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A research portfolio analysis of the collaborative research networks of public-private partnerships for neglected tropical diseases

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Abstract

Background: Public-private partnerships (PPPs) have been vital contributors to eradicating neglected tropical diseases (NTDs) by bringing together diverse actors to overcome the market failures that NTDs face. Research on their impact is still limited and researchers are calling for evaluations on how their heterogeneous characteristics affect their performance. The scientific method of research portfolio analysis (RPA) has assisted in identifying the research publications of PPPs that represent their general efforts in the discovery of new treatments, as well as enabled the multi-dimensional analysis of diversity. Diverse collaborative research networks are essential to PPPs because the increased participation of (diverse) actors that contribute their resources and capacity, as well as mitigate financial risks, will benefit the development and implementation of new treatments. Finally the results from the RPA were analyzed to uncover potential influences stemming from the different PPP characteristics.

Aim: This research aimed to analyze how the heterogeneous PPP characteristics affect their research portfolios in general and the collaborative research networks in particular.

Method: This research includes a quantitative-qualitative data driven and exploratory research design. PPP characteristics operated as independent variables and the publication count as well as the diversity of the collaborative research networks as dependent variables, with a research publication as the unit of analysis. Data was retrieved from the PPPs' websites & reports and Web of Science. Various statistical models were chosen, based on their fit with the data, to analyze for potential associations.

Research: The findings illustrate how a broad disease scope, mixed funding and having no capacity building activities are associated with a higher publication count. Collaborative research networks are most consistently affected by self-funding, large(r) network size and to a lesser extent not including capacity building, as they are associated with higher levels diversity. Overall, characteristics that affect diversity mostly do not affect publication count. Also, characteristics which influence the diversity of funders predominantly do not influence the diversity of author affiliations and vice versa, where funders are more frequently affected.

Conclusion: This research adds to PPP literature by illustrating the distribution of their characteristics and the levels of diversity present within their research portfolios. Additionally, it demonstrates which characteristics maintain a positive association with diversity and/or publication count. This knowledge can guide PPP actors in the re-examination of their strategies, as well as researchers in the further investigation of these effects. Further research is needed to create in-depth knowledge of these effects and potentially (in)validate the presented hypotheses. Lastly, this research adds to RPA literature by its multi-dimensional application within a new field.

Chapter 1

Introduction

1.1 Research Problem

In the past two decades, increasing efforts have been undertaken to supply medicine to patients suffering from neglected tropical diseases (NTDs). Despite their high global disease burden, NTDs are characterized by a considerable lack of investment as they are primarily found in the world's poorest populations (Gustavsen & Hanson, 2009). Drugs for NTDs face multiple market failures: patients with limited resources, neglect by authorities and the uncertain market size have caused NTDs to be largely ignored by drug manufacturers (Sunyoto et al., 2018). Additionally, since governments in developing countries lack the institutional capacity to develop the necessary advanced and capital intensive R&D investments, public policy makers have achieved limited progress in this field (Borrás, 2017).

A significant part of progress made is due to the activities of public-private partnerships (PPPs) (Borrás, 2017; Cohen et al., 2014; Gustavsen & Hanson, 2009; Weng et al., 2018). A PPP is a collaborative arrangement, which promises a new way of managing and governing organizations that provide public services, by engaging public and private organizations which would normally be unable or unwilling to do so independently (Hodge & Greve, 2007; Woodson, 2016)). Through PPPs, pharmaceutical suppliers can be connected to customers and barriers of entry can be lowered, so pharmaceutical companies can develop and sell medicines for NTDs. Some PPPs also provide research funds, link companies to government health organizations, participate in manufacturing and assist with the distribution and marketing (Glennerster et al., 2006; Widdus, 2001; Woodson, 2016). Scholars believe that such specialized organizational structures can overcome the multiple market failure that treatments for NTDs face and advance the research into NTDs (Brusoni et al., 2007; Moran et al., 2010; Widdus, 2001; Woodson, 2016).

Previous research has attempted to clarify the PPP structure by researching the different characteristics of PPPs, like their aim, legal structure, funding structure, and organizational structure (Borrás, 2017; De Pinho Campos et al., 2011; Moran et al., 2010; Muñoz et al., 2015; Widdus, 2005). Although previous research has descriptively mapped PPPs' differences in characteristics, an understanding of the influence they have on their R&D activities is missing. Only a few researchers have embarked on this topic, like Woodson (2016) who discovered that a PPP's specific organizational structure influences whether they embark on researching emerging technologies. Scholars call for research on how PPP characteristics, such as geo-

graphic coverage, stakeholders involved, funding and governance structure – affect PPPs' activities. Such knowledge would provide important insights into how the model could be optimized (Aerts et al., 2017).

One scientific method that can aid in illustrating PPPs' R&D activities is the method of research portfolio analysis (RPA). RPA is compatible as PPPs make use of portfolio management in their R&D activities (Bottazzi et al., 2006). While portfolios have long been used as a heuristic for managing corporate R&D, funding agencies and large public scientific institutions are increasingly using the term 'research portfolio' as a means of characterizing their research (Wallace & Rafols, 2015). The method of RPA has been used, for example, to analyze how scientific or industrial supply align with social problems or needs (Cassi et al., 2017; Ciarli & Rafols, 2018; Wallace & Ràfols, 2018; Yegros et al., 2019). Furthermore, a series of recent efforts have mapped research landscapes and portfolios as a means to understand priority setting, by uncovering topics, collaborative networks, themes and research developments visible within portfolios (Ciarli & Rafols, 2018; Rafols & Yegros, 2017; Wallace & Rafols, 2015). However, RPA has never been applied to analyze PPPs in the field of NTDs, even though PPPs actively use portfolio management in their R&D activities and are therefore compatible with RPA.

First, when analyzing the R&D activities of PPPs, it is important to focus on their research activities, characterized by their research output. PPPs allocate a large part of their spending on research activities to translate basic research into new drug leads (Lexchin, 2010). As PPPs construct research portfolios to prioritize their efforts and use their research publications rates as measures of success, analyzing their number publications can be seen as a way of measuring their impact (Woodson, 2016). Second, scientific literature on RPA and PPPs both highlight the importance of diversity for tackling complex problems (Wallace & Rafols, 2015). For PPPs, the diversity of their collaborative networks are considered a vital characteristic and advantage. A diverse collaborative network will result in a complementarity of skills and resources from a diverse set of actors that can accelerate the discovery, development and delivery of new drug innovations for NTDs as well as mitigate the financial risks (Campos et al., 2019; Jomo et al., 2016; Krattiger et al., 2018; Stadtler & Probst, 2012; Widdus, 2005). Collaborative networks are also present in a PPP's research portfolio in the form of collaborative research networks and e.g. consist of the organizations that have co-funded or collaborated with a PPP on a research publication. As such knowledge intensive collaborative networks can be influenced by various contexts, it is beneficial to analyze collaborative research networks through a multi-dimensional approach (Boschma, 2005; Wallace & Rafols, 2015). Additionally, this will allow a more comprehensive illustration of the mechanisms which facilitate collaboration and innovation (Boschma, 2005). As RPA can explicitly consider levels of diversity (Wallace & Rafols, 2015), it can be used to analyze the diversity of the PPPs' collaborative research networks by employing a multi-dimensional approach.

Thus, this research aims at analyzing how the various PPP characteristics affect their research portfolios by first identifying their general effect on the publication count and second their specific effect on the levels of diversity within their collaborative research networks. This results in the following research question:

How do the heterogeneous characteristics of public-private partnerships in the field of neglected tropical diseases affect their research portfolios in general and the collaborative research networks in particular?

1.2 Scientific and social relevance

The contributions of this research are threefold. First, insights gained from this study will benefit research on PPPs by aiding in identifying the different configurations of PPPs within the field of NTDs and analyzing how specific PPP characteristics affect research activities. Because the concept of PPPs is loosely defined (Aerts et al., 2017; Bloomfield, 2006; Hodge & Greve, 2007; Lexchin, 2010), constructive debates about PPPs' and their activities have been very difficult. Novel insights can assist the literature on PPPs in constituting a clearer definition of this particular framework and in optimizing the framework.

Second, for the scientific literature on RPA (Cassi et al., 2017; Ciarli & Rafols, 2018; Rafols & Yegros, 2017; Wallace & Rafols, 2015; Wallace & Ràfols, 2018; Yegros et al., 2019), this research will provide a case example of how to apply the method of RPA to the research portfolios of PPPs in the field of NTDs. As RPA is an important method within the field of scientometrics, this study contributes to the use of analytic methods within the innovation sciences field by applying it in a new research setting. Additionally, as this research analyzes the levels of diversity within collaborative research networks, it resonates with- and adds to the literature on RPA that defines the importance of diversity for tackling complex problems.

Third, this research will contribute to increasing medicinal access for NTDs by aiding the efforts of clarifying the organizational structure of PPPs. It is essential to support the development of the PPP framework as it plays a crucial role in advancing research into neglected diseases and in attaining goal 3 of the Sustainable Development Goals: "aiming for healthy lives and promoting the well-being at all ages" (UN, 2019).

1.3 Overview Document

This thesis is structured as follows: Chapter 2 will give an overview of the theoretical framework used for this research and will define the dependent and independent variables. Chapter 3 presents and discusses the methods that were employed for the execution of this research. In chapter 4 the results are presented. Chapter 5 displays the conclusions which follow from the attained results and chapter 6 discusses the relevance of the findings, as well as the limitations to this research.

Chapter 2

Theoretical Framework

In this chapter the theory supporting this research will be discussed. The first two paragraphs will discuss why PPPs are needed and attempt to define PPPs by discussing their characteristics and display a research gap within the PPP literature. Paragraph 2.3. introduces the theory of research portfolio analyses and how it can be applied. Lastly, in paragraph 2.4. the independent and dependent variables for this research are defined.

2.1 Introducing public-private partnerships

PPPs have generally been described to include some form of cooperation; durable relationships; development of mutual products/services; sharing of risks, costs, and benefits; and mutual value addition (Bloomfield, 2006; Hodge & Greve, 2007; Klijn & Teisman, 2002; Torchia et al., 2015; Widdus, 2005). Furthermore, PPPs can constitute a various range of partners. These can be businesses, governments, and sometimes non-profit organizations in projects in which risks, resource contributions, and skills are shared, and which aim to benefit each partner as well as the community.

Within scientific literature the dominant understanding of PPPs is as a governance or management tool, where they are established because they can benefit both the public and private sectors (Hodge & Greve, 2007). They promise a new way of managing and governing organizations that produce public services (Hodge & Greve, 2007), by engaging public and private organizations which would normally be unable or unwilling to do so independently (Woodson, 2016)

For the private sector, a reason to enter in a PPP structure is for overcoming certain market-failures. PPPs offer a less risky way of investing for the private sector, as they guarantee an income for a long period of time (Romero, 2015). The private sector expects to have better investment potential, to make a reasonable profit, and to have more opportunities to expand their business interests, when partnering with the public sector. For example, within the field of neglected tropical diseases (NTDs) PPPs are believed to be able to overcome the unattractive commercial return on investments of pharmaceutical companies in low and middle-income countries by offering an alternative model for investment (Campos et al., 2019; Reid & Pearse, 2003; Widdus, 2005).

For the public sector, PPPs are believed to fulfil civic needs which cannot be satisfied by the sector itself. Rewards from partnering with the private sector are improvement of program performance, cost efficiencies, better service provisions,

and appropriate allocation of risks and responsibilities (Romero, 2015). For NTDs, PPPs aim to fill gaps left by public health systems, as numerous of such systems possess an inability to provide public goods on their own due to lack of resources or competing priorities, among other issues.

2.2 Defining public-private partnerships

2.2.1 Ambiguity in the definition of public-private partnerships

As displayed in the former paragraph, PPPs are seen as a solution to overcome challenges which cannot be solved by the public and private sector independently. However, it is difficult to define what PPPs actually are, as they lack a universally agreed upon definition (Bloomfield, 2006; Khanom, 2010; Romero, 2015). One heavily cited definition of PPPs is from Bovaird (2004) and states "working arrangements based on a mutual commitment (over and above that implied in any contract) between a public sector organization with any organization outside of the public sector". According to Woodson (2016) this definition has gained success because of its breadth, hosting the various configurations of PPPs'.

Romero (2015) has identified up to 25 different types of conceptualizations within contemporary literature. Additionally, (Jamali, 2004) states that the term 'PPP' has become mired in a muddle of conceptual ambiguities and a direct result from this ambiguity is the internal heterogeneity of PPPs. PPPs tend to vary extensively in their membership, their size, diversity of activities and their geographical scope (Borrás, 2017). Some PPPs receive many tens of millions per year on a single endeavor, while others spread far smaller amounts across many areas. Additionally, while some are funded by public sources, others are mainly funded by philanthropies and private donations, acting as funding agents (Campos et al., 2019; Moran et al., 2010). As a result, PPPs are being used in various fields, encompassing different meanings and more and more countries are including their own definitions of PPPs in national laws and policies. Their internal heterogeneity and ambiguity makes constructive debates about the PPP framework, as well as evaluations of their efforts and impact, extremely difficult (Jomo et al., 2016; Marsilio et al., 2011; Romero, 2015). Research on PPPs for NTDs has therefore remained particularly descriptive (Aerts et al., 2017).

2.2.2 Characteristics of public-private partnerships

Researchers in the field of PPPs have attempted to clarify the extensive internal heterogeneity and ambiguity of the PPP framework by analyzing their main characteristics (Aerts et al., 2017). An overview of PPP characteristics defined by a number of researchers can be seen in table 2.1. As displayed, PPP characteristics can be broadly organized according to four domains; legal form, scope, internal structure and their strategic choices.

First, regarding the legal form of a PPP, a PPP can be either dependent or independent, permanent or temporary. Most are stand-alone entities, yet a few are part of a larger organization (Muñoz et al., 2015). Additionally, they can differ in their classification as a public/international agency, a private/not-for-profit organization

or as a private/for-profit organization/company (Widdus, 2005). Second, the scope of a PPPs can vary extensively between being very broad to having a specific focus. Some concentrate on developing a treatment for multiple diseases, while others focus on only on a single disease. Furthermore, some PPPs develop a specific medicinal product like vaccines while others produce various medicinal products. Thus, PPPs differ extensively in the diseases and types of drugs they aim at addressing (Borrás, 2017). This is also the case for other scope types, like their geographical coverage. Third, concerning their internal structure, PPP types can differ in how they perform their R&D. Woodson (2016) distinguished between PPP's that act like academic research labs, conducting their R&D inhouse, and those that contract other research institutes for their work. Furthermore, a PPP's internal structure can be characterized by their size of staff and the inclusion or exclusion of external advisory support (De Pinho Campos et al., 2011; Moran et al., 2010; Muñoz et al., 2015). Fourth, concerning the strategic choices, this can e.g. include a PPP's funding mode that can exist of self-funding, external funding or a mixed model and can include donations from the public and/or private sector and/or from philanthropic organizations. PPPs'can also be characterized by their goals, like actively undertaking capacity building activities. Capacity building could include, for instance, establishing R&D infrastructures in developing countries. A goal could also be product development or transferring technology to developing countries. Lastly, further strategic choices can for instance include specific IP policy and their partner selection (De Pinho Campos et al., 2011; Moran et al., 2010; Muñoz et al., 2015).

Table 2.1: Overview of characteristics of PPPs for NTDs

Domain	**Variables**	**Cited by**
Legal nature	(In)dependent	Muñoz et al. (2015); Widdus (2005); Moran et al. (2010)
	Permanent/Temporary	Muñoz et al. (2015)
	Stand Alone/Nested	Muñoz et al. (2015)
	Public/international agency	Widdus (2005)
	Private/not-for-profit organization	Widdus (2005)
	Private/for-profit organization	Widdus (2005)
Scope	Disease coverage	Muñoz et al. (2015); Borrás (2017); De Pinho Campos et al. (2011)
	Geographical coverage	Muñoz et al. (2015); Borrás (2017); De Pinho Campos et al. (2011)
	Type(s) of medicinal products	Muñoz et al. (2015); Borrás (2017)
	Involvement in implementation phase	Muñoz et al. (2015)
	Number of medicinal products	Borrás (2017)
Internal structure	Size of staff (& roles)	Muñoz et al. (2015)
	Outsourced/In-house R&D	Muñoz et al. (2015); Moran et al. (2010)
	Governance/Business model	Muñoz et al. (2015); De Pinho Campos et al. (2011)
	External advisorary support	Muñoz et al. (2015)
Strategic choices	IP policy	Muñoz et al. (2015)
	Partner selection & relationship	Muñoz et al. (2015); De Pinho Campos et al. (2011)
	Transfer of technology to developing countries	Muñoz et al. (2015); Moran et al. (2010)
	Capacity building for developing countries	Muñoz et al. (2015); Moran et al. (2010)
	Main focus is product development	Moran et al. (2010)
	Self-funding/External funding/Mixed model	Moran et al. (2010)
	Goal/aims of the PPP	De Pinho Campos et al. (2011)
	Private-for-profit sector involvement	De Pinho Campos et al. (2011)

2.2.3 Evaluating public-private partnerships' performance

Thanks to their collaborative nature, PPPs have the ability to tap on each of the participants' comparative advantage(s) and therefore provide a great opportunity to tackle the challenges posed by NTDs. However, in order to make the best of these alliances, one must evaluate their impact. This means analyzing how differences in their characteristics affect their performance. However, the scientific literature on PPPs for NTDs is still predominantly descriptive (Aerts et al., 2017).

According to Woodson (2016) an insight that is not yet discussed in other research on PPPs is that they actively publish their findings. PPPs' in the field of NTDs construct research portfolios to prioritize their activities and are using research publications rates as measures of their success (Bottazzi et al., 2006; Woodson, 2016). Therefore, PPPs' research activities, encompassing of their research output, can be considered an indicator of performance.

