provide a rationale for increased South-South collaboration.

Though the forums like BRICS and IBSA in their declarations may mention need for further assistance from the global community, the official development assistance (ODA) of DAC governments is a major source of finance for global health. The fact that South-South cooperation in medicine is evolving at various levels itself is a sign of pragmatism emerging across the developing world towards the will to deal with their own problems. There are discernible trends of growing efforts by the member countries from BRICS for supplementing the global flows with common initiatives led by specialised global funds, the UN and other agencies. As mentioned above, Brazil, China, India and South Africa together contributed nearly \$ 200 million on global health initiatives alone, apart from the bilateral assistance in the same sector. A number of measures are possible to further strengthen collaboration in the medical field.

It is high time that the BRICS countries' governments collectively act on their Beijing Declaration and invest more for strengthening the South-South cooperation in health collaborations and to consider such collaborations to be integral part of their science, technology, innovation and health promotion plans. With dedicated funding, the emerging economies from the South can work together to better address the local health needs that may otherwise be overlooked the by high-income countries, thereby securing timely and affordable health products for improving global health.

As already called by the BRICS Health Ministers earlier, there should be a continuous dialogue among the member countries, and greater efforts should be made to promote the alignment of their health and innovation systems in order for South-South collaborations to have health and economic impacts. In this context, the national governments from BRICS and the key health sector focused donor organisations may explore triangular cooperation which may assist in harnessing the appropriate learning between developing countries and the technological and financial strengths of the North.

International organisations and donor organisations should utilise South-South collaboration as a means for promoting development and global health. When firms in developing countries pool their strengths, that often leads to more cost-effectiveness. As a result, South-South collaboration may be able to supply health products that reach more deprived people in developing nations. The South should keep a watch on the global IPR regime as it unfolds at the WTO and other fora so as to meet their challenges in the health sector without adversely affecting the necessary incentives for innovation and development of new cost-effective technologies and products.

South-South cooperation could be far more vibrant and dynamic when supplemented by non-state actors. Therefore, there is need to encourage NGOs, academic institutions and entrepreneurs from South to play an important role in this context. Alignment of efforts by the recipient national governments is also important for the success of South-South collaboration. For instance, in the Ethiopian e-health programme, alignment with the national Continuing Medical Education (CME) programme, conducted for doctors in Ethiopia, helps them to gain knowledge on expert medical care and diagnostic expertise and encourages sustainability. Thus, more concerted effort from the South is required to focus on development of health-related infrastructure for increasing production and trade in drugs, vaccines and diagnostics.

Endnotes

- ¹ For instance Brazil, China, India and South Africa have committed more than \$40 million in total to support various activities of the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM).
- ² Chaturvedi *et al.* (2012).
- ³ DAH, as defined by IHME is, “all assistance for health channelled through public and private institutions whose primary purpose is to advance development in developing countries.”
- ⁴ Institute for Health Metrics and Evaluation (2009); Ravishankar *et al.* (2009).
- ⁵ McCoy (2009); Ravishankar *et al.* (2009).
- ⁶ WHO (2010).
- ⁷ WHO (2010).
- ⁸ WHO (2010).
- ⁹ WHO (2010).
- ¹⁰ WHO (2010).
- ¹¹ WHO (2008).
- ¹² Telemedicine is delivery of medical care through electronic channels. It may be directly to patients or even an expert advice to local doctors. With the advancements in optical fibres across several African economies, communication through telephones, internet and satellites has made is feasible to transmit medical data, still images, and live videos.
- ¹³ RIS (2008).
- ¹⁴ UNDP (2009).
- ¹⁵ The disease occurs predominantly in poor and marginalized communities. During 2000-2002, the number of reported cases in Bangladesh, India and Nepal were 24 287, 18 472 and 22 030 respectively. Estimates indicate about 100,000 cases per year in the region overall.
- ¹⁶ Schaffer (2005).
- ¹⁷ Thorsteinsdóttir *et al.* (2012).
- ¹⁸ Thorsteinsdóttir *et al.* (2012).
- ¹⁹ Thorsteinsdóttir *et al.* (2012).
- ²⁰ Kong *et al.* (2003).
- ²¹ Dandara *et al.* (2004).
- ²² Thorsteinsdóttir *et al.* (2010).
- ²³ Taylor *et al.*
- ²⁴ Thorsteinsdóttir *et al.* (2010).
- ²⁵ Sáenz *et al.* (2012).
- ²⁶ Thorsteinsdóttir *et al.* (2010).
- ²⁷ Thorsteinsdóttir *et al.* (2012)
- ²⁸ Sáenz *et al.* (2012).
- ²⁹ Thorsteinsdóttir *et al.* (2010); Aly *et al.* (2012).
- ³⁰ Konde *et al.* (2012).
- ³¹ Ke *et al.* (2012).
- ³² Over 30.0 experts from 13 low-and middle-income countries were interviewed.
- ³³ Chaturvedi, *et al.* (2012).
- ³⁴ The amendment, passed as a temporary waiver in 2003 and as a TRIPS amendment in 2005, will be made permanent when two-thirds of WTO members accept it. To date, only 28 primarily developed and middle-income countries have done so (counting the 27 European Union countries as one) so technically it is in force and can be used but it is still considered as a temporary waiver.

- ³⁵ Yusuf *et al.* (2007).
- ³⁶ Thorsteinsdóttir *et al.* (2004); Frew *et al.* (2008).
- ³⁷ Médecins Sans Frontières (2001).
- ³⁸ Thorsteinsdóttir H. *et al.* (2004); Frew *et al.* (2007); Rezai *et al.* (2008); Albader *et al.* (2009).

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