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PRODUCT DEVELOPMENT PARTNERSHIPS

Are PDPs efficient and effective in addressing the global health burden?

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ABSTRACT

Product development partnerships (PDPs) have become an important tool in addressing the problem of market failure within the area of drug development for poverty-related neglected diseases (PRNDs). While a lack of incentives for R&D-based investment in such diseases persists within today's profit-driven pharmaceutical companies, the gap between the rich and the poor in world society is increasing. Without new drug development for PRNDs, the World Health Organization (WHO) – key international organ for global health security - will be unable to meet its fundamental requirement in ensuring healthy lives and promoting well-being for all under the Sustainable Development Agenda by 2030. Within this research paper, the question of the added value of PDPs, which seek to stimulate innovation for PRND medicines, shall be addressed.
There has been a general tendency in recent times for seeking more purely private solutions regarding R&D for neglected diseases' drugs. This raises the question whether PDPs are still effective and efficient in addressing the global health burden. To further explore this point, both business models, PDPs and purely private initiatives, will be evaluated by their advantages/opportunities and disadvantages/challenges. By comparing the two business forms, with regard to their efficiency and effectiveness for achieving this fundamental global health requirement, it will be shown that PDPs are indeed a crucial solution in addressing the global health burden. It is recommended to the Swiss Agency for Development and Cooperation (SDC) to pursue a continuation of support and funding of PDPs.

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ABBREVIATIONS

APC: Advanced Purchase Commitment
ASAQ: Artesunate-amodiaquine Fixed-dose Combination
CEA: Cost-Effectiveness Analysis
CSR: Corporate Social Responsibility
BMGF: Bill & Melinda Gates Foundation
DALY: Daily-adjusted Life Year
DNDi: Drugs for Neglected Diseases Initiative
EVI: European Vaccine Initiative
FIND: Foundation for Innovative New Diagnostics
GCP: Good Clinical Practice
GSK: Glaxo Smith Kline
IAVI: International Aids Vaccine Initiative
IDRI: Infectious Disease Research Institute
IPM: International Partnership for Microbicides
IVCC: Innovative Vector Control Consortium
IVI: International Vaccine Institute
MDG: Millennium Development Goal
MMV: Medicines for Malaria Venture
MVI: Path Malaria Vaccine Initiative
PDP: Product Development Partnership
PPP: Public-Private Partnership
PRND: Poverty-related Neglected Disease
PRV: Priority Review Voucher
SDC: Swiss Agency for Development and Cooperation
SDG: Sustainable Development Goal
WHO: World Health Organisation

1. INTRODUCTION

"The enjoyment of the highest attainable standard of health
is one of the fundamental rights of every human being
without distinction of race, religion, political belief, economic or social condition."

Constitution of the World Health Organization, p. 1.

Ever since the second half of the twentieth century, the global landscape has been experiencing a widening gap between the health conditions in mostly Western developed states and least developed countries. Within an increasingly neo-liberal market-based world order and the resulting erosion of Keynesianism, financial opportunities for pharmaceutical companies rather than global health needs guide the direction of new essential drug development. Despite recent advances in health technology, a lack of commercial interest for large pharmaceutical industries, which are mainly based in Western states of the developed world, has greatly failed to stimulate innovation in the area of drug development and preventive medical care for poverty-related neglected diseases (PRNDs). Since profit plays no role for these diseases, drug innovation in this area has become the responsibility of governments and philanthropic foundations. In this context, product development partnerships (PDPs) emerged, which are collaborations between various stakeholders, such as biotechnical and pharmaceutical businesses, philanthropic foundations, governments, academia and non-governmental organizations (Stirner, 2010, p. 132). Although PDPs are concerned with activities such as capacity building and ensuring access as well, their main focus is to facilitate R&D for the drugs against neglected diseases.

In recent times, more and more purely private solutions have been sought with a majority of funding stemming from few foundations such as the Bill & Melinda Gates Foundation (BMGF) and the Wellcome Trust (Stirner, 2010, p. 38).

With reference to the Swiss Agency for Development Cooperation (SDC), this paper seeks to establish to which extent PDPs are effective and efficient in addressing global public health needs of the poor versus purely private initiatives. This will be achieved by firstly taking a closer look at the history of the health sector, the global health burden and the two business models PDPs and purely private initiatives. After this introduction into the topic, both the advantages and opportunities as well as the disadvantages and challenges of PDPs versus a purely private support of the pharmaceutical industry will be evaluated in respect to their contribution to the reduction of the global health burden. Thereafter, an evaluation of the two business

forms – PDP versus purely private – shall be made with regard to their efficiency and effectiveness for tackling the global health burden of PRNDs. It will consequently be possible to give recommendations to the Swiss Agency for Development and Cooperation (SDC) for the future support and funding of product development partnerships. The authors' conclusion will be, that a continued support of PDPs by the SDC is strongly recommended.

2. BACKGROUND

In order to boost the level of commitment and cooperation by governments to improve social and economic conditions throughout the world, 189 Members of State at the United Nations Millennium Summit in 2000 adopted the Millennium Declaration. Of eight Millennium Development Goals (MDGs), three focus on health directly (reduce infant mortality by two-thirds and maternal mortality by three-fourths as well as stop the spread of pandemic diseases) and four on social determinants of health (reduce extreme poverty by half; achieve universal primary education; promote gender equality and empower women; promote environmental sustainability). Although these goals led to a number of measures being undertaken by developed nations to tackle the health burden of PRNDs, progress has been uneven and by 2015 many of the MDGS were not fully realized. (Brown, Fourie & MacLean, 2009, p. 61; 227)
For the years 2016 until 2030, a new Sustainable Development Agenda consisting of 17 Sustainable Development Goals cover an even greater number of economic and social development issues. They build on the pre-established MDG aims and were adopted by the 193 countries of the UN General Assembly on 25 September 2015. (United Nations, 2016)

2.1. History of the Health Sector

In order to understand the concept of product development partnerships and their significant rise over the last two decades, a look back in time regarding the evolution of the health sector is necessary. Mahoney (2011, p. 2) identifies four major eras in the field of health technology innovation, which all can be characterized differently in respect to the engagement and investment by the public and private sectors.

1850

The first era – **The Era of the Public Sector** – lasted from 1850 to 1915 and stands for the dominance of health technology innovation

by the public sector. Since Louis Pasteur had found new ways to make food safe to eat, the vaccines that were then launched are deemed to have saved millions of lives. A global dissemination of vaccines by public sector institutions, such as the Pasteur Institute, followed. («Louis Pasteur: the man», 2016)

1915

The Era of the Private Sector from 1915 to 1970 marks the second era of health technology innovation. The trigger for this era was the identification of a highly profitable drug market by mostly European chemical companies. As a result, investments in the pharmaceutical sector, including research, development, manufacturing and marketing, increased rapidly. During this second era, the health care sector was significantly revolutionized in terms of global development and distribution of new health technology. However, after the Second World War, Western countries' governments started to realize, that these health sector innovations did not reach the poor in developing countries. Not only did these technologies elude the developing countries, but the entire development of drugs for the diseases of the poor – the so-called neglected diseases – was omitted. As a result, a huge discrepancy between the rich and poor countries emerged and continuously increased until the end of the 1970s. (Mahoney, 2011, p. 2)
It was also in this era when the Swiss zoologist Rudolf Geigy founded the Swiss Tropical Institute in 1944. Initially, the institute focused on tropical diseases mainly occurring in Africa. However, its focus extended: Today also diseases of the northern hemisphere, like cardiovascular diseases, obesity or diabetes are tackled. The institute also changed its name to "Swiss Tropical and Public Health Institute". (Bachmann, 2014)

1970

This divergence between the developed world and the developing world triggered the third era of health technology innovation – the so-called **Era of Public Sector Reawakening**, which lasted from 1970 to 2000. It is characterized by increased endeavours to promote new technologies in the health sector. (Mahoney, 2011, p. 2)
This was especially visible regarding the availability of anti-viral drugs against HIV/ AIDS in the 90s, a virus which threatened both the developed and the developing world. Patients in the developed

world, had access to medication, while afflicted people in the developing countries were dying one after another. A continuously advancing communication system contributed immensely to a higher awareness in societies across the world and the calls for action grew louder. (D. Reddy, personal communication, 29.05.2016)

And the public sector acted, which was displayed for example by the development of new contraceptives for the fight against HIV/ AIDS by the WHO in Geneva. (Mahoney, 2011, p. 2)

Also, in the field of other tropical infectious diseases, first partnerships emerged. In 1975, the United Nations Development Programme (UNDP), the United Nations Children Fund (UNICEF) and the World Bank founded the Special Programme for Research and Training in Tropical Diseases (TDR) with the purpose to fight tropical diseases (Stirner, 2010, p. 133). These first partnerships proved that the cooperation of the public and private sector was crucial for a successful fight against the diseases of the poor (Mahoney, 2011, p. 2).

1990

In the late 1990s, an innovative collaboration model for research management and financing of R&D for neglected diseases emerged in the form of public-private partnerships (PPPs) that came to be known as product development partnerships (WHO, 2012, p. 103; MMV, 2016). One of the first PDPs is the Medicines for Malaria Venture (MMV), which is today's driving force for the R&D stimulating process for new anti-malarial drugs (SDC, 2015a, p. 1–2). As described above, Mahoney (2011, p. 2) identifies the rise of several PDPs like MMV since 2000 as the trigger event for the fourth and present era of health technology innovation: **The Era of Partnerships**.

2.2. Global Health Burden

Neglected diseases disproportionately affect the poorest populations in the world. By contributing to a cycle of poverty through decreased productivity arising from long-term illness, disability and social stigma, PRNDs have severe and adverse impacts on poor societies. While an absence of commercial interest fails to stimulate innovation and the delivery of successful health interventions for these illnesses of the poor, a wide gap between the current share of the global disease burden within

the developing world (90 percent) and the global amount of resources devoted to it (10 percent) has become defined as a „10/ 90 gap“ (WTO, 2016).
Enshrined in a number of international and regional human rights legislations and in the constitution of the World Health Organisation, health represents a fundamental human right. A key element for populations to achieve this right is understood by the international political community, not only as access to underlying social and economic determinants for health, such as clean water and adequate sanitation, but also to medical treatments. Therefore, while discrimination in access to healthcare would create an international human right violation, states have an obligation to move as expeditiously and effectively as possible towards realizing peoples' right to healthcare. In line with this humanitarian reasoning, states therefore have the responsibility to stimulate innovation in drug development for PRNDs, as well as ensure that these much needed products become accessible and available to all, on the grounds of global social justice (Stirner, 2010, p. 52-55).