Only one previous study has analyzed how the variations in PPPs' characteristics affect their research activities. In this study, Woodson (2016) discovered that the configuration of a PPP and their specific organizational structure influences whether they embark on researching emerging technologies, by analyzing the involvement of PPPs in transformative technologies like nanotechnology. He concluded that PPPs which specialize in R&D were more likely to conduct research on transformative technologies, where no visible difference was observed between PPPs that conducted in-house R&D and those who outsourced their R&D. As no other research could be discovered, it can be concluded that there is an extensive lack of knowledge on how differences in PPP characteristics affect their performance. According to Aerts et al. (2017) this is mainly due to a lack of transparency, as there is no database which records the specific characteristics and scientific progress of PPPs.

Thus, this research can contribute to the scientific literature on PPPs in the field of NTDs by identifying the different PPP characteristics as well as uncovering potential influences the differences in PPP characteristics hold on their research activities.

2.3 Research portfolio analysis

This paragraph presents the scientific literature on the research portfolio analysis method, where in 2.3.1 it summarizes its use in former research and in 2.3.2 discusses how it can be applied for this study.

2.3.1 Research portfolio analysis method

While portfolios have long been used as a heuristic for managing corporate R&D, funding agencies and large public scientific institutions are increasingly using the term 'research portfolio' as a means of characterizing their research (Wallace & Rafols, 2015). Wallace & Rafols (2015) define a research portfolio as "the ensemble or subset of research activities supported by a funding agency, a large research performing organization or a given subset of agencies/organizations". The heuristic and analytical tool for examining a research portfolio can then be called a research portfolio analysis (RPA). Awareness surrounding RPA and its potential benefits has increased over the past years and it has been more frequently used. As explained by Srivastava, Towery & Zuckerman (2007) this is due to the increased availability of- and ability to mine data. Additionally, this comes from a desire to use tools from other disciplines like finance to examine science policy (Srivastava et al., 2007; Wallace & Rafols, 2015).

Wallace & Rafols propose to use an RPA with the approach to explore the activities of agencies and organizations for a given grand challenge (hence a subset of their overall activity), as a means to reflect on the research options that are being supported (and think as well about those that are lacking support (Wallace & Rafols, 2015). Previous research has contributed to this approach by conducting ex post reviews. Examples of such reviews, with a specific focus on topic occurrence, are of Nederhof & Van Wijk (1997) and Cassi et al. (2017) where the former performed an analysis of science portfolios for multiple countries on the topic of obesity and compared their results to national priorities, demonstrating in which disciplines or topics the national S&T strategy is (un)successful in science terms. The latter presented an exploratory investigation of science supply and societal needs on the grand challenge of obesity, assessing not only the knowledge production side of research programs, but also the articulation of research agendas with societal needs. Furthermore, researchers like Srivastava, Towery & Zuckerman (2007) have conducted research in a similar vein, but specifically focused on funding allocation, giving an overview of research portfolio analysis activities in the context of federal research funding agencies in the United States. Detailed insights provided through an RPA can be of particular importance in discerning not only the number and quality of research publication outputs in a field or country but also in discovering collaboration patterns, interdisciplinary linkages, and other research spillovers (A. Singh & Prakash, 2010).

To date, no research has been conducted using RPA to analyze the research portfolios of PPPs. Thus, this study will add to the scientific literature on RPA by giving a case example of the application of RPA to the research portfolios of PPPs in the field of NTDs.

2.3.2 Research portfolio analysis application

According to Wallace & Rafols (2015) tackling complex problems requires increased expenditure in scientific research. Currently, many of the treatments for NTDs that have made it to the market are the product of basic research, where PPPs are the most advanced of the various alternatives to the usual method of researching and developing new drugs. PPPs allocate a large part of their spending on research activities to translate basic research into new drug leads. (Lexchin, 2010; Moran, 2005). It is therefore important to analyze the publication count of PPPs, as it represents their efforts in the discovery and development of new treatments.

Furthermore, Wallace & Rafols (2015) highlight that scientific literature on RPA suggests that the use of a research portfolio should recognize the diversity that is relevant for tackling complex problems (Wallace & Rafols, 2015). Diversity in collaboration is vital as the creation and application of solutions requires knowledge from a variety of scientific fields and the involvement of (potentially many) different, even distant, stakeholders and organisations (Bone et al., 2017). If the collaborative networks in a PPP's research portfolio are composed of organizations from different sectors and geographies, this would ensure not only a diversity of collaborative research networks, but also a variety of ideas and capacities directed toward the development of treatments for NTDs (Graef et al., 2018). Additionally, a network that includes more (diverse) actors mitigates the risk of failure by spreading it over multiple parties with complementary resources (Jomo et al., 2016; Wallace & Rafols, 2015; Woodson, 2016). The application of RPA can aid in illustrating the diversity of collaborative research networks by explicitly considering levels of diversity in the analysis (Wallace & Rafols, 2015).

Lastly, the application of RPA should include a multi-dimensional approach (Wallace & Rafols, 2015). The Diversities Approach to Research Evaluation (DARE), created at the University of Sussex, provides a means to demonstrate the levels of diversity that a collaborative research effort involves (Bone et al., 2017), where it takes the individual authors as the unit of analysis. Knowledge intensive collaborative efforts can however be influenced by various contexts (Boschma, 2005). Therefore, DARE analyzes research collaborations across five different dimensions: geographical-,organizational-, institutional-, cognitive- and the social dimension, as defined by Boschma (Bone et al., 2017; Boschma, 2005). It is suggested that mapping collaborations using these five dimensions provides an effective way to assess whether diverse connections have been constructed, which may lead to opportunities for knowledge creation (Bone et al., 2017; Molas et al., 2015). Here, the researchers of DARE define the geographic dimension as the distance between places of work of the individuals involved in the project. The cognitive diversity is defined by the estimated cognitive distances between individuals working together. The social diversity characterizes people's acquaintances with one another and the institutional diversity reflects whether individuals working together are under similar rules and incentive structures. (Bone et al., 2017).

Thus, RPA will be applied to retrieve research portfolios and thereby the publication counts of PPPs. Furthermore, by integrating RPA with the DARE approach it is possible to analyze the levels of diversity within the collaborative research networks through a multi-dimensional manner.

2.4 Defining the variables

This paragraph defines the dependent and independent variables used for the purpose of this research. First the independent variables are defined, followed by the dependent variables.

Independent variables

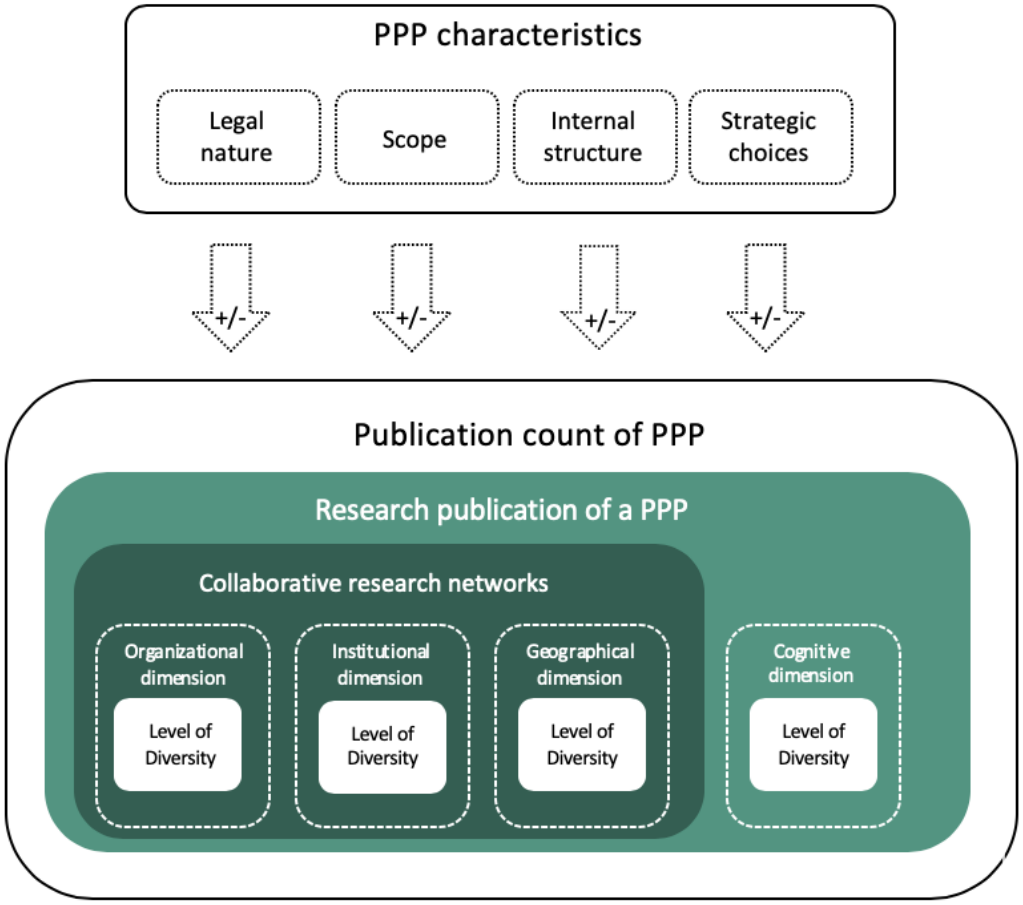
The characteristics of PPPs that work within the field of NTDs will function as the independent variables for this research. The characteristics are gathered from the current literature on PPPs and will be grouped according to the domains: legal nature, scope, internal structure and strategic choices.

Dependent variables

This research includes two dependent variables. The first dependent variable constitutes of the publication counts of the individual PPPs. The second dependent variable consists of the diversity values of the collaborative research networks. Here, diversity is defined as the diversity in research capacity, where a higher diversity means an increased inclusion of (diverse) actors that contribute their capacity and resources. The levels of diversity are calculated for four different dimensions. These dimensions are defined similarly to the DARE approach, but adjusted to the unit of analysis and excluding the social dimension. The social dimension is excluded, because this research analyzes a considerable number of research portfolios. Therefore it can not perform the micro analysis of investigating the author's social relationships with one another. The remaining four dimensions are defined as follows: the organizational dimension analyzes the collaborative networks of the author affiliations and funding agencies of a research publication. The institutional dimension analyzes whether author affiliations and the funding agencies of a publication are under similar rules and incentive structures. The geographical dimension looks at the physical distance between the authors working on a research publication. The cognitive dimension is originally analyzed in DARE by retrieving the cognitive background of every author from a publication through their previously published works (Bone et al., 2017). However, as this technique needs to be performed manually for every author, it is not feasible to employ it for this large-scale research. Instead, the scientific categories of a research publication are utilized to analyze the cognitive dimension on a publication level. Although by analyzing the scientific categories of a publication instead of the cognitive backgrounds of authors, the cognitive dimension ceases to include a collaborative research network. Therefore, the collaborative research networks are analyzed only through the institutional-, organizational- and geographical dimensions and not through the cognitive dimension.

After constructing the independent and dependent variables, possible associations between the various PPP characteristics and the dependent variables can be investigated. A visual framework of the variables and their potential associations are depicted in figure 2.1. Here it is visualised how the collaborative research networks are embedded within a research publication and analyzed through multiple dimensions. The publication count constitutes of the total amount of research publications of a single PPP. The influence of the PPP characteristics can either be be negative, positive or non existent. In the next chapter the methodology used for this research is discussed.

Figure 2.1: Depiction of the (potential) influence of the independent variables on the dependent variables



Chapter 3

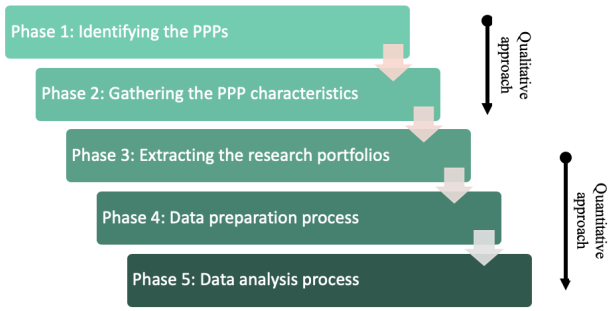
Methodology

In this chapter, the methodology for this research is presented. Paragraph 3.1 outlines the methodological process, 3.2 the discusses the data collection process and paragraph 3.3. the data preparation process. Lastly, in paragraph 3.4. the data analysis process is described.

3.1 Methods

This research will encompass a combination of qualitative and quantitative research methods and will maintain an exploratory and data driven approach. This method will allow for displaying possible associations between the variables and providing flexibility when analyzing the data. The methodology is divided into five phases. Phase I aims at identifying the PPPs operating in the field of NTDs and phase 2 defines their different characteristics. Both phase 1 and 2 take a qualitative research approach to extract the necessary information from websites, publications and reports. In Phase 3 the research portfolios of the PPPs are established by acquiring the total amount of PPPs' research publications. Phase 4 is directed at cleaning and enhancing the data in preparation of the analyses. Lastly, in phase 5 the combined results from the before-mentioned phases are analyzed with the unit of analysis being a research publication. During this phase it will be evaluated, based on the data structures, which statistical models are best fit for analyzing possible associations between the variables. Phases 3 up until 5 employ a quantitative approach and make use of Rstudio. Rstudio is an integrated development environment for R, a programming language for statistical computing and graphics ("R: The R project for Statistical Computing", n.d.). The complete methodological process is visually depicted in figure 3.1.

Figure 3.1: Visual depiction of the methodological process



3.2 Data collection

This paragraph gives an outline of the data collection process for the PPPs and their characteristics in 3.2.1. and the PPPs' research portfolios in 3.2.2.

3.2.1 Identifying the public-private partnerships

The landscape of PPPs operating in the field of NTDs is used as a scope for this research. A PPP will be included within this research if it satisfies the following inclusion criteria:

1. It encompasses a founder from the private domain as well as a founder from the public domain, and

2. It focuses on either one or more of the neglected tropical diseases, as stated by the WHO ("Neglected tropical diseases", 2020) and displayed in Appendix A. Furthermore, this focus should take up at least one third the amount of its R&D disease scope

The purpose of the first inclusion criterion is to only include organizations characterized as a public-private partnership. Regarding the second inclusion criterion, organizations that employ a more general drug/vaccine development focus are not included for this research. The reason being that their research portfolios stretch beyond the scope of neglected diseases. As a result, such organizations possess an extensive amount of scientific publications of which the greater degree does not share any affiliation with neglected diseases. PPPs like the Novartis Institute of Tropical Diseases (NITD), the Special Program for Research and Training in Tropical Disease (TDR) and the Infectious Disease Research Institute (IDRI), even though they encompass broader scopes in relation to the other PPPs, are included in this research since their focus is still largely on NTDs. For example, IDRI and NITD both focus on five diseases of which three are an NTD. Lastly, even though TDR is a very large program with considerably more research portfolios than the other PPPs, still eight of their twelve disease focuses are NTDs. Therefore, the minimum limit that a PPP's disease focus should take up at least one third of its R&D disease scope, as held by NITD & IDRI, will be maintained. The given information on the PPPs can be reviewed in Appendix H.

Most of the PPPs selected for this research are derived from the research of Aerts et al. (2017). A list of these PPPs is visible in Appendix B. This list contains an overview of PPPs in the field of NTDs of which the majority fit the inclusion criteria defined for this research. Additionally, during Phase 1-3 of the methodological process new PPPs were discovered. Two of these PPPs were included for this research, namely the Envision program and the Global Dengue & Aedes-Transmitted Diseases Consortium (GDAC). The Envision program is financed by the USAID and in partnership with CBM International, the Carter Center, Fred Hollows Foundation, Helen Keller International, IMA World Health, Light for the World, Sightsavers, and World Vision. Furthermore, it focuses solely on NTDs ("ENVISION: A World Free of Neglected Tropical Diseases — RTI", n.d.). GDAC is the continuation of the (Pediatric) Dengue Vaccine Initiative (P)DVI ("Dengue and Aedes-transmitted Diseases", n.d.). Both PPPs meet the above mentioned criteria as they are founded by private as well as a public entities and focus exclusively on NTDs. Other PPPs which were observed but not included for this research are ISGlobal, GAVI Alliance, TB Alliance and MMV, as they did not meet the criterion of directing at least one third of their R&D disease scope to NTDs. The consideration process of these excluded PPPs is laid out in Appendix **??**. The result of this process is displayed in table 3.1, which contains a list of all the PPPs included for this research.

Table 3.1: Definitive sample of Public-private partnerships used within this research

public-private partnerships
WIPO Re:Search consortium
Drugs for Neglected Diseases Initiative (DNDi)
Novartis Institute for Tropical Diseases (NITD)
The Pediatric Dengue Vaccine Initiative (PDVI)
The Dengue Prevention Program PHYTOCHIK
Stamp Out Sleeping Sickness (SOS)
HAT control program
The Special Program for Research and Training in Tropical Disease (TDR)
The Infectious Disease Research Institute (IDRI)
The German Leprosy Relief Association (GLRA)
The Global Program to Eliminate Lymphatic Filariasis (GPELF)
The Global Alliance for Elimination of Lymphatic Filariasis (GAELF)
The African Program for Onchocerciasis Control (APOC)
The Onchocerciasis Control Program (OCP)
The Onchocerciasis Elimination Program for the Americas (OEPA)
TOVA (The Onchocerciasis Vaccine for Africa)
The Regional Network for Asian Schistosomiasis (RNAS)
The Human Hookworm Initiative (HHVI)
The International Trachoma Initiative (ITI)
The ENVISION program
The Global Dengue & Aedes-Transmitted Diseases Consortium (GDAC)
The Partnership for Dengue Control (PDC)

3.2.2 Collecting the characteristics of public-private partnerships

Information on the PPPs was gathered from websites and reports to identify their characteristics. The selected characteristics were derived from current literature on PPP characteristics within the field of NTDs (De Pinho Campos et al., 2011; Moran et al., 2010; Muñoz et al., 2015; Widdus, 2005) and were grouped according to four domains: legal nature, scope, internal structure and strategic choices. A few modifications were made before the definitive list was constructed. First, as for many PPPs the size of their staff could not be extracted, the PPPs' network sizes were used as an alternative. Here the network is defined as the amount of organizations participating in the PPP as founders/partners. Second, PPPs which have received drug donations from a private company were allocated a new characteristics within the R&D variable, namely 'Donated R&D'. This was done as these PPPs could not be classified as conducting either outsourced or inhouse R&D activities. Third, as all PPPs were discovered to be independent from high levels of government control, the categories of 'dependent' and 'independent' will be adjusted to 'stand alone' or 'nested'. This choice was made as there exists a relative even distribution of PPPs over these two characteristics and they can be easily identified. Here nested stands for being a part of another institute/organization or being housed by one (Muñoz et al., 2015). Fourth, it has been decided to drop the characteristics of 'multiple medicinal types' and 'single medicinal type', because of a lack of knowledge in distinguishing medicinal types. Lastly, characteristics that were defined by literature but which could not be retrieved through investigating PPPs' websites and reports were discarded. A few specific characteristics for some PPPs because were also discarded because they could not be identified, namely the funding mode of NITD & GDAC and the network size of TDR & SOS. The final overview of the derived PPP characteristics is displayed in table 3.2.