2.2.1. Neglected Diseases and Diseases of the Poor

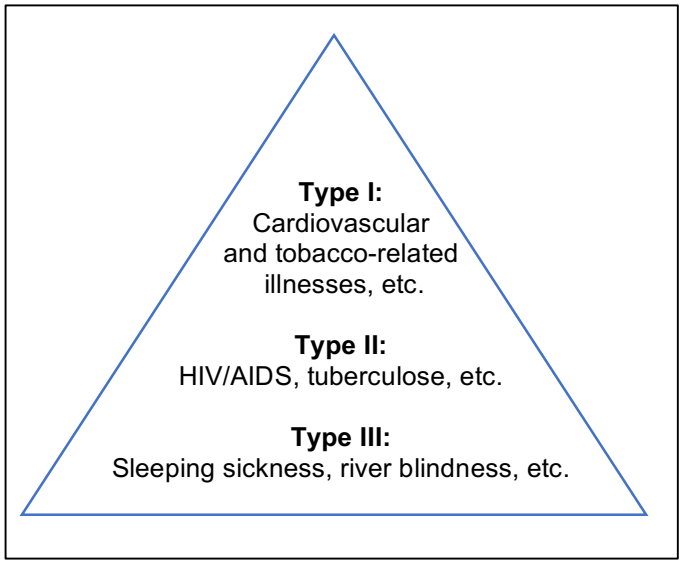

Fig. 1. *Three categories of diseases*

According to the WHO, the range of diseases affecting world society today can be divided into three different categories (**Fig.1.).** While type I diseases such as hepatitis B, haemophilus influenzae type B and measles (communicable diseases) or diabetes, cardiovascular and tobacco-related illnesses (non-communicable diseases) are typically to be found in rich countries, their recent rapid increase in poor countries is related to aspects of increased globalization.
Together, the following type II and type III categories make up the majority of PRNDs (WTO, 2016): type II diseases are illnesses, such as HIV/ AIDS, malaria and tuberculosis, which disproportionately affect low- and middle income countries. More than 90 percent of these cases can be found in the developing world. Type III diseases occur either predominantly or exclusively in poor countries. A variety of 17 „most neglected diseases“ (buruli ulcer, Chagas disease, dengue and chikungunya, drancunculiasis, echinococcosis, endemic treponematoses (yaws), foodborne

trematodiases, human African trypanosomiasis (sleeping sickness), malaria, leishmaniasis, leprosy (hansen disease), lymphatic filariasis, onchocerciasis (river blindness), rabies, schistomiasis, soil-transmitted helminthiasis, taenaiasis/ cysticercosis, trachoma) currently impair the lives of approximately one billion people (WHO, 2016).

Neglected diseases often result in permanent and severe disabilities such as impaired childhood growth, mental retardation, blindness, deformity and/ or amputation. Although only some of them are life-threatening, it is estimated that a total of approximately 530'000 deaths annually are caused by PRNDs. Most afflicted countries lie in Central- and South America, South East Asia and, in particular, Sub-Saharan Africa (Stirner, 2010, p. 33-34). The global distribution of neglected diseases, as of 2010, can be observed in **Fig. 2.**

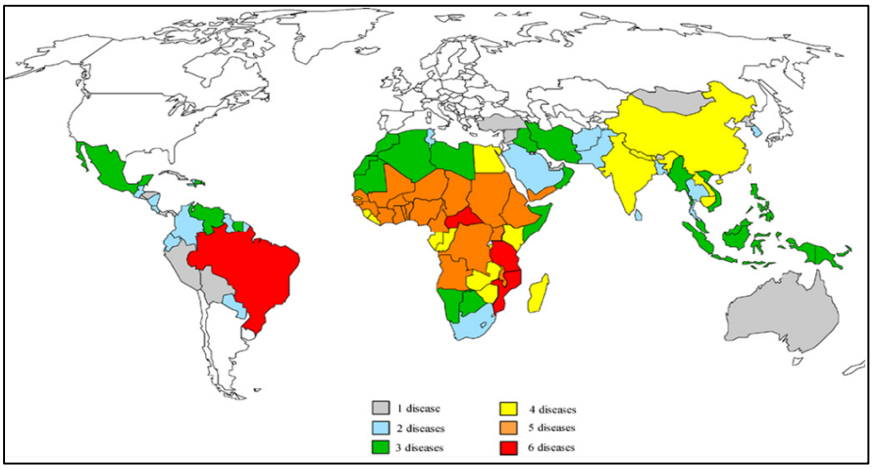

Fig.2. *Global distribution of neglected diseases*

A main feature of PRNDs is that there seems to be a low risk of transmission of these diseases beyond the tropics. Illnesses such as tuberculosis, sleeping sickness and river blindness pose little threat to populations in high-income countries. Many people in the developed world are not even aware that these diseases exist and only the truly adventurous tourist might once be affected by such an illness. Despite the significant health burden that PRNDs pose for patients in developing countries and their consequential strain on the overall social and economic development of their respective nations, PRND drug innovation has been low, if not absent. Most new medicines – including those on the WHO's list of essential medicines – are developed by the private sector, who in turn, are guided by financial incentives. While high barriers to drug innovation in developing countries persist, PRND drug development cannot be commercially viable. This constitutes a classical situation of market failure, which shall be further explored below (Gelder, Morris & Stevens, 2005, p. 9; Stirner, 2010, p. 45; WTO, 2016).

2.2.2. A Clear Situation of Market Failure

As pharmaceutical markets typically require advanced physical infrastructure, highly scientific and well-educated personnel as well as favourable financial and fiscal

policies to undertake R&D for drug development, the majority of today's advanced pharma companies are consolidated in the Western hemisphere of the world. Market forces typically drive the direction of R&D towards those diseases that assure the highest financial returns (Stirner, 2010, p. 45). Substantial fixed and sunk costs for R&D make drug development for the private sector a highly expensive, uncertain and risky endeavour. While the effective market size and aggregated consumer demand in the developing world for PRND drugs would actually be substantial, low per capita incomes and populations' non-willingness to pay high prices for medicines greatly diminish the profitability of a commercial market in this area (Gelder, Morris & Stevens, 2005, p. 9).

The lack of potential customers' purchasing power, however, depicts only one of many barriers to PRND drug innovation. High taxes and tariffs on medicines in developing countries often distort a potential drug market by driving up prices and thereby reducing demand. Poorly functioning or an absence of health insurances mean that demand for medicines remain low, because people must pay from their own pockets. These factors, in turn, further disincentive PRND drug innovation by erecting supply-side barriers. The lack of adequate institutions, including property rights, contracts and effective legal systems discourage companies from entering into these markets. While market segmentation and price differentiation have often been helpful methods for companies to ensure the provision of drugs to a wide range of potential customers, government restrictions in many developing countries on such differential pricing strategies have further inhibited drug supply. Therefore, and with the rise of generic drugs in recent years, R&D in PRND drug development remains limited (Brown, Fourie & MacLean, 2009, p. 11; Gelder, Morris & Stevens, 2005, p. 9, 10). In the following section the various stages of market failure in drug development shall be looked at in more detail.

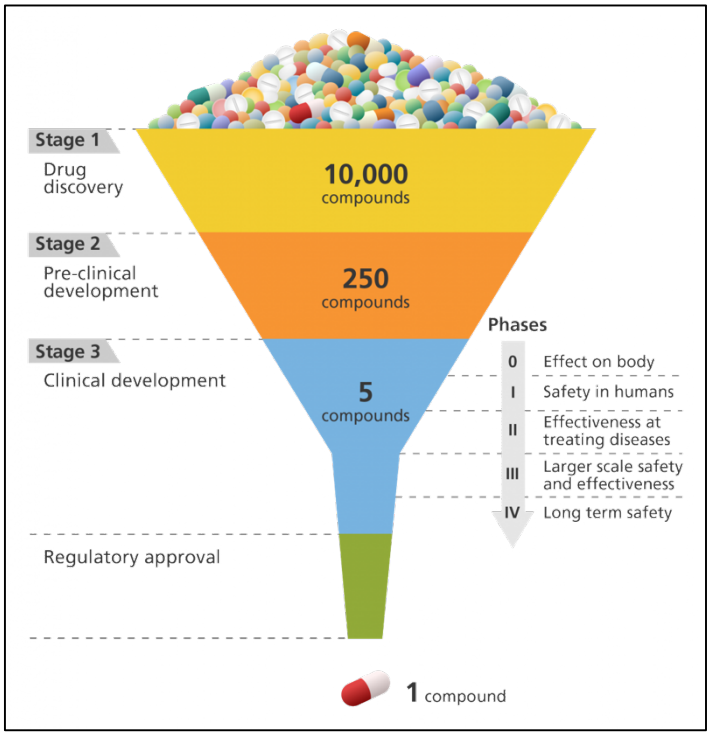

Fig. 3. *Phases of clinical trials for new drug development*

Drug development is a costly and time-intensive endeavour for pharmaceutical companies involving many phases of clinical trials which are subject to extensive regulation. Until a drug

can become successfully launched to market it typically takes up to 10 – 15 years and over one billion USD can be involved in the overall process. Further, R&D in biomedical sciences has increasingly become dominated by more sophisticated and expensive tools such as genetic mapping, molecular biology and engineering, nanotechnology and proteomics (Daems, Maes & Nuyts, 2013, p. 4). Pharmaceutical companies must, therefore, allocate substantial funds to drug development even years before a new compound is found or data is available that demonstrate the potential efficacy and effectiveness of a new product, which would allow a company to recoup its initial investments. The large and rising number of regulations, with which companies are required to comply with before launching a new drug to market, further drive up the costs of medical supply (Gelder, Morris & Stevens, 2005, p. 9–10). Various stages of the drug development process are seen in **Fig. 3.** and will be shortly described here.

Stage 1 describes the clinical trial of drug discovery. While in the past, some drugs, such as penicillin, were detected by accident, more systematic approaches like high-throughput screening or rational drug design are used today and may identify hundreds of potential lead components. In the first round of testing, many compounds will be determined as ineffective and therefore eliminated (Wellcome Genome Campus, 2014).

Stage 2 describes the process of pre-clinical development where it is established how a potential drug would be absorbed and distributed in the human body. By formulating a drug for its intended clinical use, hundreds of components are whittled down to only a handful of remaining useful components (Wellcome Genome Campus, 2014).

Stage 3 of clinical development is further divided into various phases: 0, I, II, III, and IV. It involves testing on human volunteers in order to determine a drugs safety and effectiveness (Wellcome Genome Campus, 2014). Clinical testing programs, however, represent another huge incremental cost for pharmaceutical companies in bringing new medicines to the market. By means of multi-country and multi-population clinical trials and since sunk costs are neither flexible nor recoupable, this third stage describes a decision point for companies to go or not go ahead with a future drug development process (Daems, Maes & Nuyts, 2013, p. 4).

Thereafter, in **stage 4**, only one or maximum two compounds can be submitted as a drug application to be approved by regulatory bodies. Even after full approval, pharmaceutical companies must continue to test their drug and monitor feedback in order to identify new side effects or risk factors previously not recorded (Wellcome Genome Campus, 2014).

In a **last stage** within this market-based framework, pharmaceutical companies are primarily responsible for the distribution of products within markets and set prices

according to marginal costs and benefits, regardless of a product's social value. If market demand is small and potential financial return on investment low, the possibility of a drug reaching its intended beneficiaries is diminished (Daems, Maes & Nuyts, 2013, p. 8).

In sum, the various stages of pharmaceutical drug development involving drug discovery, testing, licensing, production and distribution for developing countries' needs have exemplified high barriers to innovation within the commercial sector. While governmental policies and the institutional environment in low- and middle income countries is unlikely to improve within the short- or middle-term, new initiatives seeking alternative and innovative ways to overcome this situation of market failure have surfaced within recent decades (Daems, Maes & Nuyts, 2013, p. 9; Gelder, Morris & Stevens, 2005, p. 12). The basic principle of so-called push and pull mechanisms shall be shortly described in the following section. This provides the main theoretical basis for the further in-depth analysis of two main push mechanisms currently in evaluation by the SDC for stimulating drug innovation for PRNDs: product development partnerships and purely private initiatives.

2.2.3. Existing Mechanisms Against Market Failure

While patents – a classic market mechanism that grants exclusive rights on a specific compound for a limited time – act to overcome the situation of market failure for drug innovation in type I diseases, it has been shown that this can be no solution for PRNDs. Only within an existing commercial market for drug development, can patents create a market barrier to entry and thereby allow pharmaceutical companies to recover R&D costs (Stirner, 2010, p. 45, 101).