As depicted in table 3.2, the PPP characteristics are mutually exclusive. As an example: within the legal domain and considering its durability, a PPP can either be 'permanent' or 'temporary', but not both. The full process of gathering the information on the PPP characteristics has been documented in an Microsoft Office Excel sheet and can be acquired from the author.

3.2.3 Extracting the research portfolios

In this third phase, the research portfolios of the PPPs are established by extracting the research publications of PPPs from the year 1900 until 2020. The time limit of 1900 is used, as the PPP GLRA was already launched in 1957 ("DAHW Mission Statement", n.d.). The research publications are extracted from the database Web of Science and will count towards a PPP's portfolio if:

1. The PPP's name is mentioned as an author affiliation
2. The PPP's name is mentioned as a funding agency
3. The PPPs name is mentioned in the funding acknowledgements and the PPPs founder(s) or donator(s) is mentioned as a funding agency

Table 3.2: Overview and operationalization of Public-private partnership characteristics

Domain	Variables	PPP characteristic	Operationalization
Legal nature	Durability	Permanent	The PPP does not include a time limit[a]
		Temporary	The PPP includes a time limit or has been discontinued
	Autonomy	Nested	The PPP is nested or housed within another organization
		Stand Alone	The PPP is a stand alone organization
Scope	Disease Focus	Single disease focus	The PPP focuses on a single disease
		Multiple disease focus	The PPP focuses on multiple diseases
	Geographical area focus	Single area focus	The PPP focuses on a specific area/country
		Multiple area focus	The PPP includes no specific area focus and/or focuses on multiple areas
Internal Structure	Network size	Small network	The PPP has a small network of <5 (founding) partners/members
		Medium network	The PPP has a medium sized network of 5 <x <10 (founding) partners/members
		Small network	The PPP has a large network of >10 (founding) partners/members.
	R&D	Inhouse R&D	The PPP conducts R&D inhouse
		Outsourced R&D	The R&D of the PPP is outsourced
		Donated R&D	The PPP received R&D as a donation
Strategic choices	Capacity building activities	Capacity building	The PPP mentions capacity building activities
		No Capacity building	The PPP does not mention capacity building activities
	Funding mode	Self funding	The funding is raised by the organization itself
		External funding	The PPP receives funding through external partners/donations
		Mixed funding	The PPP's funding mode is a mix between self- and external funding

[a]Apart from the time limit related to achieving the ultimate purpose of the organization, e.g. 'eliminating onchocerciasis around the globe

3.3 Data Preparation

The data preparation is considered phase 4 of the data collection process, where the gathered data is prepared for the benefit of the data analysis. Of the 22 PPPs, 17 included at least one research publication. From the research publications of these 17 PPPs, the following fields were extracted:

1. The author affiliations
2. The funding agencies geocoded author addresses
3. The geocoded author addresses
4. The scientific categories
5. The institutional domains of author affiliations
6. The institutional domains of funding agencies

The author affiliations were extracted first and retrieved from the author addresses (C1) field of Web of Science. Microsoft Excel was employed for removing the author names, which were displayed between brackets within the addresses. The result was a list of the author affiliations, with their respective addresses. After the address parts were also removed, the author affiliations remained. Second, the funding agencies were extracted. They were retrieved from the Web of Science field 'FU' which contains the funding agencies and grant numbers of a publication. The grant numbers were displayed between brackets and removed in Microsoft Excel, leaving only the funding agencies. The data from the author affiliations and funding agencies had to undergo a few preparations, before it could be analyzed. A complication with this data is that it often contains long strings which include the parent organization as well sub-departments. An example is 'UNIVERSITY DUNDEE LIFE SCI, DIV BIOL CHEM & DRUG DISCOVERY, DRUG DISCOVERY UNIT, DUNDEE'. For the benefit of the analysis, such strings had to be reduced to a single organization's name, for this example the outcome should be 'UNIVERSITY DUNDEE'. Hardeman (2013) discusses that bibliometric organizational data suffers from a two-fold unification problem. At first there is a lack of consistency in naming organizations across entities. Second, there is a lack of consistency in the amount of and the order in which named entities occur across records (Hardeman, 2013). The first unification issue was tackled by standardizing the names of organizations which occurred frequently within the data set. The remaining entries were additionally analyzed and if needed standardized, but not to the same elaborate extent, as this would have taken up a considerable amount of time which was not available. Additionally, some of the names were simplified to achieve extra clarity e.g.'center for disease control' was simplified to 'CDC'. The second unification problem was taken up by adhering to the guidelines, for the unification process of strings. The following rules for unifying main and sub-organizations were adhered to, of which further examples can be found in table 3.3.

1. University: the name is reduced to the name of the university and the rest, like the mentioned department or college, is removed.

2. Government:

   (a) If the affiliation/funder is an autonomous institute of the government, the name is reduced to leave the autonomous institute (e.g. 'US Government, US National Institutes of Health' is reduced to 'US National Institutes of Health').

   (b) If a government institute is non-autonomous, and the string includes the non-autonomous institute as well as the governmental parent, the name will be reduced to the government in question. (e.g. 'US Government, Department of Agriculture' becomes 'US Government').

3. Programs or projects undertaken by an organization, which are mentioned together with the organization, are reduced to the organization's name (e.g. 'WHO, malaria program' becomes 'WHO').

4. If only a dependent entity of an organization is mentioned, for instance a research institute of an university, the name of the dependent entity is left unaltered, as it lays outside the scope of this research to identify the parent organizations and change all these entries (e.g. if only the 'Singapore Immunology Network' is mentioned, this is left unaltered. However if its parent organization 'A*Star' was mentioned as well, the name would have been reduced to 'A*Star').

5. If the entry concerns a joint research center of an university and a governmental body, the entry is reduced to the name of the university, as the research is generally conducted on the university's property.

Even though a few organization's names were not fully standardized and therefore contained variations, this was not a hindrance for the analysis. The reason being that across the unit of analysis, namely the publication level, the spelling of an organization's name remained consistent. To assure this fact, the data was manually analyzed to remove any variances in names which occurred within a single publication.

Table 3.3: Further examples of the unification process, where organization 1 and 2 are mentioned in the same string.

Organization 1	**Organization 2/Sub-organization/Department**	**New string**
INGEBI	CONICET	CONICET
University Cape Town	Kilimanjaro Community Center for Ophthalmology	University Cape Town
Singapore Immunology Network	A*STAR	A*STAR
Free University Amsterdam	Fac Sci	Free University Amsterdam
NIH	Fogarty International Center	US National Institutes of Health
Chinese CDC	National Institute Parasit Dis	Chinese CDC
University Oxford	Center Tropical Medicine & Global Health	University Oxford
Carter Center	Trachoma Control Program	Carter Center

The third step of the data preparation included the extraction of the geocoded addresses. For this purpose a copy of the cleaned author addresses was imported to Google Sheets. Google Sheets is a free web-based application, developed by Google for real-time online document editing (S. Singh, 2017). In Google Sheets, these addresses were geocoded. Geocoding is the process of converting addresses (like a street address) into geographic coordinates (like latitude and longitude), which you can use to place markers on a map, or position the map ("Geocoding API — Get Started", n.d.). Using the Google Apps Script feature of Google Maps, addresses were geocoded using the script written by Augusto Destrero (Destrero, 2020). This script can be found in Appendix E. The scientific categories of the research publications were the fourth to be extracted for which the Web of Science field 'SC' was used. The fifth and sixth step was to extract the institutional domains of the author affiliations and funding agencies. The institutional domains were retrieved by investigating to what extent the author affiliations and funding agencies belonging to a publication are under similar rules and incentive structures (Bone et al., 2017). For this purpose seven different types of institutions were defined:

1. Universities
2. Non-governmental organizations (NGOs)
3. Governmental organizations (GOs)
4. Hospitals
5. Industry
6. Public-private partnerships (PPPs)
7. Inter-governmental organizations (IGOs)

These institutional types are inspired by the DARE approach, however a few adjustments were made to the list provided by DARE. The institutional types of 'PPPs' and 'IGOs' were added, as these frequently occurred in the publication data. Additionally, where DARE separates hospitals into three different sub-types, this research takes hospitals as a single institutional type (Bone et al., 2017). The reason being that this research, in comparison to the DARE method, includes a great quantity of publications. Therefore, it was not possible to distinguish between these different sub-types. Thus, the institutional type 'hospitals' incorporates all hospitals and medical centers, disregarding their private, public or academic nature. Additionally, 'universities' also include research consortium's, scientific journals, and university associations. Furthermore, 'non-governmental organizations' also include societies, independent research institutes and any other forms of independent non-profit organizations.

The seven institutional types were identified through the use of keywords that were constructed in a data-driven process. At first the frequently occurring keywords were defined like 'Hospital' and 'University'. Afterwards the keywords had to be manually identified for the remaining entries. This was only done for non- unique entries which occurred at least two times within the data set. The complete list of keywords can be found in Appendix **??**. All the remaining entries which were not

defined by a keyword were manually inspected. Ultimately, for the total of 13594 affiliations and 8523 funders, 104 affiliations and 226 funders were still left unclassified (not counting the white spaces which are also identified as missing values). These unclassified entries mostly consist of unique or incoherent values. For instance, they state a generic organizational name like 'Chai', which cannot be traced back to an organization. All these unclassified entries encompass 0,77 percent and 2,65 percent of the total amount of affiliations and funders, equivalent to 1,49 percent of the total number of affiliations and funders. In order to give insights into these missing values, the have been checked for any possibly overlooked larger organizations. The largest 20 entries of the missing funders and affiliations are displayed in Appendix F for transparency purposes. Additionally, two overviews of a random set of 20 missing funders and affiliations are displayed. As unique values have a small share within the complete data set and would take a long time to manually identify, these entries were left excluded. Finally, per publication the different institutional types were counted with the use of the keywords. These counts were checked to control for errors, such as incorrect counts for multiple institutional categories.

Lastly, entries that only contained a white space were turned into missing values (NAs) and removed from the data. Additionally, trailing and leading white spaces were removed from the strings.

3.4 Data analysis

This paragraph discusses the data analysis, which is phase 5 of the methodological process. The data analysis process is divided into four phases. The first data analysis phase uncovers the quantity and distribution of the research publications across the PPPs and PPP characteristics. The data is furthermore analyzed to discover potential associations between the PPP characteristics as independent variables and the research publication counts as dependent variables. As the distribution of research publications is count data, a negative binomial regression was employed. The reason for using a negative binomial regression, instead of a poisson or quasi-poisson regression, is because the mean and variance of the data are not similar and therefore the data is largely over-dispersed.

In the second phase, the diversity of the research publications are calculated separately for the geographical-, institutional-, organizational- and cognitive dimension. The data was then analyzed with the aim of discovering potential associations between the diversity of the research publications and the various PPP characteristics e.g. whether the research publications of the temporary PPPs included a significantly higher/lower diversity compared to the publications of permanent PPPs. The Wilcoxon rank sum test was employed for conducting these analyses as it is a non-parametric method that can also be applied on data which does not assume a normal distribution. Here the null hypothesis assumes that the two populations have the same distribution with the same median and rejecting the null means that there is evidence that the medians of the two populations differ (Ford, 2017).

The approaches used for retrieving the diversity of the research publications will now be discussed per separate dimension before continuing with the third data analysis phase. At first, the method for calculating the diversity through the geographical dimension will be presented, followed by the method used in the organizational, institutional and lastly the cognitive dimension.

Geographical dimension

The DARE approach acquires the diversity of the geographical dimension by calculating the distance between places of work of individuals involved in the research collaboration. Here the distance is taken in travelling time (Bone et al., 2017). This research, however, takes a different approach which is better fitted and easier to apply to a large set of research publications. The distance between the places of work of the individuals is calculated by applying the Haversine formula on the geocoded author addresses. This formula is an equation important in the field of navigation for calculating the distance in meters between two points on the Earth's surface specified in longitude and latitude (Robusto, 1957; Winarno et al., 2017). The Haversine formula is displayed in figure 3.2.

Figure 3.2: The Haversine formula (Morgan et al., 2017)

$$d = 2r \arcsin\left(\sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos(\phi_1)\cos(\phi_2)\sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)$$

Here it applies that:

- d is the distance between the two points along a great circle of the sphere
- r is the radius of the sphere
- φ_1, φ_2 are the latitude of point 1 and latitude of point 2 (in radians)
- λ_1, λ_2 are the longitude of point 1 and longitude of point 2 (in radians)

The result is a distance matrix of the work addresses of authors that are part of the collaborative research network of a research publication. Here the measure of the distance is in meters. A publication's geographical diversity value was then constructed by taking the mean of the distances included for a publication and converting it to kilometers. In Appendix G an example of the code is displayed which was used to apply the Haversine formula on the geocoded addresses in Rstudio.

Organizational dimension

The DARE approach calculates the organizational diversity of a research collaboration by analyzing if the individuals involved are part of the same department, same organization or come from a different organization (Bone et al., 2017). As the data on author affiliations and funding agencies is standardized, it only remains possible to distinguish if the affiliated organizations of a research publication are the same organization or unique.

Collaborative research networks can benefit from the inclusion of multiple unique organizations. Although a common knowledge and competence base is a prerequisite

for enabling interactive learning, knowledge creation also depends on a capacity to coordinate the exchange of complementary pieces of knowledge owned by a variety of actors within and between organizations (Boschma, 2005). The collaboration between different unique organizations can therefore provide complementary pieces of knowledge as well as complementary resources. Hence, the organizational diversity of a research publication is retrieved by counting the number of unique author affiliations and funding agencies that collaborated on a research publication, resulting in two organizational diversity values for every research publication.

Institutional dimension

Similarly to the organizational dimension the diversity within the institutional dimension is calculated for both the funders as well as the author affiliations of a research publication, for which the institutional domains that were extracted in paragraph 3.3 are employed.

The different institutional types, defined in paragraph 3.3, have a different set of objectives which are set by their general mission and may be oriented towards commercialisation, care, open science, education and policy. The distance between each type of institution can therefore be defined by the overlap of these objectives. (Bone et al., 2017; Llopis & D'Este, 2016). For example, two funding agencies exposed to missions with the same series of objectives (for example two companies focused on industry) would be defined as having an institutional distance of 0, while those that differ completely could have an institutional distance of 1. The overlap of objectives is shown in table 3.4. These values are an adaptation of the values used by the researchers of DARE (Bone et al., 2017 p.25). As specified in paragraph 3.3 the institutional types used in DARE were adjusted to include 'PPPs' and 'IGOs' and to use 'hospitals' as a collective type without including subdivisions. With regards to their missions, PPPs are appointed a 1 for industry, 0.75 for open science, 0.25 for education and 0.5 for policy, as PPPs in the health sector focus largely on policy and industry, where policy is used to shape the environment for the implementation of treatments and industry is used for developing treatments through knowledge sharing and collaboration. Additionally, a PPPs' capacity building efforts can defined as an educational objective and is therefore awarded a value of 0.25. As PPPs do not provide care, like a hospital does, they receive a zero for this objective. In regards to the IGOs, it receives a 1 for Open Science and Policy, as it is considered identical to 'GOs' and only differs in its international scope.

Table 3.4: The missions that distinguish institutional types, inspired by DARE (Bone et al., 2017)

Objectives	Univ	NGO	GO	Hosp	Industry	PPP	IGO
Industry	0	0	0	0	1	1	0
Care	0	0	0	0.75	0	0	0
Open Science	1	1	1	1	0	0.75	1
Education	1	0	0	0.5	0	0.25	0
Policy	0	0.5	1	0	0	0.5	1

Using the symmetric binary dissimilarity method (Bone et al., 2017; Han & Kamber, 2012, p.70-71), the following distances can be obtained between each type of institution, where

$$Distance(a, b) = sum(|Attr(a) - Attr(b)|)/\text{total number of attributes}$$

. Table 3.5 features the final vector for all the institutional types. These values are then used to calculate the institutional diversity for the funders and author affiliations of a publication.