New mechanisms for the case of PRND drug innovation, therefore, also seek to de-link R&D costs from product prices. In this way, incentives for R&D can be provided through other means than prices and thereby generate a commercial market for PRND drug innovation. Push and pull mechanisms each address different stages of the drug development process (WTO, 2016). Their basic principles shall be discussed below.

Push Mechanisms

Push mechanisms motivate R&D by decreasing costs through direct initiatives. By financing the large upfront costs that pharmaceutical companies face in drug development, push-funding, however, means that rewards are granted to innovators before actual results of a healthcare innovation have been obtained. (Mueller-Langer, 2013; Stirner, 2010, p. 107; WTO, 2016) Three examples of push mechanisms are touched upon here.

- **Targeted R&D Tax Credits:** By subsidizing research inputs via direct contributions to pharmaceutical companies, tax credits can target and stimulate R&D investment for specific neglected diseases. (Daems, Maes & Nuyts, 2013, p. 10)
- **Publicly Funded Research Institutions:** R&D institutions such as universities and government laboratories, which are publicly funded, reduce the research costs incurred by a pharmaceutical industry as they are capable of creating non-patentable fundamental scientific knowledge. Thereby, this push programme can be useful in stimulating R&D for PRNDs by providing a base for later drug development of the profit-seeking pharmaceutical industry. (Daems, Maes & Nuyts, 2013, p. 10)
- **Public-Private Partnerships (PPP):** Public-private partnerships are collaborations which typically focus on different stages of the development process such as fundamental research or the development of compounds across all stages of innovation. By subsidizing R&D costs, for example, they are able to receive commitments of pharmaceutical companies to make drugs or vaccines more affordable in developing countries. Further elaborations on this business model will be made in the main part of this paper, since product development partnerships fall in this category. (Daems, Maes & Nuyts, 2013, p. 11)

Pull Mechanisms

Pull mechanisms offer financial rewards for the final outcome of a certain R&D investment, for example, by providing prizes and advanced purchase agreements for developed products. Demand-side pull mechanisms only offer funding once a product has already been developed and they are, therefore, less optimal for stimulating basic research in drugs. For this reason, these mechanisms are often used in addition to push mechanisms, by providing a way to take drug development from basic science to the next stages of innovation until product launching (Stirner, p. 101–137; Mueller-Langer, 2013). Three examples of pull mechanisms are further explained.

- **Prize Funds:** By awarding prizes conditional on the achievement of a specific stage of R&D in the area of neglected diseases, innovation for new diagnostics, vaccines or medicines with particular profiles in terms of performance, cost, efficacy or other characteristics can be stimulated (Mueller-Langer, 2013; WTO, 2016).

- **Priority Review Voucher:** Enacted in 2007 in the US, the so-called priority review voucher (PRV) grants transferable vouchers to those researchers who successfully develop treatments for a particular disease. PRV holders are then entitled to a faster regulatory review process of another drug under development. Lucrative products of the pharma industry can then be brought to market considerably earlier than under normal circumstances and thereby increase their overall net present value of sales. (Daems, Maes & Nuyts, 2013, p. 14)
- **Advanced Purchase Commitments:** By effectively guaranteeing a market for a yet to be invented drug, advanced purchase agreements with specified prices or volumes can incentivize pharmaceutical companies to undertake R&D in a certain area. Such contractual agreements between purchasers and suppliers imitate the R&D incentives which would be typically provided by a commercial market. (Mueller-Langer, 2013; WTO, 2016)

2.3. Product Development Partnerships

As this research paper seeks to establish to which extent product development partnerships are effective and efficient in addressing global public health needs of the poor, its focus will lie on the push mechanism public-private partnerships which is embodied by PDPs. To gain first-hand and in-depth information for this research paper, two PDPs have been interviewed, which will be seen as the representatives for the PDP model in general. Thereby, the Medicines for Malaria Venture (MMV), as the oldest PDP and the Drugs for Neglected Diseases Initiative (DNDi), another leading PDP, have subsequently provided a broad insight into their field of work. The following first section, will provide a clear definition of PDPs and an explanation of how this business model works, in order to fully understand what a product development partnership is. Thereafter, a few examples of existing PDPs around the world will be given, before the most important features of a PDP for further analysis can be pointed out.

2.3.1. Definition

Funding of R&D for poverty-related infectious diseases has increased significantly over the past decade, which can be directly linked to the increase of public-private partnerships (PPPs) (WHO, 2012, p. 125). In respect to neglected diseases, PPPs are collaborations between several stakeholders, such as biotechnical and pharmaceutical businesses, philanthropic foundations, governments, academia, and non-governmental organizations (NGOs) (Stirner, 2010, p. 132). Stirner (2010, p.

132) identifies two definitions for the term “public-private partnerships”: The functional definition describes public-private partnering as an activity, which includes drug donations as well as partnerships between public and private actors collaborating on R&D projects. The structural definition, on the other hand, refers to public-private partnerships for product development, which are called product development partnerships. In other words, PDPs are a form of a public-private partnership that concentrates on health technology development (Mahoney, 2011, p. 1). Although PDPs are to some extent involved in other activities as well, their main purpose is to facilitate R&D for neglected diseases (Stirner, 2010, p. 132). They now constitute a key part of the current era of Partnerships as mentioned above (cf. Mahoney & Morel, 2006).

2.3.2. How the PDP Model Works

Croft (2005, p. 9–10) points out, that none of the relevant actors, meaning the pharmaceutical industry, biotech firms, the public sector, academia and other non-profit organizations unite the necessary resources and skills to conduct research and develop drugs for neglected diseases for which there is no commercially viable market. As could be seen above, product development in the field of tropical infectious diseases is very cost-intensive, which is why it requires big investments and funding, but also highly specialized skills and know-how, excellent project managers and most importantly long-term commitment (cf. Matter & Kelly, 2008). This means that partnerships are absolutely crucial for meeting patients’ needs and for supplying millions of people with products that they require by forming collaborations which act to bring all the required skills and knowledge on board. Thus, by taking the expertise and knowledge of both the private and public sectors, the PDP model includes the capacities and skills of different actors in a pharmaceutical R&D process (Stirner, 2010, p. 132). It thereby generates innovative approaches to reduce the global health burden of neglected diseases by using each of their strengths to find the most efficient and effective solutions (MMV, 2016c). The R&D process is driven by the patients’ needs in mind and the facilitation of access to affordable and appropriate aids in the endemic countries (DSW, 2016, p. 1).
Through PDPs, mechanisms can be established that redistribute funds and pool expertise, and, essentially, share benefits and risks of investments in health R&D. This should alleviate collaboration and provide financial assistance to promising initiatives involving academia and commercial entities (WHO, 2012, p. 103; 123). Therefore, PDPs address the above described lack of commercial incentive for the private sector to undertake R&D for pharmaceutical products such as vaccines or drugs for neglected diseases (Stirner, 2010, p. 131).

PDPs use public and philanthropic funds to engage the pharmaceutical industry and academic research institutions in undertaking R&D for diseases of the developing world that they would normally, without additional incentives, be unable or unwilling to pursue independently (MMV, 2016c). Therefore, PDPs have proven to be a driving factor for ongoing R&D projects in the field of neglected diseases (LSE Report, 2005, p. 8).

As PDPs often do not have the capacity or infrastructure to undertake early stage development projects in-house, they have greatly benefited from non-financial contributions, for example, from molecule databases, laboratories and technical expertise (WHO, 2012, p. 124). PDPs pursue a unique portfolio-approach, whereby they are able to oversee the R&D pipeline and allocate resources to the most promising projects, coordinate partner activities for various stages of the R&D process and manage project portfolios (MMV, 2016c). These organizations, therefore, act as facilitators by bringing dedicated sources of funding and know-how to committed researchers, so that they can collaborate on the right projects to fulfil the objectives of PDPs' overall mission (MMV, 2016c).

This clearly shows that each actor in the R&D process has a certain role within the framework of product development. Contributions from the public sector – such as subsidized clinical trials, public health knowledge for neglected diseases or an easing of registration processes – are crucial for facilitating the development of health technologies. Research-strong academia contributes most to the early stages of product development. The pharmaceutical industry, on the one hand, can provide essential databases of chemical and medical compounds and thereby make the R&D process more efficient. In this regard, pharma companies are indispensable in the actual drug production process, because they can help transform before-hand developed knowledge into safe and effective health products.

While the specific objectives of individual PDPs vary, their basic missions are the same: to develop pharmaceutical products as a public good which addresses the health needs of vulnerable populations in the developing world (MMV, 2016c). As could be seen above, within this framework as a push mechanism, PDPs essentially perform as fund managers, resource allocators and portfolio managers (Stirner, 2010, p. 133–134; DNDi, 2016a). This unique model of PDPs helps to maximize the value of contributions from governments, philanthropic funders, academic research centres and private industry by leveraging individual competencies in meeting specific goals (WHO, 2012, p. 123). All in all, although the PDP model is currently widely used in the field of neglected diseases, it has the promise of being a possible solution for other drug development in the future, such as for resistances and orphan-diseases, which could also be solved through this approach (C. Lengeler, personal communication, 4.5.2016).

2.3.3. Examples of PDPs Around the World

To date, a number of twenty PDPs exist, which all focus on the development of vaccines, drugs, diagnostics and insecticides (SDC, 2015b, p. 4). Their work contributes to the World Health Organization's (WHO) goals of prevention, elimination and eradication of various diseases under the health-related Millennium Development Goals (DSW, 2016, p. 1). In the following, a non-exhaustive list of existing partnerships around the world is provided.

- **Aeras Global TB Vaccine Foundation** *Rockville, USA*
  The non-profit biotechnology organization Aeras is concerned with the development of affordable and accessible tuberculosis (TB) vaccines (Aeras Global TB Vaccine Foundation, 2016).
- **CD4 Initiative** *London, UK*
  The CD4 Initiative addresses HIV and AIDS care by developing a CD4 cell-counting machine, which can help determine a patient's stage of HIV infection (Dignitas International, 2014). The CD4 Initiative aims to make CD4 cell count-testing widely available in developing countries so that health workers are able to manage patients, who are in need of anti-retroviral therapy and to do so more effectively by having the knowledge of individuals' stages of the HIV disease (Evans, 2009).
- **Dengue Vaccine Initiative** *Washington DC, USA*
  The mission of the Dengue Vaccine Initiative (DVI) is to facilitate the development of vaccines against the sometimes fatal viral disease called dengue (DVI, 2016a). The DVI is a consortium of the International Vaccine Institute, the WHO Initiative for Vaccine Research, the International Vaccine Access Center and the Sabin Vaccine Institute (DVI, 2016b).
- **Drugs for Neglected Diseases Initiative (DNDi)** *Geneva, Switzerland*
  The DNDi's vision is to improve the quality of life and the health of people suffering from neglected diseases. Therefore, the PDP develops affordable and accessible drugs or new formulations for most neglected diseases (DNDi, 2016c).
- **European Vaccine Initiative (EVI)** *Heidelberg, Germany*
  The goal of the EVI is to develop vaccines against malaria and other diseases of poverty. Their aim among others is to promote the affordability and accessibility of vaccines for these diseases in low-income populations (EVI, 2016).
- **Foundation for Innovative New Diagnostics (FIND)** *Geneva, Switzerland*
  FIND's mission is to turn complex diagnostic challenges into simple solutions

by making diagnostics available to everyone for overcoming the diseases of poverty (FIND, 2016).