Table 3.5: Institutional distance defined between pairs of institutions

	Univ	NGO	GO	Hosp	Industry	PPP	IGO
Univ	0	0.3	0.4	0.25	0.6	0.5	0.4
NGO	0.3	0	0.1	0.35	0.5	0.3	0.1
GO	0.4	0.1	0	0.45	0.6	0.4	0
Hosp	0.25	0.35	0.45	0	0.65	0.55	0.45
Industry	0.6	0.5	0.6	0.65	0	0.3	0.6
PPP	0.5	0.3	0.4	0.55	0.3	0	0.4
IGO	0.4	0.1	0	0.45	0.6	0.4	0

The institutional diversity of a publication is calculated using the adapted Rao-Sterling diversity measure from the DARE approach (Bone et al., 2017; Rafols & Meyer, 2010). In DARE, diversity is interpreted as the expected mean distance, where n is the number of elements and δ_{kl} is the distance between the element k and the element l. The result is the adjusted Rao-Sterling diversity ($\alpha = 1, \beta = 1$) over all elements:

$$Diversity = \sum_{k,l}^{n} \frac{\delta_{kl}}{n^2}$$

For instance, a publication that contains three funding organizations with the following institutional types: NGO, GO and Industry, will include the following institutional diversity for its funding agencies:

$$\begin{aligned} Diversity &= \frac{NGO_1GO_1}{n^2} + \frac{NGO_1Industry_1}{n^2} + \frac{GO_1Industry_1}{n^2} + \frac{GO_1NGO_1}{n^2} + \\ &\quad \frac{Industry_1NGO_1}{n^2} + \frac{Industry_1GO_1}{n^2} \\ &= \frac{1}{3^2}\delta_{NGO_1GO_1} + \frac{1}{3^2}\delta_{NGO_1Industry_1} + \frac{1}{3^2}\delta_{GO_1Industry_1} + \frac{1}{3^2}\delta_{GO_1NGO_1} + \\ &\quad \frac{1}{3^2}\delta_{Industry_1NGO_1} + \frac{1}{3^2}\delta_{Industry_1GO_1} \\ &= \frac{1}{3^2} * 0.1 * 2 + \frac{1}{3^2} * 0.5 * 2 + \frac{1}{3^2} * 0.6 * 2 \\ &= \frac{0.2 + 1 + 1.2}{9} = 0.27 \end{aligned}$$

Thus, this publication would receive an institutional diversity value of 0.27 for its funding agencies. A low score suggests that the team is homogeneous. A score of 1 would indicate that every element is located at a maximum (normalised) institutional distance from each other (Bone et al., 2017).

Cognitive dimension

Originally in the DARE approach, the cognitive dimension is analyzed by assembling the prior publications of the individuals within a research collaboration. These are then assigned to a Web of Science category. As a result, each individual is assigned a vector of 224 Web of Science categories, which is compared to other individuals in the team. This method of analysis can not be recreated as the unit of analysis for this research is not the individual researchers but the research publications. Additionally, the assembling of the prior publications, as well as the creation of the vectors is done manually, and therefore can not be translated to a large-scale analysis. The scientific categories that define the cognitive background of a publication will therefore be used. Similar to the organizational dimension, the number of unique scientific categories that are included for a publication are counted. The more unique scientific categories are attributed to a publication, the higher its cognitive diversity. This analysis is based on the assumption that the inclusion of multiple scientific categories indicate the collaboration of actors from multiple specialized fields, instead of one specialized field.

As the methods for retrieving the diversity values have now been discussed, the last two data analysis phases are presented. The third data analysis phase displays the diversity values of the research publications according to the four dimensions and grouped per PPP. The last data analysis phase, phase 4, includes the ranking of the PPPs according to the diversity values of their publications. The highest rank achievable is 17, because the diversity values were calculated for the 17 PPPs that possessed at least one research publication. The rankings were constructed for all four dimensions, where the institutional and organizational dimension include a ranking for the author affiliations as well as the funding agencies of the publications. The mean value of the six rankings was then used to create a 'total diversity rank'. Analyses were then conducted to investigate for potential associations between the total diversity ranking and the various PPP characteristics, where the total diversity rankings functioned as dependent variables and the PPP characteristics as independent variables. An ordinal logit regression was used for these analyses, as the dependent variables contain more than two categories that are ordered on a single dimension.

In the next chapter, the results which were the product of the data collection and analysis processes, will be presented and discussed.

Chapter 4

Results

This chapter is divided into four parts. Paragraph 1 discusses the distribution of characteristics and research publications across the PPPs. Additionally, the distribution of publications across the different characteristics is presented, followed by an analysis to discover if certain PPP characteristics are associated with a higher/lower publication count. In the second paragraph the calculated diversity values of the publications are presented per dimension. For every dimension analyses are performed to investigate potential associations between the diversity of research publications and the different PPP characteristics. The third paragraph presents the diversity values of the research publications that belong to the individual PPPs' research portfolios. In the fourth paragraph the PPPs are given a rank based on the diversity values attained in paragraph three. Additionally, a total diversity value is created for every PPP and used in an analysis to investigate potential associations between the total diversity and the PPP characteristics.

4.1 Characteristics and research publications of public-private partnerships

In this paragraph an overview will be created of the PPPs, their respective characteristics and publication counts. In section 4.1.1, the distribution of characteristics over the PPPs is presented. Section 4.1.2 displays the distribution of research publications across the PPPs and 4.1.3 the distribution of research publications over the different characteristics. Lastly, in 4.1.4 analyses are conducted for discovering possible associations between the different the publication counts and the different PPP characteristics.

4.1.1 Distribution of characteristics across the public-private partnerships

This paragraph displays the results from the qualitative data collection. A complete overview of the PPPs and their characteristics can be found in Appendix H. In table 4.1 the PPPs are grouped according to their characteristics.

As can be seen in the domain legal nature, 63.64% of PPPs do not contain a time limit to their existence or do not state one. The other 36,36% have a time-limit or have already ended. Additionally, 68,18% of the PPPs are housed or nested in another organization. The remaining 31,81% are stand-alone entities. For the domain 'scope', 59,09 % of PPPs focus on a single disease. The remaining 40,9% do not mention a focus or include multiple diseases within their portfolio. Only 9,09% of PPPs focus on a specific geographical area and the other 90,91% operate across multiple geographical areas.

For the domain 'internal structure', 59,09% of PPPs include a large, 13,64% a medium and 27,27% a small network size. Considering their R&D, 27,27% of PPPs conduct inhouse R&D, 27,27% outsource their R&D and 36,36% receive donated R&D. Of two PPPs the R&D activities are unknown, these are SOS and TDR.

Lastly, the domain 'strategic choices' shows that 72,73% of PPPs state that they are involved in a form of capacity building. The other 27,27% do not mention any capacity building activities. These PPPs focus either on developing treatments (PHYTOCHIK, TOVA and HHVI) or on distributing treatments (OEPA, OCP, and ITI). Considering the funding modes, 22,73% of PPPs receive funding from their own founders, 31,83% receive external funding and 36,36% receive funding from their own founders as well as external donations. The funding modes of NITD and GDAC could not be identified.

Thus, the majority of PPPs are permanent, nested, focus on a single disease, operate across multiple areas, include a large network, receive donated R&D, are active in capacity building and receive mixed funding.

Table 4.1: Overview of PPPs and their research publications, grouped according to the PPP characteristics

Domain	Variable	PPP characteristics	PPPs	Number of PPPs	Total publications	Average publications
Legal nature	Durability	Temporary	(P)DVI, PHYTOCHIK, TOVA, OCP, HAT CP, HHVI, ENVISION, APOC	8	409	51,125
		Permanent	OEPA, WIPO Re:Search, GAELF, DNDI, NITD, IDRI, GPELF, TDR, GLRA, GDAC, RNAS, PDC, SOS, ITI	14	2097	149,79
	Autonomy	Stand alone	DNDI, OEPA, PHYTOCHIK, RNAS, GLRA, IDRI, GAELF	7	582	83,14
		Nested	TOVA, WIPO Re:Search, NITD, (P)DVI, HAT CP, ITI, TDR, GDAC, APOC, GPELF, GAELF, OCP, HHVI, ENVISION, PDC	15	1924	128,27
Scope	Disease focus	Single disease	P)DVI, PHYTOCHIK, ITI, SOS, GAELF, HAT CP, GPELF, APOC, OCP, OEPA, TOVA, HHVI, PDC	13	477	36,69
		Multiple diseases	WIPO Re:Search, DNDI, NITD, TDR, RNAS, IDRI, GDAC, ENVISION, GLRA	9	2029	225,44
	Geographical focus	Single area	PHYTOCHIK, SOS	2	3	1,5
		Multiple areas	RNAS, OCP, GAELF, ITI, APOC, OEPA, WIPO Re:Search, DNDI, NITD, (P)DVI, TOVA, HAT CP, TDR, GDAC, IDRI, GLRA, GPELF, HHVI, ENVISION, PDC	20	2503	125,15
Internal structure	Network size	Small network	Small & SOS, PDC, HAT CP, GDAC, OCP, HHVI	6	163	27,17
		Medium network	NITD, (P)DVI, PHYTOCHIK	3	194	64,67
		Large network	WIPO Re:Search, DNDI, RNAS, TDR, ITI, TOVA, IDRI, APOC, GLRA, GPELF, GAELF, OEPA, ENVISION	13	2149	165,31
	R&D	Inhouse R&D	NITD, PHYTOCHIK, TOVA, RNAS, HHVI, IDRI	6	213	35,5
		Outsourced R&D	WIPO Re:Search, DNDI, (P)DVI, GDAC, PDC, GLRA	6	598	99,67
		Donated R&D	OCP, GPELF, APOC, OEPA,GAELF, HAT CP, ITI, ENVISION	8	386	48,25
Strategic choices	Capacity building activities	Capacity building	RNAS, WIPO Re:Search, GLRA, DNDI, NITD, (P)DVI, SOS, HAT CP, TDR, GDAC, IDRI, GPELF, GAELF, APOC, ENVISION, PDC	16	2208	138
		No capacity building	PHYTOCHIK, OEPA, OCP, TOVA, HHVI, ITI	6	297	49,5
	Funding mode	Self funding	HAT CP, OEPA, TOVA, RNAS, ENVISION	5	108	21,6
		External funding	(P)DVI, PHYTOCHIK, IDRI, GPELF, GLRA, PDC, HHVI	7	354	50,57
		Mixed funding	APOC, WIPO Re:Search, DNDI, SOS, TDR, GAELF, OCP, ITI	8	1972	246,5

4.1.2 Distribution of research publications across public-private partnerships

Now the results from the quantitative data collection are presented. An overview of the PPPs' publication counts can be viewed in table 4.2. As displayed, TDR includes by far the highest amount of publications, namely 1306. This result is understandable because TDR is a collaboration between large and trans-national organizations, focuses on 12 diseases of which eight are considered NTDs and supports the development of research across the globe, as displayed in Appendix H. A few PPPs did not include any publications. These PPPs are TOVA, PHYTOCHIK, the HAT control programme, WIPO Re:Search and RNAS.

Table 4.2: Overview of publications per PPP

PPP	Number of publications
TDR	1306
DNDI	387
ITI	126
(P)DVI	123
OCP	104
IDRI	93
ENVIS	90
GLRA	81
NITD	71
HHVI	49
APOC	43
OEPA	18
PDC	6
GAELF	3
SOS	3
GPELF	2
GDAC[1]	1
TOVA	0
WIPO Re:Search	0
PHYTOCHIK	0
HAT CP	0
RNAS	0
TOTAL	2506

An overview of the PPPs which do not contain any publications, including their respective characteristics, are displayed in table 4.3. As can be seen, the PPPs are more or less evenly distributed across the PPP characteristics. A few tendencies can be observed. For the legal domain there is a tendency towards the temporary nature and a nested structure. Within the domain scope, a tendency towards the single disease focus and the multiple geographical area focus is clear. Regarding their internal structure, the PPPs tend to be large and conduct the R&D inhouse. Lastly, a tendency is observed within their strategic choices towards having capacity building activities and self-funding.

[1]GDAC listed around 20 publications on their website but these same papers couldn't be retrieved through WoS using the method defined for this research. Therefore these papers were excluded.

Table 4.3: PPPs without publications grouped per characteristic

Domain	Variable	PPP Characteristic	PPPs	Number of PPPs
Legal nature	Durability	Temporary	PHYTOCHIK, TOVA, HAT CP	3
		Permanent	WIPO Re:Search, RNAS	2
	Autonomy	Stand alone	PHYTOCHIK, RNAS	2
		Nested	TOVA, WIPO Re:Search, HAT CP	3
Scope	Disease focus	Single disease focus	PHYTOCHIK, HAT CP, TOVA	4
		Multiple disease focus	WIPO Re:Search, RNAS	2
	Geographical focus	Single area focus	PHYTOCHIK	1
		Multiple area focus	RNAS, WIPO Re:Search, TOVA, HAT CP	4
Internal structure	Network size	Small	HAT CP	1
		Medium	PHYTOCHIK	1
		Large	WIPO Re:Search, RNAS, TOVA	3
	R&D	Inhouse R&D	PHYTOCHIK, TOVA, RNAS	3
		Outsourced R&D	WIPO Re:Search	1
		Donated R&D	HAT CP	1
Strategic choices	Capacity building activities	Capacity building	RNAS, WIPO Re:Search, HAT CP	3
		No capacity building	PHYTOCHIK, TOVA	2
	Funding mode	Self funding	HAT CP, TOVA, RNAS	3
		External funding	PHYTOCHIK	1
		Mixed funding	WIPO Re:Search	1

4.1.3 Distribution of publications across public-private partnership characteristics

In table 4.1 the PPPs and their publication counts can be viewed grouped according to the different PPP characteristics. When looking at the average amount of publications in the legal nature domain, temporary PPPs (51,125) contain less publications than permanent PPPs (149,79). Additionally, nested PPPs contain more publications than stand alone PPPs, namely 128,27 compared to 83,14.

Within scope, PPPs that focus on multiple diseases have on average more publications (225,44) than those that focus on a single disease (36,69). Furthermore, PPPs with a single area focus contain less publications (1,5) than those that operate across multiple geographical areas (125,15).

For the domain internal structure, PPPs with large sized networks contain most publications, namely 165,31. PPPs with a medium (64,67) or small (27,17) network size have fewer publications on average. Concerning the R&D activities, PPPs that outsource their R&D have on average the highest amount of publications (99,67), followed by the PPPs with donated R&D (48,25) and the smallest amount is produced by the inhouse R&D PPPs (35,5).

Within the domain strategic choices, PPPs that involve capacity building activities contain on average more publications (138) than those that do not conduct capacity building activities (49,5). Lastly, PPPs with mixed funding (246,5) have on average more publications than externally funded (50,57) and self funded PPPs (21,6).

Thus, the highest averages of publication counts are attributed to PPPs that are permanent, nested, focus on multiple diseases across multiple areas, include large networks, outsource their R&D, are active in capacity building and receive mixed funding.

4.1.4 Analyses on potential associations between publication count and public-private partnership characteristics

Potential associations between the publication count and the PPP characteristics will now be investigated with the use of negative binomial regressions. After the initial analysis of the characteristics, it is important to control for the network size. It would be naturally expected that the network size, indicated by the characteristics 'small', 'medium' and 'large' from the domain internal structure, could influence the number of publications. The reason being that with a larger network, there would be higher number of involvement with other actors active in scientific research, resulting in a capacity for producing research publications. In table 4.4 the models (1) and (3) display the initial regressions for the PPP characteristics of the domain 'legal nature' and (3) and (4) display the regressions which control for the effect of network size. As can be seen in models (1) and (3), no significant correlations exist between any of the characteristics from the legal domain and the publication count. The largest difference is observed between the coefficients of model (1) and (2). It displays how the correlation between 'permanent' and the dependent variable turns negative, when controlling for size. Subsequently, the correlation between 'temporary' and the dependent variable turns positive. However, the coefficients remain insignificant.

Table 4.4: Count regressions for the legal nature domain

	Dependent variable:			
	research publications			
	(1)	(2)	(3)	(4)
Permanent	0.759	−1.132		
	(0.786)	(0.742)		
Medium		1.526		1.090
		(1.131)		(1.116)
Large		2.840***		2.263***
		(0.758)		(0.844)
Stand Alone			−0.320	−0.990
			(0.796)	(0.841)
Constant	4.404***	3.619***	5.077***	3.484***
	(0.661)	(0.751)	(0.432)	(0.599)
Observations	17	17	17	17
Log Likelihood	−97.566	−95.258	−97.897	−95.087
θ	0.461*** (0.132)	0.557*** (0.163)	0.448*** (0.128)	0.567*** (0.167)
Akaike Inf. Crit.	199.133	198.516	199.795	198.175
Note:				*p<0.1; **p<0.05; ***p<0.01

The regressions for the PPP characteristics of the domain scope, are visible in table 4.5, where models (2) and (4) again display the regressions which control for the effect of network size. From models (1) and (3) it appears that a significant positive correlation exists between the characteristics 'multiple diseases' as well as 'multiple areas' and the dependent variable. Subsequently, a significant negative correlation exists between 'single area' as well as 'single disease' and the dependent variable. However, in the models (2) and (4) it shows that, when controlling for the effect of network size, only the disease focus characteristics remain significant. Here, 'multiple diseases' multiplies the number of publications by $e^{1.574} = 4.826$ with p-value <0.05, compared to a 'single disease' focus. This result seems logical as focusing on multiple diseases, opposed to a single disease, would require extra research endeavours. Consequently resulting in more published research.

Table 4.5: Count regressions for the domain scope

	Dependent variable:			
	research publications			
	(1)	(2)	(3)	(4)
Single Disease	-1.804^{***}	-1.574^{**}		
	(0.644)	(0.660)		
Medium		0.753		0.886
		(1.096)		(1.148)
Large		0.615		1.681^{**}
		(0.735)		(0.785)
Single Area			-3.954^{**}	-2.590
			(1.572)	(1.586)
Constant	5.669^{***}	5.050^{***}	5.053^{***}	3.689^{***}
	(0.493)	(0.782)	(0.355)	(0.664)
Observations	17	17	17	17
Log Likelihood	-94.649	-94.318	-96.624	-94.906
θ	0.590^{***} (0.175)	0.607^{***} (0.181)	0.497^{***} (0.144)	0.575^{***} (0.169)
Akaike Inf. Crit.	193.298	196.637	197.247	197.813
Note:				*p<0.1; **p<0.05; ***p<0.01

For the PPP characteristics that are part of the domain 'internal structure', the regression analyses are displayed in table 4.6. Here model (1) and (2) display the initial regressions and model (3) controls for the effect of network size. Model (1) displays a significant positive correlation between the characteristic 'large' and the dependent variable, where having a large network multiplies the number of publications by $e^{1.886} = 6.593$ with p-value <0.05, compared to having a small network. With regards to the R&D characteristics, models (2) and (3) indicate that none of the characteristics maintain a significant correlation with the dependent variable.