- **Global Alliance for TB Drug Development** *New York, USA*
  The TB Alliance is a not-for-profit organisation positioned to leverage a global network of public and private partners to discover and to develop better, faster-acting and more affordable tuberculosis drugs which can be made available to those who need them (TB Alliance, 2016).
- **Infectious Disease Research Institute (IDRI)** *Seattle, USA*
  IDRI's mission is to develop new, advanced products for the diagnosis, prevention and treatment of neglected diseases (IDRI, 2016).
- **Innovative Vector Control Consortium (IVCC)** *Liverpool, United Kingdom*
  IVCC was established in 2005 and focuses on areas where diseases transmitted by insects are endemic (IVCC, 2016a). Therefore, IVCC, together with their partners, develop insecticides as well as pesticides against vector-born diseases, such as malaria, dengue, and yellow fever (IVVC, 2016b).
- **International Aids Vaccine Initiative (IAVI)** *New York, USA*
  The IAVI aims to develop preventive AIDS vaccines, which are safe, effective and accessible to all. For this purpose, IAVI conducts research and clinical assessments of candidate vaccines against HIV with many partners around the world (IAVI, 2016).
- **International Partnership for Microbicides (IPM)** *Silver Spring, USA*
  IPM's mission is to provide women with safe, effective and affordable products for the protection against a HIV infection. Therefore, IPM develops microbicides based on types of already existing anti-retroviral drugs to prevent HIV/ AIDS transmission from mother to child (IMP, 2016).
- **International Vaccine Institute (IVI)** *Seoul, South Korea*
  The IVI has the belief, that the health of children in developing countries can be significantly ameliorated by the development of new and enhanced vaccines. In this sense, their mission is to discover, develop and deliver safe and affordable vaccines (IVI, 2016).
- **Medicines for Malaria Venture (MMV)** *Geneva, Switzerland*
  The Geneva-based Medicines for Malaria Venture is the leading PDP in the field of anti-malarial drug research and development. By discovering, developing and enabling the delivery of new, effective and inexpensive anti-malarial drugs, it is their mission to decrease the burden of malaria in disease-endemic countries (MMV, 2016b).
- **Meningitis Vaccine Project** *Ferney-Voltaire, France*
  MVP is a partnership between PATH and the WHO. Its mission is to eradicate

meningitis as a public health problem in sub-Saharan Africa by developing, testing, introducing and broadly using conjugate meningococcal vaccines (MVP, 2016).

- **Path Malaria Vaccine Initiative (MVI)** *Seattle, USA*
  The MVI is one of PATH's flagship product development programs which identifies potentially promising malaria vaccine approaches and moves them through the development process (DSW, 2016; MVI, 2016).
- **Sabin Vaccine Institute (Sabin)** *Washington DC, USA*
  The Sabin Vaccine Institute was founded by the oral polio vaccine developer Dr. Albert B. Sabin and is dedicated to reducing human suffering by using vaccines against preventable and neglected tropical diseases (Sabin, 2016a). This PDP focuses on the development of sustainable and low-cost vaccines against the human hookworm schistosomiasis, the Chagas disease, leishmaniasis and the severe acute respiratory syndrome (SARS) (Sabin, 2016b).

As we have seen so far, the specific objectives and missions of different PDPs around the world vary. However, their goal is the same: to reduce the burden of neglected diseases and the diseases of the poor. There are several important features that all PDPs have in common, which will subsequently be shown below.

2.3.4. Important Features of PDPs

Network

To achieve their goals, PDPs, such as MMV, recognize the importance of partnerships and collaborations. Because PDPs, for example, do not possess the necessary infrastructure or human capital to conduct research and development of drugs or are able to distribute drugs all by themselves, their networks consist of a wide range of actors. These can ben found in the area of industry, academia, governments, international organisations and NGOs. (D. Reddy, personal communication, 29.3.2016)

Pooled Funding

Conducting a public-private partnership in the field of R&D allows large profit-oriented businesses to spilt R&D costs with partners. In collaboration with several funding-partners, a PDP can cover some, if not all, of a single enterprise's external project expenses. In this way, projects for neglected diseases become cost-neutral to multi-national partner-companies. In other words, shared funding with many partners reduces R&D and investment costs as well as the overall risks for a single funder

significantly. This essentially means that large businesses can put resources into what they may originally deem uninteresting R&D projects, such as those for neglected diseases, while simultaneously keeping up with shareholders' expectations. (Moran, 2005)

Portfolio Approach

Traditionally, big pharma firms concentrate on the development of one or a small number of drugs. PDPs use a portfolio approach, which means that they pursue several different R&D projects at the same time. This is done in order to be able to find and develop the most promising drugs. (D. Reddy, personal communication, 29. March, 2016)

Access to Medicine

Ensuring accessibility to the developed drugs for those who need them most is another important feature of this business model. PDPs principally work without commercial interests and have an often creative intellectual property approach, which allows for the provision of inexpensive, affordable and accessible health products. (Stirner, 2010, p. 135)

Capacity Building

Capacity building is an important feature regarding long-term impact on endemic countries. In principle, it's less about giving the endemic countries a complete solution, but rather about including them into the solution process. Since the ultimate goal is to enable endemic countries to develop drugs and treatments themselves, capacity building entails the strengthening of local R&D and, in particular, clinical research capacities. (T. Saugnac, personal communication, 11. April, 2016)

2.4. Purely Private Initiatives

As stated in the introduction of this paper, there has been a general tendency in recent times for more purely private solutions to have been sought regarding R&D for neglected diseases' drugs. Within this research paper, the following understanding of purely private initiatives shall apply for subsequent use of this term.

In general, private solutions range from CSR initiatives of large pharmaceutical companies to bilateral partnerships between philanthropic foundations, such as the Bill and Melinda Gate Foundation, and the private sector. The main differentiation between purely private initiatives and product development partnerships will be further elaborated within this chapter.

Principal examples of private intiatives are the Novartis Malaria Initiative, a CSR initiative based on a not-for-profit business model which has the goal of supplying current malaria treatments at affordable prices to low- and middle income countries. It also does research on next-generation anti-malarial treatments and improves new drugs. This initiative has also become the largest access-to-medicine program of the health care industry[1].

Another example of a private partnership is the Vaccine Discovery Partnership between the Bill and Melinda Gates Foundation and the US-based pharmaceutical company Glaxo Smith Kline (GSK). This joint initiative is an endeavour for early stage research in vaccine thermostability, which is a crucial element for addressing global health needs, particularly on the part of preventive measures against the diseases of the poor.[2]

In general, however, purely private initiatives that have a main focus on R&D for new drugs against the diseases of the poor, are rather uncommon. Most private initiatives are primarily constituted as access-to-medicine programs. Developing new drugs is then only a secondary objective. Furthermore, the R&D aspect of these initiatives often takes place solely in collaboration with PDPs. (Novartis Malaria Initiative, 2016c; Roche, 2016, p. 1; T. Saugnac, personal communication, 11. April 2016; Burri, 2016; Access to Medicine Index, 2014, p. 77)

In this sense, an absolute distinction between the two models as it is used in the present paper is actually not entirely possible due to the above stated facts. This relativization of purely private initiatives should particularly be kept in mind with regard to the advantages and disadvantages of PDPs and purely private intiatives in section 3, as both models can to some extent profit from each other in certain areas of drug development for PRNDs. Nonetheless, the hereby defined model of purely private initiatives and partnerships will subsequently serve as the main alternative when evaluating the product development partnerships.

3. ADVANTAGES AND DISADVANTAGES OF PDPs VERSUS PURELY PRIVATE INITIATIVES

After a comprehensive overview on the subject matter of neglected diseases and the introduction of the product development partnership model, the following chapter

[1] *Novartis Malaria Initative: http://www.malaria.novartis.com/malaria-initiative/the-malaria-initiative/index.shtml*

[2] *Vaccine Discovery Partnership (VxDP): https://us.gsk.com/en-us/media/press-releases/2013/new-partnership-between-gsk-and-the-bill-andamp-melinda-gates-foundation-to-accelerate-research-into-vaccines-for-global-health-needs*

shall provide a review of this model and its current alternative of purely private partnerships and initiatives. In a first part, the advantages and opportunities of the PDP model will be presented with a special focus on its added value regarding the facilitation of access to medicine for neglected diseases. In continuation, the disadvantages and challenges facing this endeavour will be addressed. After a subsequent elaboration on purely private partnerships, a short summary at the end shall then prepare for a final evaluation of both models regarding their efficiency and effectiveness in addressing the global health needs of the poor.

3.1. Advantages and Opportunities of the PDP model

The unique nature of the PDP model for addressing the neglected diseases issue has many advantages and therefore generates an important and urgently necessary added value for meeting global health needs of the poor. From a general perspective, the most important added value of PDPs lies in their ability to enhance the transition from basic research, as done so by academic and research institutions, to the later phases of clinical research and drug development (De Jongh et. Al., 2014, p. 37).
On a more practical note, the PDP model's main advantages lie in the aspects of its portfolio-approach, cost-effectiveness, a vast network of partners, its function in capacity building and lastly in ensuring access to health products.

3.1.1. Portfolio-Approach

Drawing from the finance industry, a portfolio-approach is a renowned strategy to mitigate risks. The underlying principle is to diversify one's investment holdings in order to reduce exposure to risks of over-concentration within a specific company or sector. It is then able to deliver the highest returns to institutions or investors. (Charette, 2011, p. 1)
In the area of R&D for neglected diseases, an adaption of this approach yields a big advantage. As stated above, the portfolio-approach of PDPs is based on pursuing a variety of R&D projects which ranges from the choice of simple compounds in early stages to readoption and re-innovation of old treatments. This is fundamentally different from a traditional industry approach, which often focuses solely on one or just a few R&D projects, resulting in a higher risk if the respective compound should fail. (D. Reddy, personal communication, 29. March 2016; T. Saugnac, personal communication, 11. April 2016)
The principal advantage of such a portfolio-approach is, thus, the possibility to choose the "best" project and direct an R&D focus towards leading projects. According to MMV, many PDPs can manage their compound portfolio by using

standardized assays to compare compounds directly against one another. Neutral in-house expertise can ensure an independent review process as they do not mind where the molecules come from and therefore enable investments in the best compounds at the appropriate phases of development. (D. Reddy, personal communication, 29. March 2016)

A portfolio-approach, therefore, has the advantage that it not only enables PDPs to choose the best available options, but also to greatly reduce inherent R&D risks. PDPs, in their role as fund allocators, can, in this way, reduce risk in a government's choice of optimal R&D projects by distributing funds to a variety of projects, instead of simply subsidizing individual projects (D. Reddy, personal communication, 29. March 2016). These advantages apply primarily to the first stage of drug discovery due to a large number of available compounds and thereby contain a high risk of failure. Nonetheless, the portfolio-approach is also relevant in later stages of clinical development.

3.1.2. Cost Effectiveness

As a not-for-profit entity with no commercial interests, PDPs have the advantage of significant cost-effectiveness in drug development by the use of public funds (Stirner, 2010, p. 135; 167). This advantage is of special importance in addressing the global health burden of PRNDs due to the fact that ensuring affordable medicine for neglected diseases is crucial. The advantages of a cost-efficient business model are applicable to just about all stages of drug development.

The central reason for PDPs' cost-effectiveness lies in the fact that PDPs can generally select cheaper collaborators than private initiatives can. As industry partners are often asked to contribute to the drug development costs (i.e. in-kind contributions) and since PDPs often conduct large part of R&D activities of later drug development stages in endemic countries, overall expenses are naturally much lower. (Stirner, 2010, p. 168)

Other factors that contribute to cost-effectiveness are the generally lower salaries than in the pharmaceutical industry, the pooled-funding approach, the issue of open access regarding intellectual property and the PDP's function as a proxy (D. Reddy, personal communication, 29. March 2016; T. Saugnac, personal communication, 11. April 2016).