Table 4.6: Count regressions for the domain internal structure

	Dependent variable:		
	papers		
	(1)	(2)	(3)
Medium	1.090		0.381
	(1.147)		(1.042)
Large	1.886**		0.271
	(0.752)		(0.766)
Outsourced		0.521	0.277
		(0.859)	(0.866)
Donated		−0.253	−0.027
		(0.813)	(0.914)
Constant	3.484***	4.263***	4.019***
	(0.615)	(0.680)	(0.844)
Observations	17	15	15
Log Likelihood	−95.736	−80.383	−80.326
θ	0.537*** (0.157)	0.729*** (0.238)	0.736*** (0.241)
Akaike Inf. Crit.	197.472	166.766	170.652
Note:			*p<0.1; **p<0.05; ***p<0.01

The last domain, that of strategic choices, is displayed in table 4.7. Model (1) and (3) display no significant correlations between the PPP characteristics and the dependent variable. However, model (2) and (3) which control for the effect of network size, display two significant correlations. First, including capacity building activities seems to significantly multiply the number of publications by $e^{-1.437} = 0.238$ with p<0.1, compared to having a having no capacity building activities. This result could be due to PPPs that conduct capacity building activities being less research oriented and rather active in the distribution and implementation of treatments. Second, a mixed funding mode significantly multiplies the number publications by $e^{1.797} = 6.033$ with p<0.1, compared to self-funding.

It is unfortunately not possible to include a complete regression model, which incorporates all the PPP characteristics. A complete regression model would result in a low degree of variance and would therefore include multiple singularities. The next paragraph, 4.2, discusses the diversity values of the publications according to the geographical-, organizational-, institutional- and cognitive dimensions.

Table 4.7: Count regressions for the strategic choices' domain

	Dependent variable:			
	research publications			
	(1)	(2)	(3)	(4)
Capacity Building	0.828	−1.437*		
	(0.845)	(0.805)		
Medium		2.331**		1.815
		(1.175)		(1.411)
Large		3.074***		1.354*
		(0.762)		(0.754)
External funding			0.089	0.361
			(1.070)	(1.065)
Mixed funding			1.652	1.797*
			(1.050)	(1.002)
Constant	4.307***	3.681***	3.989***	2.635**
	(0.739)	(0.773)	(0.927)	(1.147)
Observations	17	17	15	15
Log Likelihood	−97.570	−95.207	−86.364	−84.930
θ	0.461*** (0.132)	0.559*** (0.164)	0.588*** (0.184)	0.678*** (0.216)
Akaike Inf. Crit.	199.140	198.413	178.728	179.861
Note:				*p<0.1; **p<0.05; ***p<0.01

4.2 Diversity values of PPP characteristics

In this paragraph the diversity values of research publications are calculated according to the four dimensions. First the diversity values within the geographic dimension are discussed, followed by the organizational-, the institutional- and lastly the cognitive dimension. The organizational and institutional dimensions both produce two diversity values, one for the author affiliations and on one for the funders of a research publication.

4.2.1 Geographic dimension

In figure 4.1 the mean distances between the author addresses of a publication are displayed in boxplots. Here (a) relates to the legal nature (b) to the scope (c) to the internal structure and plot (d) to the domain of strategic choices. The distances are in kilometers (km). The descriptive statistics can be found in table 4.8.

For the domains legal nature and scope, the publications of PPPs that are nested and focus on a single disease have a significantly higher geographic diversity than publications of PPPs that are stand alone and focus on multiple diseases. With regards to the domain internal structure, publications of PPPs which receive donated R&D (compared to inhouse- or outsourced R&D) display a significantly higher geographic diversity. Lastly, for strategic choices, the publications of PPPs which are not active in capacity building, that are self funded (compared to receiving external- or mixed funding) or receive mixed funding (compared to external funding) have a significantly higher geographic diversity. The highest amount of differences can be found in the domain strategic choices and the highest significant differences between donated R&D (compared to outsourced R&D), no capacity building (compared to capacity building) and self funding (compared to external funding).

The next paragraph will display and discuss the organizational diversity values that were obtained for both the author affiliations as well as the funding agencies of the PPP publications.

Table 4.8: Descriptive statistics of geographical diversity

Domain	Characteristic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	Permanent	1,882	4,188.7	3,074.0	0.01	1,438.4	4,104.8	6,156.2	16,793.8
	Temporary	347	4,330.5	2,806.4	0.1	2,032.0	4,190.5	6,304.9	12,073.7
	Stand alone	502	3,871.7	2,981.5	0.01	1,276.5	3,587.2	5,797.4	16,793.8
	Nested	1,727	4,306.5	3,043.6	0.02	1,630.1	4,322.0	6,388.1	16,545.1
Scope	Single disease	407	4,516.1	3,072.3	0.1	1,886.8	4,333.4	6,804.4	14,479.3
	Multiple diseases	1,822	4,142.6	3,021.7	0.01	1,461.6	4,070.8	6,104.9	16,793.8
	Single area	3	3,079.3	2,666.0	1.1	2,295.0	4,588.8	4,618.4	4,648.0
	Multiple areas	2,226	4,212.3	3,034.5	0.01	1,559.6	4,121.7	6,187.8	16,793.8
Internal structure	Small network	115	4,498.2	2,927.1	0.3	1,509.0	4,467.2	6,829.3	12,116.6
	Medium network	173	3,969.0	3,483.1	0.1	557.2	3,326.2	6,622.8	14,291.2
	Large network	1,941	4,215.3	2,996.8	0.01	1,712.9	4,135.7	6,139.0	16,793.8
	Inhouse R&D	196	4,375.0	3,469.8	0.2	1,112.7	4,226.3	7,010.1	14,291.2
	Outsourced R&D	514	3,830.4	2,995.8	0.01	973.9	3,482.2	5,778.6	16,793.8
	Donated R&D	331	5,232.8	2,742.0	0.2	3,396.5	5,406.9	7,018.9	14,479.3
Strategic choices	Capacity building	1,987	4,110.6	3,017.8	0.01	1,412.4	3,995.5	6,080.8	16,793.8
	No capacity building	241	5,003.9	3,017.3	0.2	2,757.7	5,282.6	7,256.5	14,479.3
	Self funding	107	4,960.0	2,335.9	3.1	3,433.9	5,309.4	6,552.9	12,073.7
	External funding	313	3,771.5	3,016.3	0.1	1,234.2	3,322.0	5,801.2	13,183.5
	Mixed funding	1,744	4,204.7	3,015.3	0.01	1,599.2	4,142.1	6,104.6	16,793.8

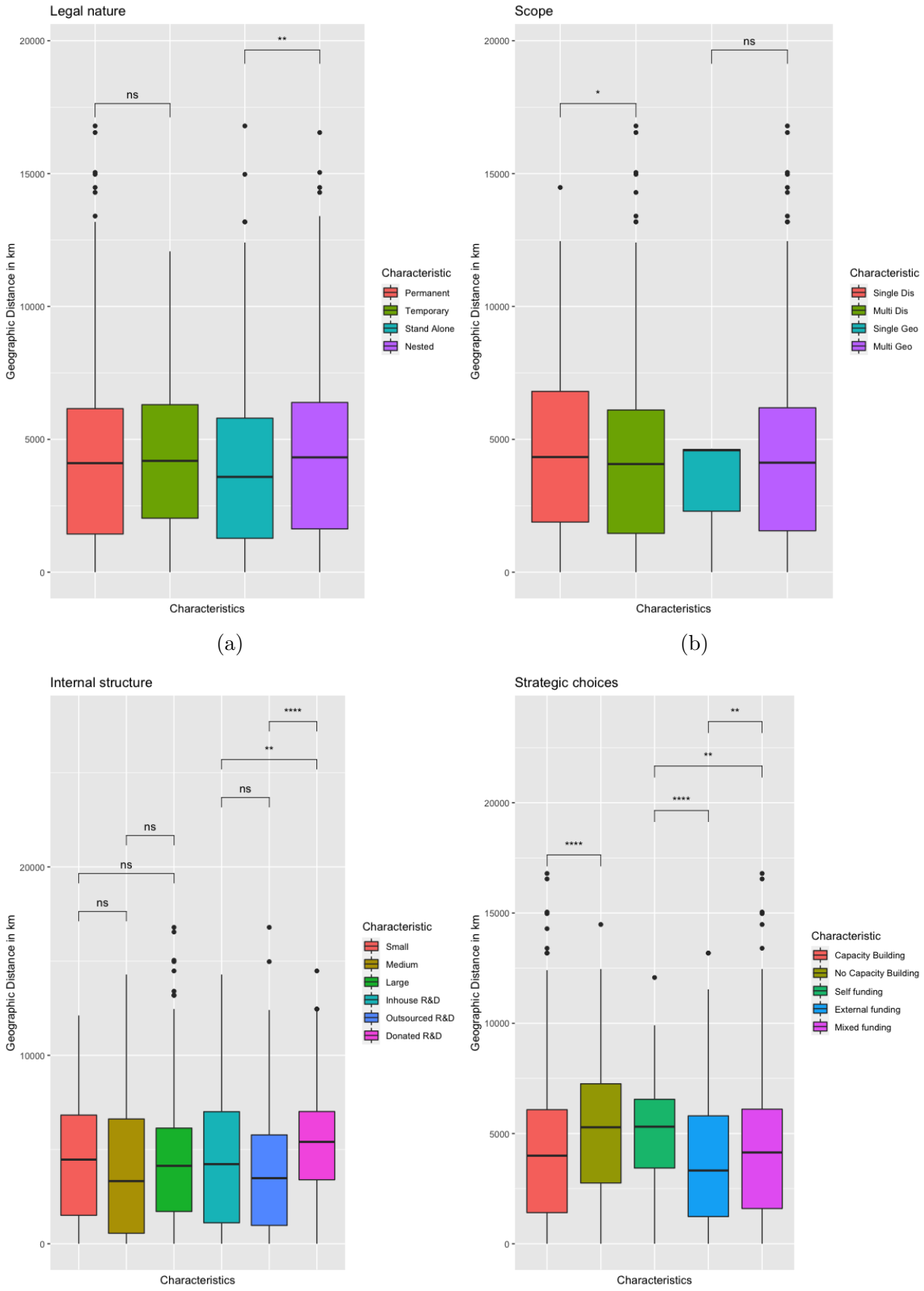


Figure 4.1: Geographic diversity of publications grouped per PPP characteristic

4.2.2 Organizational dimension

The organizational dimension is split into two sections: author affiliations and funders, where the author affiliations are discussed first. Here table 4.9 and figure 4.2 relate to the organizational diversity of author affiliations. The organizational diversity of funders is displayed in table 4.10 and figure 4.3. For both figure 4.2 and figure 4.3, plot (a) relates to the legal nature domain, plot (b) to scope (c) to the internal structure and (d) to strategic choices.

Author Affiliations

Within the domain legal nature, publications from PPPs that have a temporal durability (instead of being permanent) and are stand alone entities (instead of nested) have a higher organizational diversity for their author affiliations. No significant differences were identified within the scope. For internal structure, publications from PPPs that have a large (instead of medium) network and receive donated R&D (instead of outsourcing) are perceived to have higher organizational diversity for their author affiliations. In strategic choices, the publications of PPPs which are self funded (instead of external- or mixed) include author affiliations with significantly higher organizational diversity values.

Table 4.9: Descriptive statistics of organizational count for author affiliations

Domain	Characteristic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	Temporary	409	6.2	14.1	1.0	2.0	4.0	6.0	172.0
	Permanent	2,097	4.5	4.0	1.0	2.0	4.0	6.0	94.0
	Nested	1,924	4.7	7.2	1.0	2.0	4.0	6.0	172.0
	Stand alone	582	4.9	5.1	1.0	2.0	4.0	6.0	94.0
Scope	Single disease	477	5.5	13.1	1.0	2.0	4.0	5.0	172.0
	Multiple diseases	2,029	4.6	4.1	1.0	2.0	4.0	6.0	94.0
	Single area	3	3.3	2.5	1.0	2.0	3.0	4.5	6.0
	Multiple areas	2,503	4.8	6.8	1.0	2.0	4.0	6.0	172.0
Internal structure	Small network	163	4.9	8.8	1.0	2.0	4.0	5.0	107.0
	Medium network	194	4.0	2.9	1.0	2.0	3.0	5.0	18.0
	Large network	2,149	4.8	6.9	1.0	2.0	4.0	6.0	172.0
	Inhouse R&D	213	5.3	7.7	1.0	3.0	4.0	6.0	107.0
	Outsourced R&D	598	4.8	5.2	1.0	2.0	4.0	6.0	94.0
	Donated R&D	386	6.5	13.5	1.0	3.0	5.0	7.0	172.0
Strategic choices	Capacity building	2,208	4.8	6.8	1.0	2.0	4.0	6.0	172.0
	No capacity building	297	4.8	6.7	1.0	2.0	4.0	5.0	107.0
	Self funding	108	7.8	4.1	2.0	5.0	7.0	11.0	21.0
	External funding	354	4.8	6.3	1.0	2.0	4.0	6.0	107.0
	Mixed funding	1,972	4.6	7.1	1.0	2.0	4.0	5.0	172.0

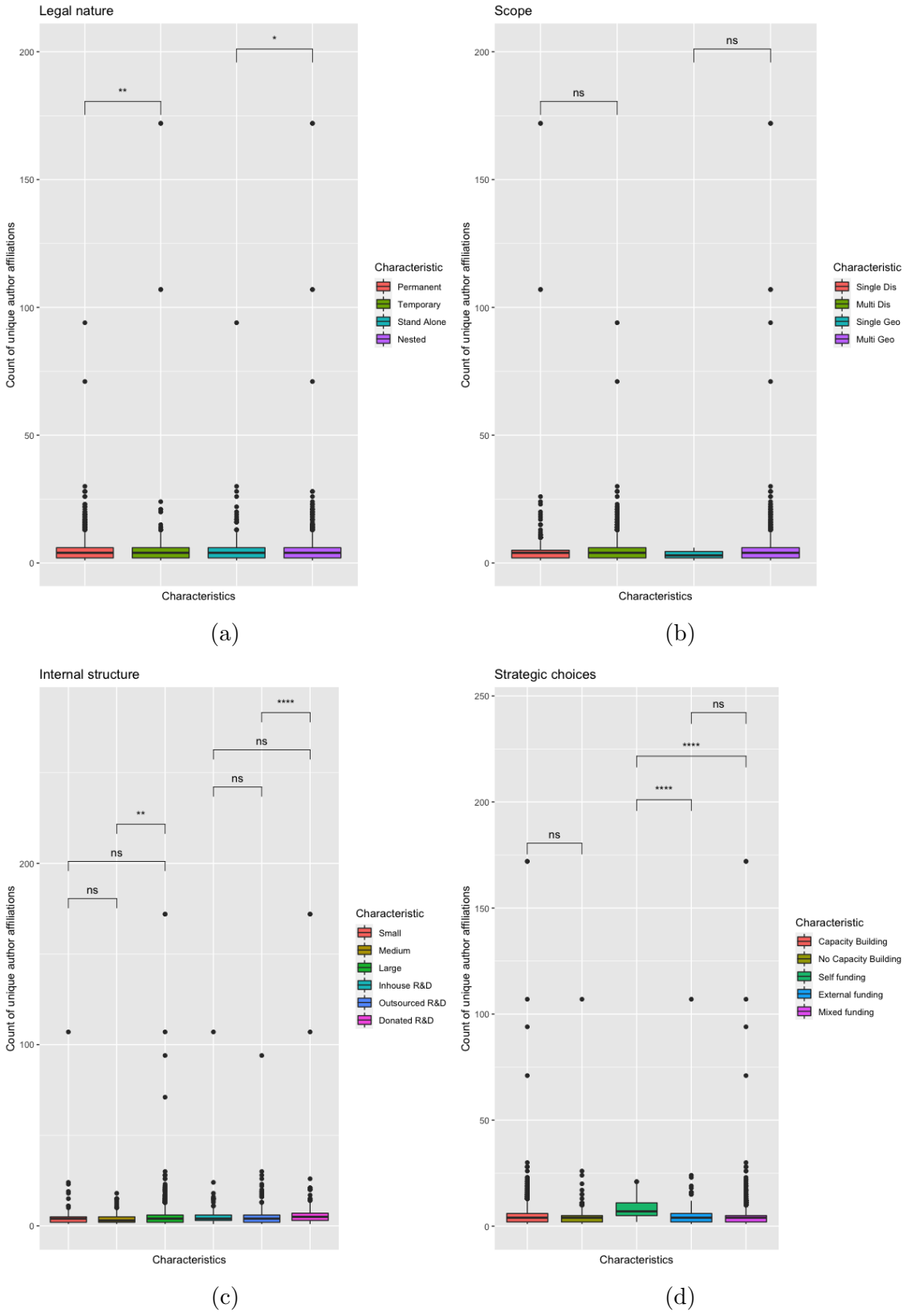


Figure 4.2: Organizational diversity of author affiliations grouped per PPP characteristic

Funders

For the funding agencies more significant differences are observed compared to the author affiliations. Regarding the domain legal nature, the observations for the funding agencies are exactly opposite from the observations of the author affiliations. Here, publications of PPPs that are permanent (instead of temporary) and nested (instead of stand alone) have a higher organizational diversity. Within scope, where the author affiliations included no significant differences, the funders of publications of PPPs with a single (compared to multiple) disease focus have a higher organizational diversity. For the domain internal structure and regarding the network size, the observations are more straightforward for the funders than for the author affiliations. Here, publications of PPPs with a large (compared to medium) network and a medium (compared to small) network include funding agencies with a significantly higher organizational diversity. The observations of the R&D characteristics are identical to those of the author affiliations, where publications from PPPs with donated (compared to outsourced) R&D, and self (compared to external- or mixed) funding include funders with higher organizational diversity. Within strategic choices, the observations are identical to those of the author affiliations. Funders of publications from PPPs that receive self (compared to external- and mixed) funding have a higher organizational diversity. However, where no significant differences were observed between the author affiliations, the funding agencies of publications from PPPs that do contain capacity building (compared to those that don't) have a higher organizational diversity.

In the next paragraph the institutional diversity values, which were also obtained for both the author affiliations as well as the funding agencies of the PPP publications, are presented and discussed.