By having an open access strategy (which most PDPs do) PDPs share their knowledge openly and there is therefore no need to file costly registrations and patents all over the world. This is important, because keeping intellectual values in-house generates a lot of costs in terms of business development, IP and various regulatory mechanisms. (T. Saugnac, personal communication, 11. April 2016)

A last element of cost-effectiveness is the PDPs' function as a proxy among the various companies involved in the first stage of drug discovery for neglected diseases. A PDP can work as a so-called "drug development booster" because it has the potential to accelerate time and reduce the amount of money needed to identify a compound of interest to move ahead. By tapping into the best knowledge of different pharmaceutical companies and sharing the knowledge of potential compounds, PDPs can thus accelerate drug development at a lower cost. (T. Saugnac, personal communication, 11. April 2016)

3.1.3. Vast Nework of Partners and Collaborators

The PDPs' extensive networks are their most central and important assets in addressing the issue of neglected diseases. As stated in the beginning of this research paper, their network consists of a wide range of actors. All the relevant private and public stakeholders constitute an enormous expertise and share wide ranging connections, which result in the following advantages, again applicable to all stages of drug discovery:

The partnership network of PDPs firstly allows them to share the costs and the burden of development with their partners. This collaboration can present itself on the one hand in practical matters such as the PDPs' use of research facilities (e.g. laboratories) provided by academia and the industry, which means that they don't have to replicate it all (D. Reddy, personal communication, 29. March 2016). In relation to this, there can also be a certain learning effect for pharmaceutical companies themselves when they collaborate with PDPs in regard to the needs and the business environment of endemic countries (Stirner, 2010, p. 164). Regarding the provision of access to medicine, PDPs can also often create a very important bridge between the WHO, national governments, malaria control programs and manufacturers, which at times would otherwise be found to be very difficult (D. Reddy, personal communication, 29. March 2016). Such networking is, however, essential for bringing medicines to those who need it most as it enables an understanding of what is most needed in poor countries.

Having such a network also allows for the integration of essential public skills. By public skills one understands inputs such as technical, scientific and clinical expertise regarding neglected diseases, access to necessary facilities that the private sector no longer possesses, knowledge regarding endemic countries and most importantly guarantees regarding public demand of the final pharmaceutical products (Diaz, Garrison, Guzman, Moran and Ropars, 2005, p. 10; Grace, 2006, p. 15).

Another advantage is also the extensive collaboration between PDPs themselves. Different PDPs support each other in terms of communication, advocacy and also via

many of their operational skills. Their business model is often about helping others and sharing know-how and expertise on chemical compounds or diagnostic tools. Additionally, the different PDPs also support each other regarding the later phase of regulatory approval through granting access to their respective networks. This fact is especially interesting as this extent of cooperation is something not commonly found in the pharmaceutical industry. (De Jongh, 2014, p. 30; D. Reddy, personal communication, 29. March 2016)

3.1.4. Capacity Building in Endemic Countries

With their work in developing countries, PDPs also contribute to capacity building in the field, particularly, but not solely, towards the stages of clinical development of drugs. This is another important advantage and aspect of added value of the unique business model of PDPs. Their goal is, hereby, to strengthen local capacities and it has the ultimate objective to enable endemic countries' skills in autonomous development of pharmaceutical products. (De Jongh, 2014, p.36-37; Baner & Poll, 2009, p. 2–3) As such, it presents an important part of enhancing particularly the long-term effect of a reduction of neglected diseases.

The way it works is for one thing through the collaboration with various partners, which allows for knowledge sharing and technology transfers to developing countries. This translates explicitly in utilizing, capitalizing upon and reinforcing clinical capacities together with infrastructural requirements in endemic regions. The local population can thereby also benefit from training and education, particularly in the many on-site clinical trials, sometimes in extremely remote settings. (Stirner, 2010, p. 169; T. Saugnac, personal communication, 11. April 2016; DNDi, 2016b)

Although there is a risk of losing a certain amount of time in the development by including endemic countries in the R&D process, the motivation for many PDPs is to give an opportunity to local stakeholders to step up and be part of a more long-term, sustainable solution (T. Saugnac, personal communication, 11. April 2016; Baner & Poll, 2009, p. 2–3).

Another aspect of capacity building concerns the access to medicine, where PDPs often support programs on the ground regarding training and implementation of treatment plans to increase awareness and the actual experience in using the respective health products. This can be achieved through bringing together representatives of national drug delivery programmes, regulatory authorities, academia and others, where barriers such as obstacles to roll-out policies, eventual policy changes in certain countries, the requirements of the national authorities in terms of data and information can be tackled. Furthermore, certain PDPs also aim at enabling industrial partners in the endemic regions to take their part in the

manufacturing process through technology transfer. This serves to ensure a widespread distribution of new treatments, maintaining competitive prices and again reinforce the technological and scientific capacities of endemic countries. (D. Reddy, personal communication, 29. April, 2016; DNDi, 2016b)
Thus, capacity building is another important advantage of the PDP model, which other approaches cannot achieve or at least not as extensively.

3.1.5. Access to Medicine

Ensuring that the developed treatments actually reach those who need it most is a central objective of most PDPs. The way this aspect is achieved in their R&D processes is to be seen as another crucial advantage. It shall be emphasized again that PDPs principally work without commercial interests, which allows for the provision of affordable health products. (Stirner, 2010, p. 135)
The first and foremost advantage of PDPs regarding access to medical treatments is the simple fact that they are often the only actors in the area of neglected diseases. As an example, in the field of sleeping sickness, lysophimaniasis and even chagas disease, there is only one sole actor (DNDi) addressing this matter. The fact that PDPs often go where others do not thus make a real difference. This can even be seen as potentially challenging for the relevance of other private models. (T. Saugnac, personal communication, 11. April 2016).
A second advantage contributing to the accessibility of medicine is the PDPs needs-oriented and patient-centred approach. This generally means the development of drugs and treatments, which are adapted to their environment and the specific patients needs (Stirner, 2010, p. 136). It implies a necessary understanding of culture, physiognomy of patients and the overall context of the target region (Stirner, 2010, p. 164). Questions are raised as an example concerning what is the optimal way of dosing – is it just once a day and should it be liquid or in tablet form? (D. Reddy, personal communication, 29. March 2016). Having “ears on the ground” is therefore very important to learn about the needs, the ability to understand the context, to be capable of running clinical trials and also to increase legitimacy of future treatments from the beginning (T. Saugnac, personal communication, 11. April 2016).
The advantages in ensuring accessibility to medicine is a crucial factor in fighting neglected diseases by researching and developing what is most needed with the goal to reach those who need it most.

In summary, the PDP model has the following advantages in addressing global health needs:

Portfolio-Approach to R&D	- *possibility to choose the "best" R&D project*
	- *mitigation of inherent R&D risks by investing in variety of projects*
Cost-Effectiveness	- *industry partners contribute to development costs*
	- *open access strategy regarding intellectual property eliminates costly registration processes*
	- *function as drug development booster as proxy between different stakeholders*
	- *ability to select lower-cost collaborators*
Extensive Network of Partners	- *sharing of costs and burden of development*
	- *creation of necessary bridges between relevant actors to address neglected diseases*
	- *integration of public skills*
	- *extensive collaboration between PDPs themselves*
Capacity Building in Endemic Countries	- *strengthening local capacities with the goal to enable self-development*
	- *enabling local stakeholders to be part of long-term solution*
Access to medicine	- *PDPs are often the sole actor addressing certain diseases*
	- *needs-oriented approach ensures accessibility*
	- *not having commercial interests enables affordable health products*

Fig. 4: *Advantages of the PDP model*

3.2. Disadvantages and Challenges of the PDP Model

In spite of PDPs' crucial importance in fighting neglected diseases, the model has several disadvantages and challenges that it has to overcome. These factors are mostly centred on the issue of funding and the difficulties arising from the work in developing countries.

3.2.1. Necessity of Continuous Funding

Due to their business model, PDPs are completely dependent on external funding. As stated above, these funds come from different sources like governments, philanthropic foundations, international organizations and the industry. The dependence on donors, which itself is an essential disadvantage, creates a number of challenges for PDPs, that could potentially undermine their work. The key aspects to name here are the inherent necessity for PDPs to search for donors, the insecure funding due to limited time-frames and doing justice to the demands of the donors.

That there is a need to search for donors is logically inherent to the PDPs business model. What presents a disadvantage here is, on the one hand, the time-consuming nature of such an endeavour, which can certainly impede and delay R&D projects and the PDP's ability to establish partnerships with the industry (Stirner, 2010, p. 136). On the other hand, the search for funding is probably the only area where there is a potential competition between different PDPs that could also have a negative impact (T. Saugnac, personal communication, 11. April 2016).

The lack of sustainability in the funding of PDPs does create several other serious disadvantages and it is an issue of great concern. Traditionally, funding from the public sector was provided on an annual basis, which cause difficulties for PDPs that have commitments for much longer periods during the R&D process. Having said this, lobbying before governments has already helped in partially increasing this time-frame to 3-5 years, which has been valued as extremely helpful. (Stirner, 2010, p. 172)

Nonetheless, the financial uncertainty can also be an ethical problem since it often endangers the completion of clinical trials while the respective participants, however, agreed to involvement and expect to continue to the end (Stirner, 2010, p. 171). Furthermore, when R&D projects actually reach the stage of clinical development, they require heavily increased investments, which certainly complicates the issue of financial insecurity (Stirner, 2010, p. 136; De Jongh, 2014, p. 30; L. Igwemezie, personal communication, 20. April 2016).

The last point to make here is the donor interests that need to be adequately attended. The PDPs long-term success does depend on their ability to meet the needs and preferences of the stakeholders who provide their funds. Although the donors certainly do not expect a financial return on investment, they have demands that have to be included, nonetheless (T. Saugnac, personal communication, 11. April 2016). The respective disadvantages regarding donor interests are twofold: On one hand, the PDPs' reliance on philanthropic funding and the goodwill of donors makes this model potentially less sustainable and raises the question of their suitability as long-term solutions to provide required health tools for endemic countries. Furthermore, this models' dependency on relatively few philanthropic sources (this does not concern all PDPs) creates the danger of a sudden shift of a

R&D focus depending on the funders' interests and can even lead to a complete shutdown of certain R&D areas. (Stirner, 2010, p.136)
Such dependency on interests of philanthropic funding that could potentially change direction at anytime, therefore, presents one of the most dangerous and serious challenges to PDPs.