Table 4.10: Descriptive statistics of organizational count for funders

Statistic	Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	temporary	409	3.1	5.6	1.0	1.0	2.0	3.0	74.0
	Permanent	2,097	3.2	2.6	1.0	1.0	2.0	4.0	23.0
	Nested	1,924	3.2	3.4	1.0	1.0	2.0	4.0	74.0
	Stand alone	582	3.1	2.9	1.0	1.0	2.0	4.0	22.0
Scope	Single disease	477	3.2	5.5	1.0	1.0	2.0	4.0	74.0
	Multiple diseases	2,029	3.2	2.5	1.0	1.0	2.0	4.0	23.0
	Single area	3	4.0	0.0	4.0	4.0	4.0	4.0	4.0
	Multiple areas	2,503	3.2	3.3	1.0	1.0	2.0	4.0	74.0
Internal structure	Small network	163	1.9	2.7	1.0	1.0	1.0	2.0	32.0
	Medium network	194	3.2	2.0	1.0	2.0	3.0	4.0	13.0
	Large network	2,149	3.3	3.4	1.0	1.0	2.0	4.0	74.0
	Inhouse R&D	213	3.0	2.8	1.0	1.0	2.0	4.0	32.0
	Outsourced R&D	598	3.1	2.7	1.0	1.0	2.0	4.0	17.0
	Donated R&D	386	3.4	5.9	1.0	1.0	2.0	4.0	74.0
Strategic choices	Capacity building	2,208	3.2	3.3	1.0	1.0	2.0	4.0	74.0
	No capacity building	297	2.8	3.3	1.0	1.0	1.0	3.0	32.0
	Self funding	108	4.1	2.9	1.0	2.0	4.0	5.0	22.0
	External funding	354	2.8	2.5	1.0	1.0	2.0	3.0	32.0
	Mixed funding	1,972	3.2	3.4	1.0	1.0	2.0	4.0	74.0

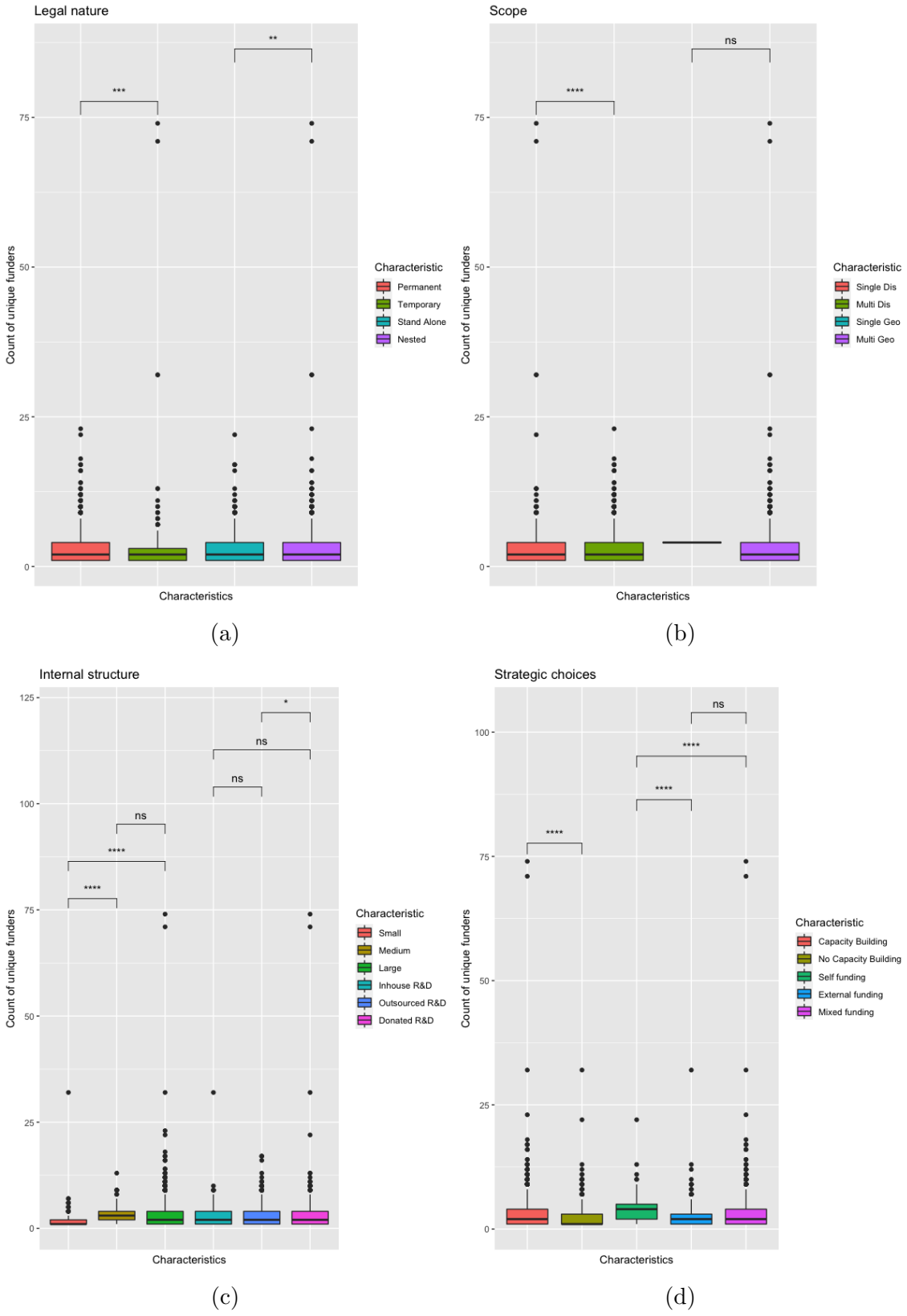


Figure 4.3: Organizational diversity of funders grouped per PPP characteristic

4.2.3 Institutional dimension

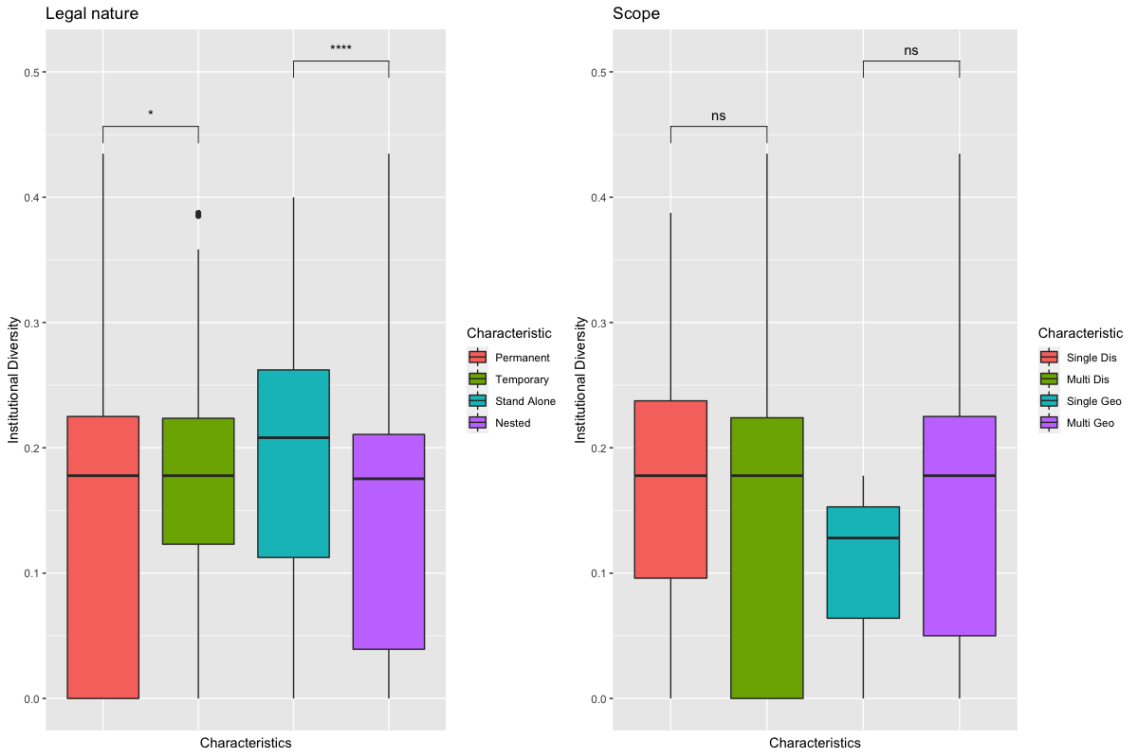
Akin to the organizational dimension, the institutional dimension is split into two parts: the author affiliations and the funders. Table 4.11 and figure **??** relate to the institutional diversity of the author affiliations, which are discussed first. Table 4.12 and figure 4.5 relate to the institutional diversity of the funders. For both **??** and 4.5, plot (a) relates to the legal nature domain, plot (b) to the scope, plot (c) to the internal structure and plot (d) to the strategic choices

Author Affiliations

Within legal nature, publications from PPPs which are of a temporal durability (compared to being permanent) and are stand alone (compared to nested) include author affiliations with a significantly higher institutional diversity. For the domain scope no significant differences are observed. As for the internal structure, publications from PPPs that conduct inhouse (compared to outsourced- or donated) R&D, encompass author affiliations with a higher institutional diversity. Regarding the strategic choices, author affiliations of publications from PPPs that include no capacity building activities (compared to those that do) and receive self- or external (compared to mixed) funding, have a higher institutional diversity.

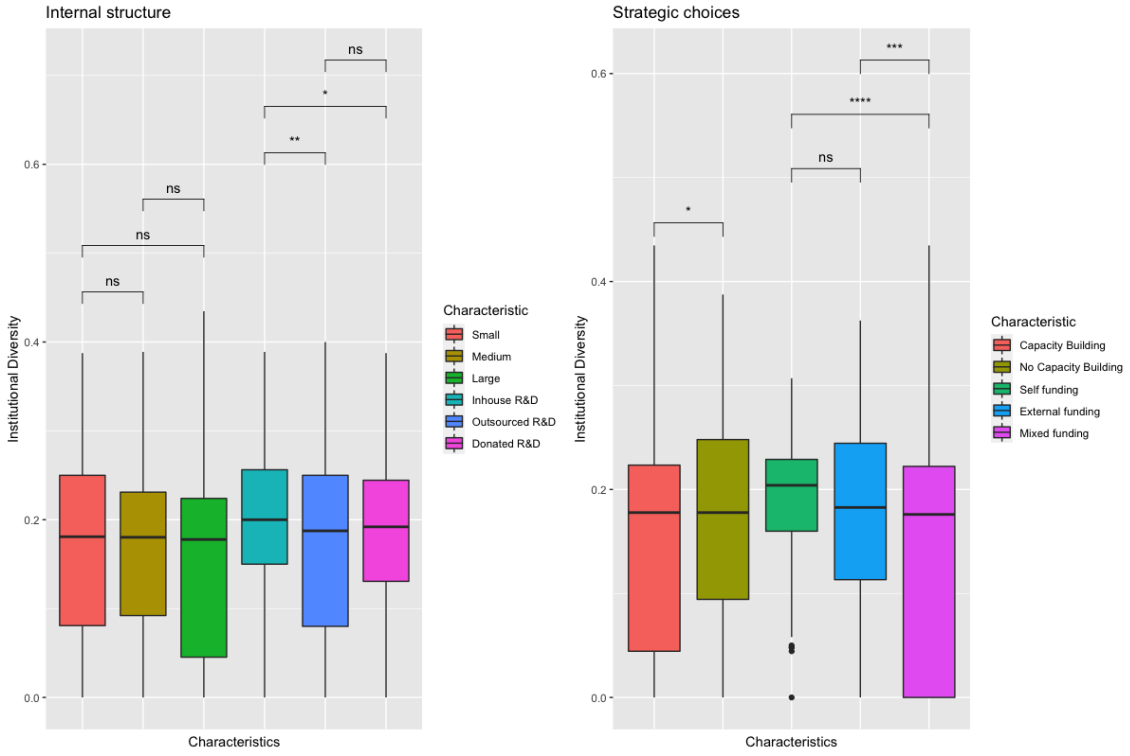
Table 4.11: Descriptive statistics of the institutional diversity of author affiliations

Domain	Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	Permanent	2,086	0.150	0.104	0.000	0.000	0.178	0.225	0.435
	Temporary	390	0.165	0.092	0.000	0.123	0.178	0.224	0.388
	Stand alone	574	0.178	0.109	0.000	0.112	0.208	0.262	0.400
	Nested	1,902	0.144	0.099	0.000	0.039	0.175	0.211	0.435
Scope	Single disease	458	0.162	0.097	0.000	0.096	0.178	0.238	0.388
	Multiple diseases	2,018	0.150	0.103	0.000	0.000	0.178	0.224	0.435
	Single area	3	0.102	0.092	0.000	0.064	0.128	0.153	0.178
	Multiple areas	2,473	0.152	0.102	0.000	0.050	0.178	0.225	0.435
Internal structure	Small network	144	0.165	0.109	0.000	0.081	0.181	0.250	0.388
	Medium network	194	0.164	0.103	0.000	0.092	0.180	0.231	0.389
	Large network	2,138	0.150	0.101	0.000	0.045	0.178	0.224	0.435
	Inhouse R&D	213	0.194	0.097	0.000	0.150	0.200	0.256	0.389
	Outsourced R&D	590	0.165	0.108	0.000	0.080	0.188	0.250	0.400
	Donated R&D	367	0.175	0.091	0.000	0.131	0.192	0.244	0.388
Strategic choices	Capacity building	2,197	0.151	0.102	0.000	0.044	0.178	0.223	0.435
	No capacity building	278	0.164	0.100	0.000	0.094	0.178	0.248	0.388
	Self funding	108	0.191	0.059	0.000	0.160	0.204	0.229	0.307
	External funding	347	0.170	0.098	0.000	0.113	0.183	0.244	0.363
	Mixed funding	1,949	0.145	0.103	0.000	0.000	0.176	0.222	0.435



(a)

(b)



(c)

(d)

Figure 4.4: Institutional diversity of author affiliations grouped per PPP characteristic

Funders

The observations regarding the institutional diversity of funding agencies are noticeably different to those of the author affiliations. Within the legal domain, the funders of publications from PPPs that are nested, instead of stand alone actually display a significantly higher institutional diversity. The only domain that portrays similar results to the author affiliations is scope, where no significant differences are observed. As for the internal structure, where the author affiliations displayed no differences between the network sizes, publications from PPPs with a medium (compared to small or large) network and a large (compared to a small) network include funders with significantly higher institutional diversity. For the R&D characteristics it is publications from PPPs with outsourced (compared to inhouse- or donated) R&D, that comprise the institutionally most diverse funders. All characteristics within the domain strategic choices portray significant differences. Here, the funders of publications from PPPs that undertake capacity building (compared to those that do not) display a significantly higher institutional diversity. This is exactly opposite to the observations from the author affiliations. Regarding the funding mode, it is the publications from PPPs with self or mixed (compared to external) funding that portray significantly higher diversity values.

The next paragraph will illustrate the cognitive diversity values of the PPP publications and discuss any relevant findings.

Table 4.12: Descriptive statistics of the institutional diversity of funders

Domain	Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	Permanent	1,867	0.128	0.096	0.000	0.000	0.150	0.200	0.350
	Temporary	298	0.134	0.089	0.000	0.048	0.162	0.200	0.344
	Stand alone	443	0.120	0.098	0.000	0.000	0.133	0.200	0.347
	Nested	1,722	0.131	0.094	0.000	0.000	0.150	0.200	0.350
Scope	Single disease	335	0.122	0.087	0.000	0.044	0.133	0.182	0.344
	Multiple diseases	1,830	0.130	0.097	0.000	0.000	0.150	0.200	0.350
	Single area	3	0.203	0.138	0.044	0.154	0.264	0.282	0.300
	Multiple areas	2,162	0.129	0.095	0.000	0.000	0.150	0.200	0.350
Internal structure	Small network	61	0.091	0.087	0.000	0.000	0.050	0.150	0.300
	Medium network	189	0.162	0.082	0.000	0.128	0.178	0.200	0.344
	Large network	1,915	0.127	0.096	0.000	0.000	0.150	0.200	0.350
	Inhouse R&D	184	0.101	0.094	0.000	0.000	0.050	0.179	0.289
	Outsourced R&D	477	0.140	0.094	0.000	0.044	0.150	0.200	0.347
	Donated R&D	253	0.116	0.087	0.000	0.032	0.128	0.189	0.273
Strategic choices	Capacity building	2,000	0.132	0.096	0.000	0.000	0.150	0.200	0.350
	No capacity building	164	0.096	0.079	0.000	0.041	0.095	0.150	0.289
	Self funding	105	0.153	0.082	0.000	0.109	0.188	0.216	0.267
	External funding	301	0.112	0.091	0.000	0.000	0.128	0.178	0.344
	Mixed funding	1,692	0.129	0.096	0.000	0.000	0.150	0.200	0.350

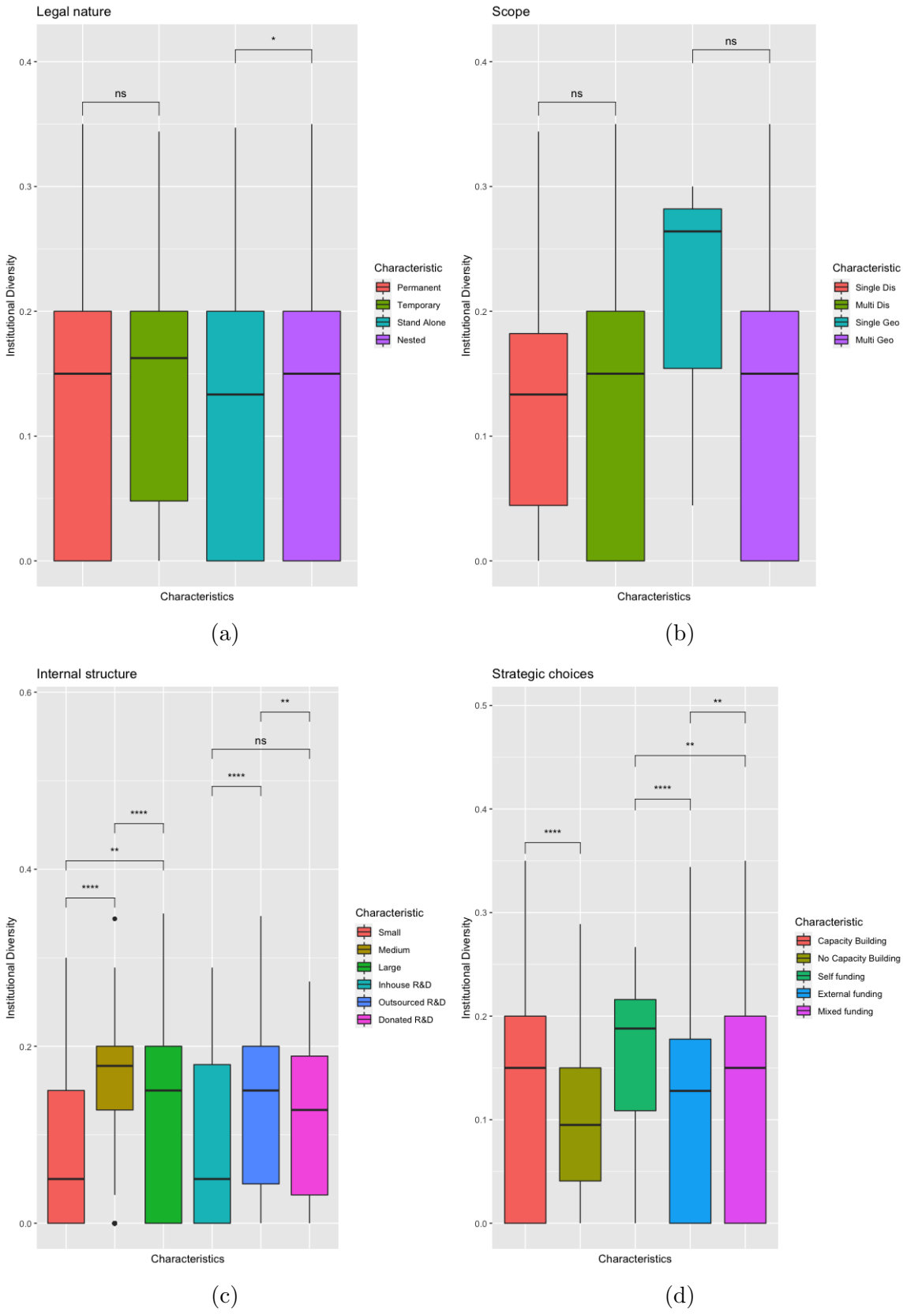


Figure 4.5: Institutional diversity of funders grouped per PPP characteristic

4.2.4 Cognitive dimension

This paragraph presents the diversity of publications within the cognitive dimension. The descriptive statistics are visible in table 4.13 and the boxplots in figure 4.6. In table 4.13 it can be observed that the publications of PPPs have a median of 2 scientific categories per publication for almost all the different PPP characteristics. The only exception is 'self funding' with a median of one scientific category per publication. Within three of the domains a significant difference is observed. For the domain legal nature, the publications of PPPs that are stand alone (compared to nested) include a higher cognitive diversity. The domain scope does not display significant differences. Regarding the internal structure, publications from PPPs with outsourced (compared to inhouse or donated) R&D include a significantly higher cognitive diversity. Lastly, within strategic choices, a significantly higher cognitive diversity is observed for publications from PPPs which receive external (instead of self-) funding.

In the next paragraph the research publications, grouped according to the individual PPPs, are presented with their corresponding diversity values.

Table 4.13: Descriptive statistics of scientific category count

Domain	Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Legal nature	Permanent	2,097	1.9	0.9	1.0	1.0	2.0	3.0	5.0
	Temporary	409	1.8	0.8	1.0	1.0	2.0	3.0	3.0
	Stand alone	582	2.0	0.9	1.0	1.0	2.0	3.0	5.0
	Nested	1,924	1.8	0.8	1.0	1.0	2.0	3.0	5.0
Scope	Single disease	477	1.9	0.8	1.0	1.0	2.0	3.0	3.0
	Multiple diseases	2,029	1.9	0.9	1.0	1.0	2.0	3.0	5.0
	Single are	3	2.0	1.0	1.0	1.5	2.0	2.5	3.0
	Multiple areas	2,503	1.9	0.8	1.0	1.0	2.0	3.0	5.0
Internal structure	Small network	163	1.9	0.7	1.0	1.0	2.0	2.0	3.0
	Medium network	194	1.8	0.9	1.0	1.0	2.0	3.0	3.0
	Large network	2,149	1.9	0.9	1.0	1.0	2.0	3.0	5.0
	Inhouse R&D	213	1.8	0.8	1.0	1.0	2.0	2.0	3.0
	Outsourced R&D	598	2.0	0.9	1.0	1.0	2.0	3.0	5.0
	Donated R&D	386	1.8	0.8	1.0	1.0	2.0	2.8	3.0
Strategic choices	Capacity building	2,208	1.9	0.9	1.0	1.0	2.0	3.0	5.0
	No capacity building	297	1.9	0.8	1.0	1.0	2.0	3.0	3.0
	Self funding	108	1.7	0.8	1.0	1.0	1.0	3.0	3.0
	External funding	354	2.0	0.9	1.0	1.0	2.0	3.0	4.0
	Mixed funding	1,972	1.9	0.8	1.0	1.0	2.0	3.0	5.0

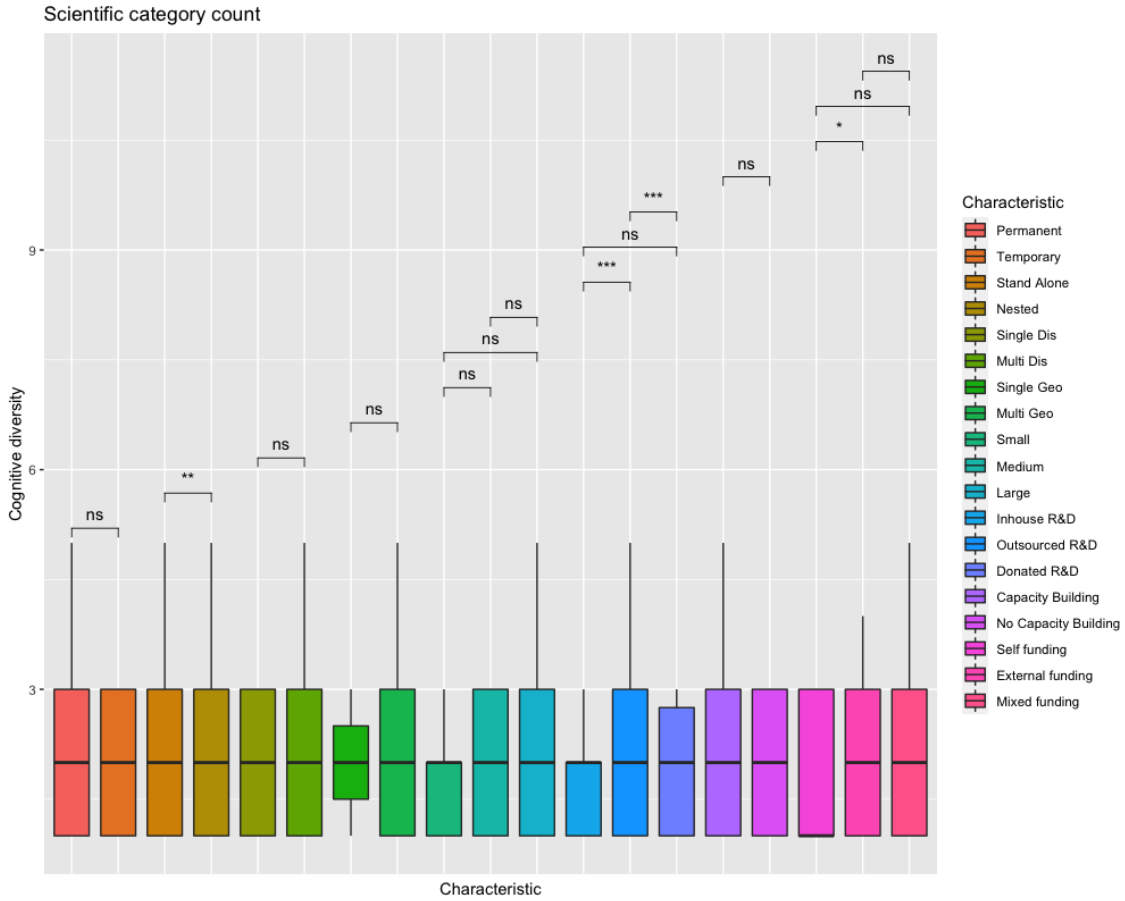


Figure 4.6: Cognitive diversity of publications grouped per PPP characteristic

4.3 Diversities of publications per public-private partnership

This paragraph presents the diversity values attributed to the research publications of the individual PPPs. Figure 4.7 (a) displays the geographical- and (b) the cognitive diversity. Additionally, figure 4.8 exhibits the organizational- and figure 4.9 the institutional diversity of the publications per PPP. First the results from the geographical dimension are discussed, followed by the findings from the organizational-, institutional- and lastly cognitive dimension.

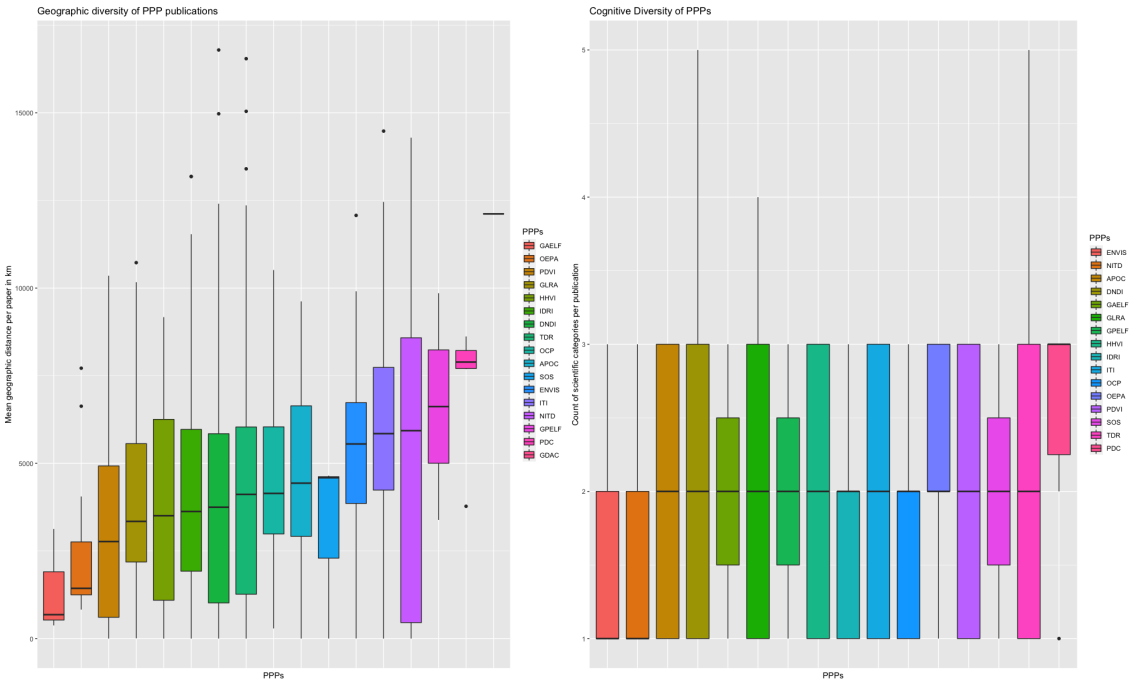
For the geographical dimension, the average median geographic diversity of all PPPs is 4123 km. In figure 4.7 (a) it can be seen that the three highest median values derive from GDAC, PDC and NITD, with values of 12117, 7889 and 5931 km, respectively. The lowest values are displayed by OEPA and GAELF, with 1433 and 681 km.

Regarding the organizational dimension, the average median value is four author affiliations and three funding agencies per publication. Generally, the networks of author affiliations display higher levels of diversity than the networks of funding agencies. Figure 4.8 (a) displays the organizational diversity of the author affiliations where the highest median values originate from PDC (14.5), GPELF (11) and ENVIS (8). The lowest median values can be attributed to SOS, PDVI, NITD, which all include 3 author affiliations per publication. The PPPs with the highest median of funders, displayed in 4.8 (b), are GAELF and OEPA with 5 funding agencies per publication. GDAC, GPELF and OCP only include a median of one funder and therefore have the lowest organizational diversity.

As to the institutional diversity, the average median of all PPPs is 0.178 for the author affiliations and 0.15 for the funding agencies. For this dimension it is also true that the author affiliations display higher levels of diversity than the networks of funding agencies. Figure 4.9 (a) displays how GDAC, OEPA and PDC have the highest median diversity of author affiliations, namely of 0.320, 0.259 and 0.253 respectively. The lowest are seen in SOS (0.1), HHVI (0.159) and ITI (0.160). Looking at the funders in 4.9 (b), the highest median values are from SOS (0.264), PDC (0.2) and ENVIS (0.188). GDAC and GPELF have the lowest median institutional diversity of funders with values zero.

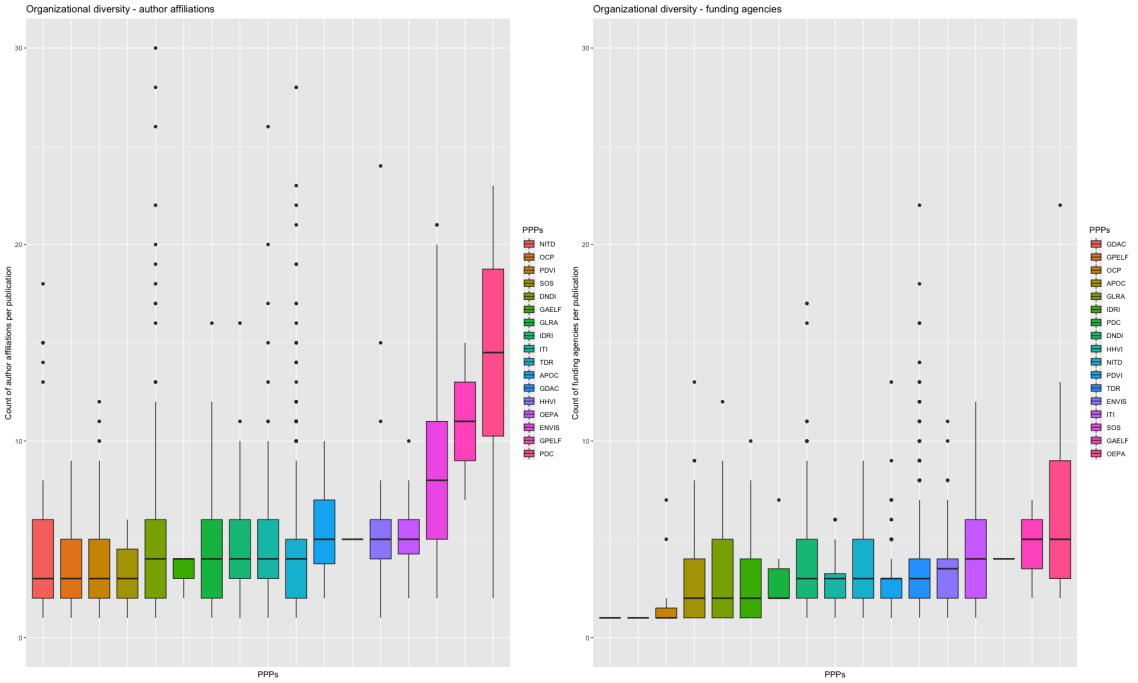
For the cognitive diversity in 4.7 (b), almost all PPPs contain a cognitive diversity of two scientific categories per publication, which is also consequently the overall median value. The only PPPs that stand out are PDC & GDAC with a median of three and NITD & ENVIS with a median of one scientific category per publication.

In the next paragraph the PPPs will be ranked according to their publications' mean diversity values. The mean value of these ranks will be used to create a total diversity rank. Additionally, potential associations between the total diversity ranks and the different PPP characteristics will be investigated.



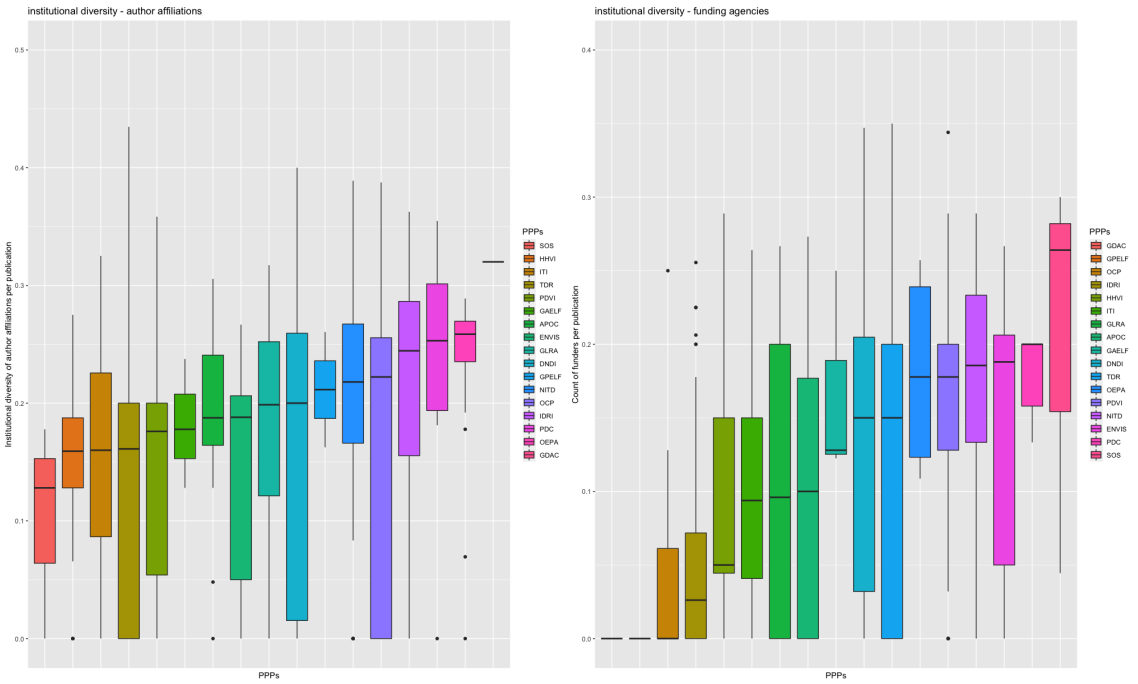
(a) (b)

Figure 4.7: Geographic and cognitive diversity of publications grouped per PPP



(a) (b)

Figure 4.8: Organizational diversity of publications grouped per PPP



(a) (b)

Figure 4.9: Institutional diversity of publications grouped per PPP

4.4 Total diversity rankings

In this paragraph the PPPs are ranked according to the median diversity values of their publications. For all the dimension it applies: the higher the diversity, the higher the rank. As there are a total number of 17 PPPs that include at least one research publication, the best total diversity rank is 17. Table 4.14 displays the median diversity values and corresponding ranks of the PPPs for all four dimensions, as well as their total diversity rank.