3.2.2. Challenges Regarding Work in Endemic Countries

With the PDPs' commitment of working in and cooperating with endemic countries, certain challenges may arise that could potentially hamper their efforts.
One problem is, that in the developing countries there are still large amounts of sub-standard drugs, which are made available parallel to some of the high-quality drugs developed by PDPs. This, therefore, presents the challenge for PDPs to then ensure that the people have access to quality. (D. Reddy, personal communication, 29. March 2016; L. Igwemezie, personal communication, 20. April 2016)
Other obstacles regarding the infrastructure, is the lack of sufficient sites in endemic countries. Poor countries are most often inadequately equipped to conduct clinical trials at the standards required to secure regulatory approval. There are also difficulties in registration, purchase and distribution processes related to the relevant R&D stages undertaken in endemic countries. (Diaz et al.,2005, p. 33)
From a more general viewpoint, it is also important to state that PDPs cannot provide a comprehensive long-term solution for the problem of neglected diseases due to their small number. Tackling PRNDs in the future will, therefore, also require the commitment of developing countries to address their health problems with the help of an increased sensitivity and solidarity of developed countries. (Stirner, 2010, p. 196)

3.2.3. Other Obstacles for PDPs

Besides the two areas mentioned above, disadvantages of the PDP model are the following: a restricted access to potential components of the pharmaceutical-industry and the simple fact that PDPs certainly cannot deliver without the contributions of their partners from the industry, academia and others (T. Saugnac, personal communication, 11. April 2016; L. Igwemezie, personal communication, 20. April 2016). Furthermore, obtaining intellectual property rights licences presents another potential barrier, as the process to receive necessary IP rights can be very complex, difficult and time-consuming. This is especially a problem in negotiations with universities or small companies in the US, as intellectual properties are for those entities the most valuable assets for them to receive investments. (Stirner, 2010, p. 170-171)

In summary, the PDP model faces the following challenges and disadvantages:

Necessity of continuous funding	- *donor search and their interests can potentially interfere with R&D work*
	- *insecurity of funding due to limited timeframe*
Challenges regarding the work in endemic countries	- *large amount of sub-standard drugs parallel to high-quality drugs*
	- *lack of infrastructure and insufficient clinical trial sites*
	- *difficulties regarding the performance of clinical trials*
Other Challenges	- *restricted access to potential compounds of industry*
	- *intellectual property rights present time and cost consuming impediments*

Fig. 5: *Challenges and Disadvantages of the PDP model*

3.3. Advantages and Opportunities of Purely Private Partnerships

Purely private partnerships, as the current alternative to the PDP model, possess several features that can constitute advantages in the R&D process for neglected diseases. Their strengths lie primarily in the following categories: the actual provision of medicine, a more focused R&D approach and the fact that they are potentially better at motivating industry participation.
It shall, however, be noted again, that a strict differentiation between the PDPs and purely private partnerships is not entirely possible due to their frequent collaborations and mutual dependence. It is consequently important to understand, that many of the PDPs' advantages, thus, also partially apply to purely private initiatives. (L. Igwemezie, personal communication, 20. April 2016)

3.3.1. Supply of Medicine

The actual provision of treatments at affordable prices in endemic countries, is one main element, where private initiatives have a particular strength. To repeat the statement from above, purely private initiatives are predominantly constituted as access-to-medicine programs and as such integrate the industry's strengths (Access to Medicine Index, 2014, p. 128).
As part of the pharmaceutical companies' CSR programs, agreements with humanitarian organisations and philanthropic funding, the private initiatives are able to provide treatments at affordable prices directly and on a large-scale basis to those

who need it most. Such enabling of access can even be expanded through elements, such as innovative price segmentation, etc. (Novartis Malaria Initiative, 2016a; L. Igwemezie, personal communication, 29. April 2016)

3.3.2. More Focused R&D

Purely private partnerships have the advantage of an often more targeted approach in developing a new drug or treatment. By focusing on only a few compounds in the drug discovery and pre-clinical development stage, they are able to pursue a much more focused approach also for the later phases of development. This can then potentially result in an overall faster R&D process (D. Reddy, personal communication, 29. March 2016; L. Igwemezie, personal communication, 20. April 2016).

3.3.3. Better at Motivating Industry Participation

The most important advantage of purely private partnerships is that they are often a better option for getting imperative industry partners on board in order to tackle the neglected diseases issue. The pharma-industry's motivations to participate in this area of R&D are generally rather long-term business considerations, than financial returns. It is, thus, interests like CSR, reputation gains for the addressing of neglected diseases, strategic interests to define a market position in developing countries or gaining access to high-skilled and low-cost research environments. (Diaz et al., 2005 p. 7; Stirner, 2010, p. 131)

Due to their more bilateral nature, private partnerships can allow for a greater leverage of their industry partners, which is certainly to be seen as an appealing factor. This could thus also be seen as a more favourable approach to tap into the valuable private sector skills, knowledge and experience, which the industry has amassed over their long history (D. Reddy, personal communication, 29. March 2016).

In summary, the purely private initiatives have the following specific advantages:

Providing affordable medicine on a large scale	- access-to-medicine programs can integrate the industry's strengths
More focused R&D approach	- *potentially accelerated R&D process of a specific treatment or drug*
Better at motivating industry partners	- *bilateral nature of partnerships allows for greater industry leverage* - *favourable position in getting access to valuable private sector skills and experience*

Fig. 6: *Specific Advantages of Purely Private Initiatives*

3.4. Disadvantages and Challenges of Purely Private Partnerships

On a general note, it can be argued that many of the advantages of the unique PDP model are what constitute certain impairments of purely private partnerships – especially regarding reduced access to public skills through often inferior networks. Thus, the weaknesses of purely private partnerships are most importantly a certain lack of public skills, a less sufficiently guaranteed access to medicine, the risks of a too focused R&D approach and an issue of donor dependency.

3.4.1. Limited Access to Public Skills

To point it out again, public skills are the kind of input that the industry does not have, but which are of utmost importance in addressing neglected diseases. These skills are inherent within the following elements: technical, scientific and clinical neglected disease expertise; access to facilities that multinational companies no longer have (e.g. parasite houses, developing country clinical trial sites); knowledge of endemic country profiles (i.e. markets) and experience in dealing with developing country regulatory and health authorities. Lastly, the brokering of “guarantees” of public demand (public involvement is seen as essential for the final implementation and actual use of new treatments). (Diaz et al., 2005, p. 10; Grace, 2006, p. 15) Especially this last aspect be can seen as very difficult to address without having a public partner. The point to be made here, is that purely private partnerships cannot provide these public inputs or only to a lesser extent. It does, therefore, constitute a disadvantage of this model, with relevance particularly in the later stages of drug development.

3.4.2. Less Proficient in Ensuring Accessibility of Health Products

Overall, ensuring access to medicine is a central element in the fight against neglected diseases. However, access is generally based on principles such as affordability, extensive networks and needs-orientation (D. Reddy, personal communication, 29. March 2016; T. Saugnac, personal communication, 11. April 2016).
Purely private partnerships, on the other hand, have an inherent weakness in ensuring accessibility, since they do not enjoy an extensive network with public institutions and governments, such as PDPs do (T. Saugnac, personal communication, 11. April 2016). Furthermore, their inferior network can impede the

recognition and integration of valuable information such as the specific needs and requirements within target regions.
Lastly, there is a certain risk factor in the dialogue between pharma companies (in the case of them being negotiators in purely private partnerships) and regulatory agencies in the endemic countries. This is because there is always a kind of suspicion that there is a profit goal behind the negotiations – these are suspicions that could potentially undermine a necessary regulatory approval. In the case of PDPs, such risks are bypassed when PDPs act as a so-called trust proxy for the industry. (T. Saugnac, personal communication, 11. April 2016)

3.4.3. Risks of Focused R&D Approach and Donor Dependency

As stated above, a portfolio-approach towards R&D by most PDPs, has the advantage of mitigating the risk of failure in a development process (L. Igwemezie, personal communication, 26. April 2016). On the other side, while a more focused R&D of purely private partnerships can potentially yield accelerated results and have a larger impact, there is the disadvantage of a higher risk of failure when research is concentrated on one or just a few compounds (T. Saugnac, personal communication, 11. April 2016; D. Reddy, personal communication, 29. March 2016).
The issue of donor dependency, as was elaborated above, constitutes a challenge of the PDP model, but is also presents a potential problem for purely private partnerships. It can even be argued that it causes for even greater concern as in purely private partnerships there is generally no pooled funding but traditionally one donor (e.g. philanthropic foundations) partnering up with one company from the private sector. (T. Saugnac, personal communication, 11. April 2016, D. Reddy, personal communication, 29. March 2016, C. Lengeler, personal communication, 04. May 2016)
However, it shall be nonetheless noted that this disadvantage is only potentially an issue, depending on the behaviour and integrity of respective donors.

To summarize, the purely private initiatives face the following challenges and disadvantages:

Limited access to public skills	- *not having an extensive network undermines access to crucial public skills*
Less proficient in ensuring product accessibility	- *less extensive networks with public sector institutions and governments*
	- *inferior network can impede the recognition and integration of valuable information regarding the needs in the field*
	- *certain risk factor in the dialogue between private initiatives and regulatory agencies in the endemic countries*
Other Challenges	- *inherent risks of large donor dependency*
	- *greater risks of failure by focused R&D approach*

Fig. 7: *Challenges and Disadvantages of the Purely Private Initiatives*

3.5. Interim Summary

It can be stated, that both the PDPs and purely private partnerships are absolutely crucial solutions in addressing neglected diseases and the diseases of the poor. However, the endeavour of both of addressing an area in which traditional business models typically fail certainly has advantages, but also faces them with extensive challenges. In regards to the different stages of drug development, most of the demonstrated aspects above apply to all relevant phases of R&D and additionally even to the later phases of regulatory approval and the provision of medicine. Although the primary focus of PDPs lies in basic research, their function and impact on the later stages of drug development is also of paramount importance.

The PDP model principally excels with its advantages by its portfolio-approach in R&D projects, its cost-effectiveness, its vast network of partners enabling a comprehensive strategy for drug development and accessibility of health products. Lastly, its function in capacity building within endemic countries is also crucial. Nonetheless, PDPs have to face the challenges of a lack of sustainable and long-term funding, doing justice to donor interests while also keeping a certain level of strategic independence and overcoming difficulties regarding the work in developing countries.

Purely private partnerships, on the other hand, have the strength of utilizing a more targeted R&D approach more common to their industry partners. This can then lead to an accelerated R&D process. And with the regard to the pharmaceutical industry's interest of keeping expertise in-house, they comprise a potentially better option in motivating industry participation. However, it is, yet again, important to state that they also face severe challenges and disadvantages, such as limited access to imperative public skills, a weaker ability in ensuring accessibility of health products, a higher risk factor in the development process and an even stronger dependency on donor interests.

On a more general note, it is important to indicate what the challenges of both models are in the overall fight against neglected diseases and diseases of the poor. There are firstly difficulties in performing clinical trials in developing countries, which stem from a lack of in-house endemic country experience as well as a tough environment in these resource-poor countries. Secondly, there is a cultural divergence between industrialized countries and developing regions, which exists at all phases of development. Thirdly, one has to take into account the insufficient or a lack of distribution infrastructure in endemic countries, which can undermine the accessibility element provided especially by PDPs. And lastly, there is a lack of government commitment in both endemic and industrialized countries regarding the overall issue of health needs. (Stirner, 2010, p. 225)

In regard to these obstacles, it is important to address the role that governmental institutions should incorporate to support PDPs in the future. What is most critical is of course a larger financial support. But where governmental institutions, like the SDC, could particularly use their policy influence, is in the creation of more incentives for collaborations with PDPs (i.e. through tax credits) and in the creation of a national network structure which links the different PDPs possibly also together with purely private partnerships and other relevant stakeholders. (Stirner, 2010, p. 227–228, 243–244)

4. EVALUATION OF EFFICIENCY AND EFFECTIVENESS

This last section of the present research paper will comprise an evaluation of the PDP model and the private initiatives regarding their efficiency and effectiveness in tackling PRNDs. Key points which were elaborated in the previous chapter are to be kept in mind. A short elaboration at the beginnin on the difficulties of a cost-effectiveness analysis regarding the topic at hand will provide for the necessary background information. Thereafter, efficiency will be addressed in terms of newly developed drugs and a brief outline of their respective development costs. This

should as such enable a certain comparison, although keeping in mind the different calculations of the both business models. Effectiveness, on the other hand, will be addressed firstly in regard to the access element, in terms of ensuring accessibility to medicines in poor countries and the effective number of treatments provided in these states. Secondly, their respective impact on building capacity in these countries will be elaborated. The subsequent evaluation shall be illustrated particularly along the lines of MMV and DNDi, who act as the representatives of the PDP model within this paper. The same applies to the Novartis Malaria Initiative, which is an example for a private initiative.

4.1. The Challenges of a Cost-Effectiveness Analysis

This paper is of a purely qualitative and therefore descriptive nature. While research work in pharma-economics typically employs cost-effectiveness analyses (CEAs) involving the standard method of so-called daily-adjusted life years (DALYs), this tool cannot be applicable to the field of work in this paper. In short, health impact assessment measures via DALYs summarize the reduction of a diseases' mortality, morbidity and transmission by a new health intervention. However, even once such a new health product has been developed and become globally available, a lack of quality data in the area of neglected diseases for particular health outcomes makes a CEA measurement extremely difficult. Moreover, the various PDPs and private initiatives observed within this paper each prioritize different diseases with different mortality, morbidity and transmission rates and therefore require health solutions with other health-related costs. A direct one-to-one and quantitative cost-effectiveness comparison of these various health programs by both PDPs and private initiatives is not possible.

Furthermore, PDPs present a relative new push mechanism in the field of pharma-economics and their work would have to be divided into short- and medium term versus long-term issues for a CEA to bring about some conclusion. PDPs, however, are essentially R&D stimulating organisations and much of their work lies in the long-term and risky nature of clinical trials. While new health products may take anything from five to ten years or more to reach the market, their potential impact cannot be measured now. Not only is there still an inherent risk of failure at each stage of the drug development process (as explained in section 2.2.2), but also because it is unknown whether a new product would be better than anything else already existing on the market. Leaving aside these circumstances, the measurement of a new health interventions' impact on patients' health is further limited by the fact that the mere delivery of health products does not guarantee their actual and appropriate usage in the respective disease-endemic countries.

As could be observed above, conducting a CEA in the case of PDPs' health impact would not only be an extremely ambiguous and highly misleading undertaking, but also an inherently difficult and complex one, which would effectively have little to say

in the end. The focus of this paper, thus, remains in PDPs' and private initiatives' overall value added. The authors of this paper assume that PDPs are thus cost-effective simply because PDPs address a market failure in an area into which no pharmaceutical company would otherwise venture and because they have the ability to bring new health interventions to market versus a situation where there exist only few or even no health interventions at all. (Boulton, Glaue, Meredith & Mertenskoetter, 2015, p. 6–7)

4.2. Efficiency: Development of New Drugs and Costs

The development of new drugs is arguably the most crucial aspect in the fight against PRNDs. In this regard, PDPs are absolutely crucial as R&D is often their main focus, as could be observed in the previous chapters and will also be shown in the following exemplary portfolios.

The Medicine for Malaria Venture has, altogether, launched five new products[3] against malaria within their partnership network since 2009. And they currently have seven new medicines in the clinical development phase, which aim at addressing future medical needs. This is all in addition to an extensive portfolio of potential compounds which are still in the first stages of drug discovery. (D. Reddy, personal communication, 11. April 2016; MMV, 2016d)

The Drugs for Neglected Diseases Initiative addresses most neglected diseases such as sleeping sickness or leishmaniasis and has already delivered six new treatments. They are currently working on thirteen potential new drugs in their R&D pipeline, which are planned to be delivered within the next few years. (T. Saugnac, personal communication, 2016; DNDi, 2014)

Regarding the private initiatives, an emphasis shall again be put on their, for the most part, omission of proactive R&D for new drugs. To put this statement in context: private initiatives on their own are absolutely important in the fight against PRNDs as their primary focus is on access-to-medicine programs. However, inquiries for this research paper have shown, that R&D for new drugs mainly occur out of initiatives and/ or partnerships with PDPs or other public sector stakeholders. (Novartis Malaria Initiative, 2016c; Roche, 2016, p. 1; T. Saugnac, personal communication, 11. April 2016; L. Igwemezie, personal communication, 29. April 2016; Burri, 2016)

It is nonetheless important to state that private initiatives and more specifically the private sector itself, do possess a critical role in the actual drug development process

[3] *New products launched: Coartem® Dispersible, Eurartesim®, Pyramax®, Artesun® Injected and SP-AQ® (D. Reddy, personal communication, 11. April 2016; MMV, 2016d)*

regarding their provision of laboratory facilitates and expertise, chemical compounds and overall R&D expertise.
To conclude this matter, PDPs are a crucial element for initiating the development of new drugs, but they cannot do so without private initiatives. Seen from the other way around, private initiatives (specifically the private sector) would not do it without the PDPs. Thus, there exists a certain mutual dependence in the promotion of development for new drugs.

Evaluating R&D costs, however, is a rather difficult aspect in view of the comparison of the two models. This is so, since there are very different cost calculations in PDPs and in the private sector. The industry is hereby the relevant actor in regard to cost calculations of private initiatives. Nonetheless, the subsequent outline of exemplary development costs should allow, to some degree, for a careful but meaningful assessment.
To begin with, the overall cost for the development of a new drug, from the first stage of drug discovery to the last stage of regulatory approval, is currently estimated by industry standards to be circulating around $2.6 billion USD (L. Igwemezie, personal communication, 29. April 2016). PDPs, such as DNDi, on the other hand, estimate their development costs to range from $100 – $170 million USD (DNDi, 2015, p. 8). Fig. **8.** below shows this divergence of costs from another perspective as it assesses MMV's R&D costs in comparison to standard industry costs (in accordance of two industry benchmarks).

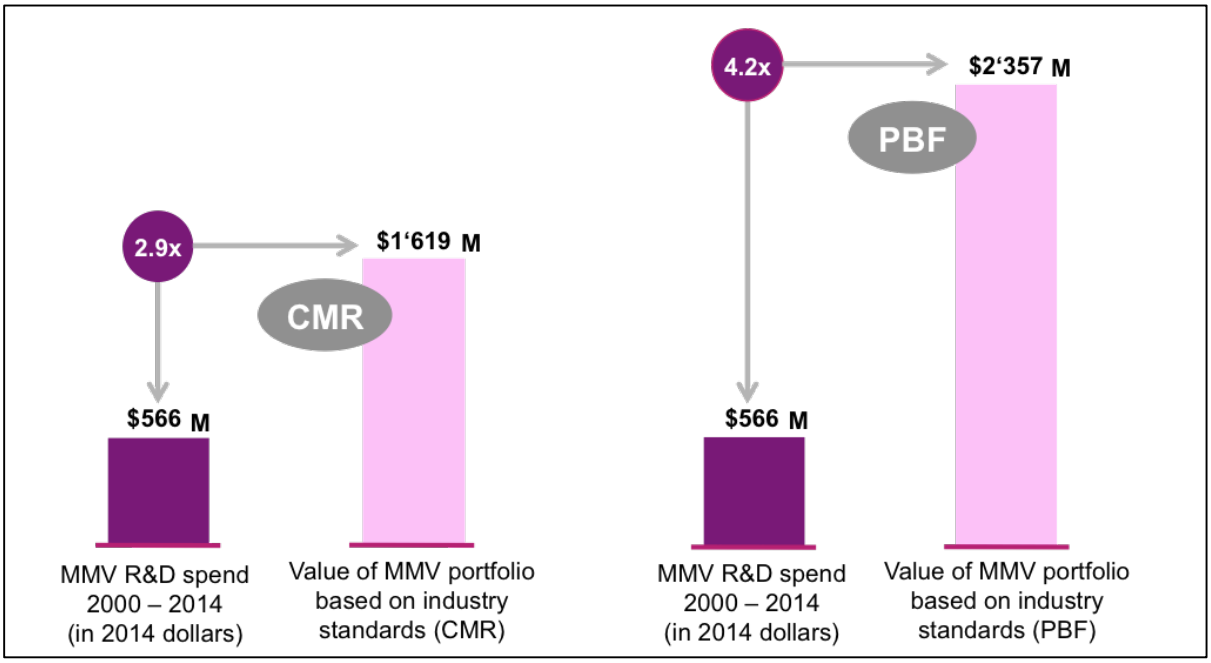

Fig. 8: *Donor investment to create MMV portfolio versus standard industry costs (CMR & PBF are two different industry benchmarks)*

These differences certainly appear to be extremely high, but there is a two-fold reasoning behind this. On the one hand, the private sector cost calculations are fundamentally different, due to their commercial interests and include far more elements than PDP calculations, such as preliminary target identification costs, patent costs and most importantly also opportunity costs regarding other possible endeavours. In this regard, PDPs do restrict their calculations mainly to the R&D process itself and value these more moderately, which yields a first part of the demonstrated cost difference. (T. Saugnac, personal communication, 11. April 2016; C. Lengeler, personal communication, 04. May 2016; L. Igwemezie, personal communication, 26. April 2016)

On the other hand, the most important difference is the specific cost-efficiency aspect of the PDP model. To recall the different factors: PDPs are able to reduce costs through extensive collaboration within their network by conducting a large part of their clinical trials in low-cost endemic countries. They also have an (often) open-access strategy regarding intellectual property. They can maintain low overhead expenses and most importantly achieve efficiency through matched pharma-funding and in-kind contributions of the pharma industry. The last element of leveraging industry's support is illustrated in **Fig. 9**. Through an often matched funding by their pharma-industry partners and their respective in-kind contributions (provision of laboratories or access grants for potential compounds), PDPs can achieve a value multiplication of their donor funds and as such develop drugs at far lower costs than the industry itself or purely private initiatives. (D. Reddy, personal communication, 29. March 2016; T. Saugnac, personal communication, 11. April 2016; Stirner, 2010, p. 135;167–168).

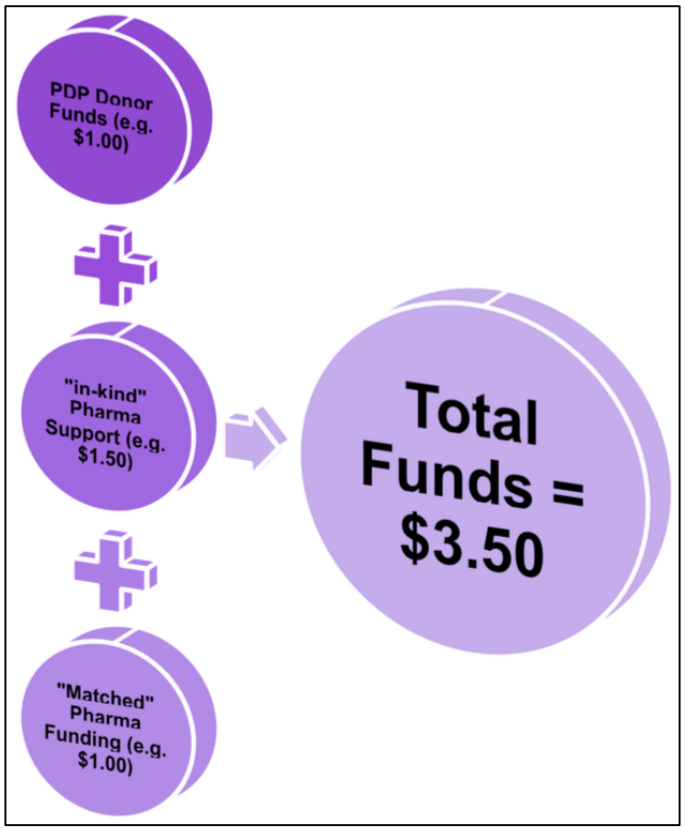

Fig. 9: *Leveraging Donor Funds (Exemplary illustration)*

Therefore, under their unique business model, PDPs are able to maximize the value of contributions from governments, philanthropic funders, academic research centres and private industry by leveraging their individual competencies towards specific goals (WHO, 2012, p. 123).

In conclusion, PDPs thus seem to possess a significant advantage in efficiently addressing the development of new drugs, although their critical dependence on partners from the private sector shall not be forgotten. From the nature of their different business model, private initiatives themselves are not able to profit from such a strong maximisation of funds and large cost reduction factors.

4.3. Effectiveness: Access and Long-Term Impact

In order to assess both models' (PDPs and private initiatives) effectiveness in tackling PRNDs, the aspect of access to medicine shall serve as an assessment tool in this paper. There are principally two sides to this issue. On the one hand, it is about ensuring access to a final product during the drug development phases with regards to affordability and suitability. On the other hand, it is also about ensuring the actual provision and distribution of the products themselves.

Ensuring accessibility begins in the R&D process already with respect to keeping research costs low, developing suitable treatment formats and most importantly, including patient-needs. This is where PDPs possess great strengths due to their extensive partnership network, non-commercial business nature and their close work relationship with endemic countries. (MMV, 2016a; DNDi, 2014; Stirner, 2010, p. 135)

The actual provision of medicine is the one element, where private initiatives possess a particular strength, although the impact of PDPs is not to be underestimated either.

To recall the information stated above, purely private initiatives are predominantly constituted as access-to-medicine programs and as such integrate the industries strengths in simply providing medicine at affordable prices (Access to Medicine Index, 2014, p. 128). The Novartis Malaria Initiative, as illustrated before, has become one of the industry's largest access-to-medicine programs for malaria treatments over the last decade. To date, this initiative has delivered more than 750 million malaria treatments to children and adults and saved an estimated 6.2 million lives. (Novartis Malaria Initiative, 2016d, p. 3) Next to the provision of an enormous number of treatments without profit, the initiative's additional impact is constituted by the elements of further improving access through new supply venue research towards remote regions and innovative access expansions through price segmentation or implementation of mobile phone technology. (Novartis Malaria Initiative, 2016c; L. Igwemezie, personal communication, 29. April 2016)

While this is certainly impressive, it has to be kept in mind that the respective malaria treatments were developed in a partnership with the PDP Medicine for Malaria Venture (MMV, 2016d; Novartis Malaria Initiative, 2016a)

The Drugs for Neglected Diseases Initiative, on the other hand, achieved a treatment of 320 million malaria patients in Africa and 1.2 million in Latin America and Asia, respectively. Additionally, their drugs for sleeping sickness and leishmaniasis reached another 40'000 patients. (DNDi, 2014, p. 8)

However, at this point it is crucial to remember that a comparison of the two models at hand, regarding the access to medicine, is principally not possible within the extent of this research paper. Firstly, the different PDPs and private initiatives address a number of different diseases, which affect different number of people. And secondly, it is often the case that access-to-medicine programs of private initiatives utilize drugs, which were developed in collaboration with PDPs. (T. Saugnac, personal communication, 11. April 2016)

Therefore, the conclusion of the access evaluation in this paper, is that PDPs are great at ensuring accessibility by actually initiating new drug development and including affordability and suitability considerations from the beginning, while private initiatives have their strengths in actually providing affordable medicines on a large scale.

Another crucial element of fighting neglected diseases is the aspect of capacity building. As it has been stated above, it presents an important part of enhancing particularly the long-term effect of a reduction of neglected diseases. Thus, in order to conclude how PDPs and purely private intiatives effectively address the global public health needs, several diverging approaches of the PDPs and the purely private initiatives will be shown, with a special focus laid on their respective impact.

Capacity building, as one of the main objectives of the Drugs for Neglected Diseases Initiative entails the following aspects: it is, in principle, about making change happen within the endemic countries. The R&D process should also not be driven from first world countries. In other words, for DNDi, it is not about giving poor countries an end result, but giving them, among others, the tool of technology transfer with the ultimate goal that they may develop drugs and treatments themselves. (T. Saugnac, personal communication, 11. April 2016)

On a practical side, this translates into an operation of nine regional offices in 53 countries, for DNDi, who employs mostly local staff and works closely together with local institutions and governments. DNDi's efforts are, thus, to strengthen existing clinical research capacities, as well as to build new capacities where it is necessary. They approach this matter by setting up three regional disease-specific platforms in Africa and Latin America. These platforms, such as the Leishmaniasis East Africa

Platform (LEAP)[4], are necessary, on the one hand, to bring together key regional actors (ministries of health, national control programmes, regulatory authorities, academia, civil society groups and many others). On the other hand, they are are able to utilize, capitalize upon, and reinforce clinical capacities in endemic regions. They also address infrastructural requirements where necessary and provide on-site training in clinical research in sometimes extremely remote settings. (DNDi, 2016b)
In addition, they also aim to enable industrial partners in the endemic regions to take on their part in the manufacturing process through technology transfer. This serves to ensure a widespread distribution of new treatments, maintain competitive prices and reinforce the technological and scientific capacities of endemic countries. An example of such technology transfer is the ASAQ (artesunate-amodiaquine fixed-dose combination) treatment, produced as a non-patented product with manufacturing partners in Morocco and Tanzania. (DNDi, 2016b)
The Medicines for Malaria Venture (MMV), as another PDP example, lays an even stronger focus on strengthening clinical research capacities. To illustrate this, two percent of their total R&D budget is invested in capacity building with regards to equipment, infrastructure and training. Their main approach is to bring their significant network of 55 clinical trial sites in 24 countries up to the international standard of Good Clinical Practice (GSP), in order to run high-quality trials. This is done by keeping the long-term goals in mind of enabling these institutions to apply for international grants, to sustain their research, offer skills and laboratory facilities to other clinical research initiatives and even to become high-level advisors to national health authorities. (Baner & Poll, 2009, p. 2–3)

As an example of a capacity building approach by purely private partnerships, one could firstly look at the Novartis Malaria Initiative. This private initiative undertakes capacity building particularly as aim to ensure access to medicine. It is thus constituted by the elements of training healthcare workers, raising awareness, creating best-practice workshops for the different national malaria control programs, sharing expertise in the supply chain for their malaria drug and ultimately the development of clinical expertise in endemic countries. (Novartis Malaria Initiative, 2016)
A second example would be the AmpliCare initiative by the pharmaceutical company Roche. Although mainly an HIV diagnosis and early screening program for tuberculosis (with an element to provide affordable early diagnosis tests), its main capacity building aspects are to train of healthcare workers and set up testing centres

[4] Other regional platforms are the Human African Trypanosomiasis (HAT) and the Chagas Clinical Research Platform (CCRP): http://www.dndi.org/strengthening-capacity

in endemic countries. Thus, the focus is hereby laid on establishing trained laboratory technicians and functioning diagnostics facilities. (Roche, 2016)

In conclusion, capacity building thus presents an important objective for both models and therefore seems to make PDPs and private initiative effective mechanisms in addressing particularly the long-term reduction of global health burdens. Regarding their respective content and focus, their various approaches seem rather similar. Hence, the ultimate impact of both the PDPs and purely private initiatives is certainly to be valued positively. However, there is one element of divergence worth noting, which is the motivation and underlying nature of capacity building. Although it does not explicitly stand out as such, PDPs have a strong tendency to share their knowledge and expertise regarding R&D skills to enable self-realisation by the institutions in endemic countries. This is less the case with purely private initiatives, who certainly have an important impact in building capacities towards logistics management and good clinical practice, but they do not share know-how and skills specific to R&D processes very widely (AMI, 2014, p. 73). This could be contributed to their commercial interests, which entails the keeping of such valuable expertise in-house. (DNDi, 2016b; Baner & Poll, 2009, p. 3; Novartis Malaria Initiative, 2016; T. Saugnac, personal communication, 11. April 2016; L. Igwemezie, personal communication, 26. April 2016)

To conclude this evaluation, the problematic nature of a thorough distinction between the two models shall be highlighted again. It has been shown in principle, that the PDP model, although it is dependent on private initiatives and particularly the private sector, does present a great mechanism in efficiently and effectively addressing the global public health burden.

5. CONCLUSION

This research paper has shown that since the end of the Second World War the gap between the health conditions in Western developed states and least developed countries has increasingly widened. This has mainly been caused by an absence of treatments for diseases which are mostly found in low- and middle income countries. Expressed in numbers, a variety of 17 most neglected diseases currently impair the lives of approximately one billion people. (WHO, 2016) However, only ten percent of the global amount of health-related resources are devoted to the global disease burden within the developing world (90 percent), which has become defined as the „10/90 gap”. (SDC, 2015, p. 2) This grievance is mainly a result of a lack of commercial interest by large pharmaceutical industries for investing in the area of drug development and preventive medical care for PRNDs. To fill the gap between

the existing demand and the lacking supply in drug development for PRNDs, drug innovation in this area has become the responsibility of governments and philanthropic foundations. In this context, PDPs emerged as collaborations between both the public and private sector and focus on the facilitation of R&D projects in the field of PRNDs. Although PDPs are also concerned with other aspects, such as capacity building and ensuring access as well, their main focus is to facilitate R&D for drugs against neglected diseases. (Stirner, 2010, p. 132) There has been a general tendency for searching more purely private solution regarding the reduction of the global health burden. These private solutions range from CSR initiatives of large pharmaceutical companies to bilateral partnerships between philanthropic foundations and large pharma-businesses.

The review of the advantages and disadvantages of PDPs and purely private initiatives has shown, however, that the PDP model principally excels with its advantages for the development of new drugs against neglected diseases, as the actual R&D process mainly happens in collaboration with or by initiation of PDPs. However, PDPs have to face the various challenges of a lack of sustainable and long term funding, doing justice to donor interests while keeping a certain level of strategic independence and overcoming difficulties regarding the work in developing countries. Private initiatives on the other hand, have their strengths particularly in providing medicine on a large-scale basis and in motivating industry participation itself. Nonetheless, they often only possess limited access to crucial public skills and can face inherent risks of large donor dependency.

In respect to efficiently and effectively addressing the global health burden, the evaluation in the last section has revealed that both models are generally necessary for the fight against PRNDs. PDPs are critical for the inititation of new R&D processes and enjoy a profound ability in maximising donor funds in this regard, while additionally enhancing the long-term effect of addressing the global health burden through profound capacity strengthening. Then again, although private initiatives and partnerships do not primarily develop drugs for PRNDs on their own, they are nonetheless crucial for the said process, as they are necessary for the actual process of drug development as well as they play an important role and have a strength in ultimately providing access to affordable PRND medicines.

In summary, it has been demonstrated that PDPs are absolutely crucial for the development of drugs against PRNDs, and thereby for the reduction of the global health burden. The several PDPs around the world, with this goal in mind to decrease PRND-related deaths and suffering, are the driving factor for the realisation of new drugs. In this sense, PDPs are efficient and effective when it comes to addressing the global health burden and must be continuously supported and funded.

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Thomas Saugnac, Director of Operations Drugs for Neglected Diseases Initiative.
Personal Interview at the DNDi office in Geneva on 11 April 2016.

Linus Igwemezie, Head of the Novartis Malaria Initiative.
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Christian Lengeler, Head of Unit at the Swiss Tropical and Public Health Institute.
Telephone interview on 4 May 2016.

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