Looking at the total diversity in table 4.14, PDC is awarded the highest rank (14.3) and OCP the lowest (6.25). Regression analyses were carried out to further analyze the total diversity rankings and identify potential associations between them and the PPP characteristics.

Table 4.14: Ranking of PPPs according to the median diversities of their publications

PPP	Geographic diversity	Rank	Organizational diversity author affiliations	Rank	Organizational diversity funding agencies	Rank	Institutional diversity author affiliations	Rank	Institutional diversity funding agencies	Rank	Cognitive diversity	Rank	Total diversity rank
PDC	7889.4	16	14.5	17	2	5.5	0.253	15	0.2	16.0	3	16.5	14.333
OEPA	1433.1	2	5	12.5	5	16.5	0.259	16	0.178	12.5	2	9	11.417
GDAC	12116.6	17	5	12.5	1	2	0.32	17	0	2.0	3	16.5	11.167
ENVIS	5552.3	12	8	15	3.5	13	0.188	8	0.188	15.0	1	1.5	10.75
SOS	4588.8	11	3	2.5	4	14.5	0.128	1	0.264	17.0	2	9	9.167
GPELF	6619.1	15	11	16	1	2	0.211	11	0	2.0	2	9	9.167
NITD	5931.6	14	3	2.5	3	10	0.218	12	0.186	14.0	1	1.5	9
DNDI	3747.7	7	4	7.5	3	10	0.2	10	0.15	10.5	2	9	9
ITI	5846.8	13	4	7.5	4	14.5	0.160	3	0.094	6.0	2	9	8.833
APOC	4434.3	10	5	12.5	2	5.5	0.188	7	0.1	8.0	2	9	8.667
GAELF	681.9	1	4	7.5	5	16.5	0.178	6	0.128	9.0	2	9	8.167
TDR	4113.5	8	4	7.5	3	10	0.161	4	0.15	10.5	2	9	8.167
IDRI	3625.8	6	4	7.5	2	5.5	0.244	14	0.026	4.0	2	9	7.667
HHVI	3505.2	5	5	12.5	3	10	0.159	2	0.05	5.0	2	9	7.25
GLRA	3343.3	4	4	7.5	2	5.5	0.199	9	0.096	7.0	2	9	7
PDVI	2768.2	3	3	2.5	3	10	0.176	5	0.178	12.5	2	9	7
OCP	4142.1	9	3	2.5	1	2	0.222	13	0	2.0	2	9	6.25

In table 4.15 the results from the regression analyses are displayed. Here none of the results portray significant associations. This paragraph will only highlight the positive associations. The remaining characteristics therefore possess a negative association with the total diversity value. Within the legal domain, PPPs that are permanent and nested have a positive association with the dependent variable. Looking at the scope, the only characteristics which maintains a positive association with the total diversity is the multiple diseases focus. For the internal structure, PPPs with a small or large network and which contain outsourced or donated R&D have positive associations with the total diversity value. Regarding the strategic choices, PPPs that include capacity building activities have a positive association with the total diversity. The most prominent result is the noticeably high positive association self funding maintains with the dependent variable, compared to the other two funding modes. However, as previously stated, none of the results are significant.

Table 4.15: Ordinal logit regressions analyses between the total diversity ranking and the PPP characteristics

Domain	Variable	PPP characteristic	Coefficient (standard errors)	Odds Ratios
Legal nature	Durability	Temporary	-1.307 (0.7474)	0.2706494
		Permanent	1.307 (0.7474)	3.694817
	Autonomy	Nested	0.3252 (0.6593)	1.384305
		Stand Alone	-0.3252 (0.6593)	0.7223839
Scope	Disease focus	Single Disease	-0.2229 (0.6194)	0.800226
		Multiple Diseases	0.2229 (0.6194)	1.249647
	Geographic focus	Single Area	0.7153 (1.082)	0.8447519
		Multiple Areas	-0.7153 (1.082)	0.4890357
Internal structure	Network size	Small network	0.4367 (0.763)	1.547577
		Medium network	-0.707 (0.9331)	0.4931405
		Large network	0.03526 (0.6512)	1.035891
	R&D	Inhouse R&D	-0.5733 (0.7454)	0.5636603
		Outsourced R&D	0.2589 (0.7417)	1.295524
		Donated	0.2376 (0.6495)	1.268246
Strategic choices	Capacity building activities	Capacity building	0.5958 (0.776)	1.814546
		No capacity building	-0.5958 (0.776)	0.551102
	Funding mode	Self funding	2.338 (1.147)	10.35924
		External funding	-0.7256 (0.7319)	0.4840342
		Mixed funding	-0.2998 (0.6759)	0.7409823

*significant at 0.05 level; ** significant at 0.01 level; *** significant at 0.001 level

Chapter 5

Conclusions

This chapter presents the conclusions that follow from the results summarized in table 5.1. The goal of this research has been to analyze "how the heterogeneous characteristics of public-private partnerships, in the field of neglected tropical diseases, influence their research portfolios in general and the collaborative research networks in particular". Associations between the PPPs' characteristics and publication counts were analyzed. Additionally, associations were analyzed between the PPPs' characteristics and the levels of diversity within the publications, specifically within the collaborative research networks. This chapter will discuss the most important findings that stem from this research.

First, from the analysis in 4.1 it can be concluded that the characteristics of focusing on multiple diseases, conducting no capacity building activities and receiving mixed funding are associated with higher publication counts.

Second, regarding the distribution of the significant associations, the highest amount can be detected within the domains of legal nature and strategic choices. "Scope" displays the least amount of significant associations. This is mainly due to the geographic focus not portraying any effects, meaning that limiting the geographic focus does not automatically indicate a significant decrease in diversity. From all the characteristics it is self-funding that displays the most frequent significant positive associations with higher levels of diversity.

Third, the funding agencies are more frequently affected by the PPP characteristics than the author affiliations. The networks of funders contain roughly 1,5 times as many significant associations with higher levels of diversity. Additionally, multiple contrasting findings can be observed between the funding agencies and author affiliations. PPP characteristics that influence the diversity of the author affiliations frequently do not influence the diversity of funders and vice versa. The only PPP characteristics which generally portray consistent positive associations with higher levels of diversity for both the author affiliations as well as the funding agencies, are self-funding and a large(r) network size.

Fourth, from the results in paragraph 4.2 it can be concluded that PPPs with 1) self-funding and 2) a large(r) network size, compared to mixed- & external funding and smaller networks, generally include publications that display regular significant positive associations with diversity. An observed peculiarity is however that for the funding agencies, PPPs with medium sized networks contain a significantly higher institutional diversity than those with large networks. Although a small network size is never associated with higher diversity values. Furthermore, not having capacity

building activities is also, but to a lesser extent, associated with higher levels of diversity. These findings are not consistent with the results from 4.1. This indicates that PPP characteristics which are associated with higher levels of diversity are not necessarily associated with a higher publication count. Only the characteristic of not including capacity building activities is both associated with a higher publication count as well as with higher levels of diversity in certain areas.

To conclude, the heterogeneous characteristics of public-private partnerships in the field of neglected tropical diseases affect their research portfolios in general by translating this heterogeneity into their research portfolios, where the characteristics that positively influence the diversity of the research portfolios predominantly do not influence the publication count. The collaborative research networks are most significantly influenced by the characteristics of 1) a self-funding mode 2) having a large(r) network and to a lesser extent 3) conducting no capacity building activities. These three characteristics were associated with higher levels of diversity. Additionally, characteristics that influence the networks of author affiliations for the most part do not influence the networks of funding agencies and vice versa, where the funding agencies are more frequently affected by the characteristics than the networks of author affiliations.

Table 5.1: Complete overview of results

Domain	Variable	PPP characteristics	N. papers	Geographic diversity	Organizational diversity		Institutional diversity		Cognitive diversity	Total diversity
				Affiliations	Funders	Affiliations	Funders			
Legal nature	Durability	Temporary - Permanent	ns	ns	Temporary**	Permanent***	Temporary*	ns	ns	ns
	Autonomy	Stand Alone - Nested	ns	Nested**	Stand Alone*	Nested**	Stand Alone****	Nested*	Stand Alone**	ns
Scope	Disease focus	Single Disease - Multiple Diseases	Multiple diseases**	Single Disease*	ns	Single Disease****	ns	ns	ns	ns
	Geographic focus	Single Area - Multiple Areas	ns	ns	ns	ns	ns	ns	ns	ns
Internal structure	Network size	Small - Medium network	ns	ns	ns	Medium****	ns	Medium****	ns	ns
		Small - Large network	ns	ns	ns	Large****	ns	Large**	ns	ns
		Medium - Large network	ns	ns	Large**	ns	ns	Medium****	ns	ns
	R&D	Inhouse - Outsourced R&D	ns	ns	ns	ns	Inhouse**	Outsourced****	Outsourced***	ns
		Inhouse - Donated R&D	ns	Donated**	ns	ns	Inhouse*	ns	ns	ns
		Outsourced - Donated R&D	ns	Donated****	Donated****	Donated*	ns	Outsourced**	Outsourced***	ns
Strategic choices	Capacity building activities	Capacity - No Capacity building	NCB*	NCB****	ns	CB****	NCB*	CB****	ns	ns
	Funding mode	Self - External funding	ns	Self funding****	Self funding****	Self funding****	ns	Self funding****	External funding*	ns
		Self - Mixed funding	Mixed funding*	Self funding**	Self funding****	Self funding****	Self funding****	Self funding**	ns	ns
		External - Mixed funding	Mixed funding*	Mixed funding**	ns	ns	External funding***	Mixed**	ns	ns

Chapter 6

Discussion

In this chapter the theoretical implications of the findings, their relevance and possible avenues for future research are discussed. This is followed by the limitations of the methods and results.

The conclusions from this research include multiple implications for literature on PPPs as well as for the actors involved in a PPP construction. The results have demonstrated that heterogeneity is not solely present in the PPP characteristics, but also within their research portfolios. Actors that are part of a PPP construction should therefore be aware that their organizational structure can affect the structure of their R&D activities. This is especially true for the networks of funders, as they are most frequently affected. Furthermore, the results indicate that increasing the levels of diversity within collaborative research networks largely calls for a different strategy than when aiming to increase the publication count.

In case the aim is to solely increase the publication count, the results suggests navigating towards a broad(er) disease scope and a mixed funding mode as well as ceasing to conduct capacity building. Regarding the first, the positive influence of focusing on multiple diseases could be explained as a broader disease scope maximises the research investments with cross-disease benefits (Beyeler et al., 2019). Second, mixed funding might display this effect as it expands the financial resources by both gathering them from internal as well as external sources, consequently expanding the financial resources available for research activity. However, future research into the different funding modes of PPPs is needed to investigate if mixed funding indeed results in more financial resources compared to the other two modes. Third, the effect of no capacity building activities could be explained by the majority of these PPPs being specialized in drug development and conducting their R&D inhouse. However, as inhouse R&D does not portray significant positive associations with the publication count, it might caused by other factors. Overall, the results can not yet be explained by secondary literature. Further research is needed for gaining in-depth knowledge into why including capacity buildings activities negatively influences the publication count.

Although the results indicate that having no capacity building activities is associated with a higher publication count, researchers in the field of PPPs have stressed the importance of the development of research capacity within- and the engagement of scientists and institutions from developing countries for long-term sustainability of drug R&D for NTDs (Jomo et al., 2016; Muñoz et al., 2015; Nwaka & Ridley, 2003; Pratt & Loff, 2013). Interestingly, next to influencing the publication count,

not having capacity building is also associated with a higher geographical diversity. This result contradicts the assumption that PPPs which include capacity building would have a higher geographic diversity as they might share more engagement with actors from disease endemic countries. Unfortunately, the results are limited in that they cannot exhibit the ratio between actors from developed and actors from developing countries. Such knowledge could help identify if PPPs without capacity building perhaps include relatively more actors from endemic countries, thereby actually building capacity by way of sharing and transferring knowledge, or if this geographic diversity is due to the inclusion of distant researchers from other developed countries.

If the actors in a PPP aim to increase the levels of diversity within their research portfolio, the results from this research suggest a navigation towards a self-funding mode and to increase their network. First, the reason for why self-funding is associated with higher levels of diversity may be due to these PPPs including a more collaborators. This is demonstrated in the results from the organizational dimension on page 44 & 46. The larger number of research collaborators might have been necessary to assemble sufficient resources and capacity. These PPPs lack external financial resources and therefore might be more dependent on the resources of their research collaborators. The higher number of research collaborators might also be related to the positive effect that a large(r) network maintains. PPP literature is not yet able to shed light on the reasons behind these observations. Future research could investigate the funding modes of PPPs in order to identify the reasons why self-funded PPPs include more, as well as more diverse, actors and funders within their collaborative research networks. Such research can also be extended by identifying the ratio of public and private financial resources a PPP receives and if this ratio perhaps differs between funding modes. Additionally, future research could investigate to what extent, and potentially why, the effects of a large(r) network and the self-funding mode are related.

Overall, the findings of this research benefit the scientific literature on PPPs in the field of NTDs as it discloses the different characteristics these PPPs include. Furthermore, this research has heeded the call of scientist for evaluating the influence the heterogeneous characteristics of PPPs hold on their performance, by analyzing their effect on the research portfolios of PPPs. Therefore it provides an insightful initial illustration of these influences, which can be further explored by future research endeavours and can aid the potential further optimization of the PPP framework. The improvement of the PPP framework could ultimately benefit the discovery, development and implementation of treatments for NTDs and assist in realizing goal 3 of the Sustainable Development Goals.

This research expands upon the DARE approach by translating its methods to allow for a large-scale analysis. Furthermore, it adds to the scientific literature on RPA by giving a case example of its application to a novel field. As RPA literature has stressed the importance of a multi-dimensional analysis and of diversity when dealing with complex problems, this research has complied by being the first to perform a multi-dimensional analysis that combines RPA with elements of the DARE approach for evaluating the levels of diversity in collaborative research networks. However, it has been doubted if diversity is in all cases beneficial. Wallace & Rafols (2015) signify that high levels of specialization in the cognitive dimension, and thus low diversity, may present advantages for increasing collaboration and developing

transferable techniques or technologies (Wallace & Rafols, 2015). The results from this research illustrate that most research publications of PPPs include two scientific categories. In order to know if this result actually indicates cognitive proximity, further research would be needed to determine to what extent these categories are in fact similar. However, as these publications are all largely focused on drug development, it can be assumed that they mostly involve actors from the same specialized field. Furthermore, this research further adds to literature on RPA by presenting the result that levels of diversity most frequently differ within the collaborative networks of funders. This observation might be explained by funding agencies being inherently more diverse than author affiliations, as funding can be awarded by every type of organization. However, further research endeavours are needed to investigate if this result is also present in other fields or exclusive to PPPs in the field of NTDs.

As this is the first research to analyze associations between the PPP characteristics and research portfolios employing an exploratory and large-scale quantitative approach, it succeeds in giving an initial illustration of how the differences in PPP characteristics affect their performance. However, the need of future research is crucial for confirming and further understanding the acquired results. This is even more true as the methods and results face multiple limitations. The internal validity of this research is largely compromised as it present associations between the variables and can not, nor aims to conclude any causal effects. Efforts have been undertaken to improve the internal validity by selecting statistical models based on the best model fit and by controlling for the effect of variables which impacted the regression outcomes.

The external validity of the results is compromised as all publications were retrieved from Web of Science. Thereby this research excluded potential PPP publications from other sources. However, the publications that were acquired still give a good approximation of PPPs' research portfolios in the field of NTDs and future research could benefit improve upon the method by adding publications multiple sources. Furthermore, during the construction of the institutional diversity values, a small percentage of the data entries was excluded from the analysis. This was due to those entries not being picked up by the keywords that were used to extract the institutional types. As a result, the institutional dimension does not provide a complete representation of the actual data. However, efforts have been undertaken to limit the excluded entries, which now only constitute 1,49 percent of the total entries. Furthermore, investigations were conducted to validate that these missing entries only included unique or incoherent values, which could not significantly alter the values for the institutional diversity.

The construct validity is limited as the number of staff couldn't be retraced and therefore the network size was used as a measure. Although the network size does not portray a PPP's capacity in human resources, it does give an interesting illustration of the extent of their collaborative network. As the collaborative networks are considered the most prominent characteristic as well as advantage of the PPPs, characterizing PPPs by the extent of their network instead of staff size can also be argued to be more fitting. Furthermore, future research can improve upon the construct validity by investigating other methods for analyzing the cognitive dimension of a research publication. The approach used in this research, although insightful, is limited in the knowledge it can award on the cognitive proximity as well as the cognitive diversity of the research.

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Appendix A

WHO list of neglected tropical diseases

("Neglected tropical diseases", 2020)

- Buruli ulcer
- Chagas disease
- Dengue and Chikungunya
- Dracunculiasis (guinea-worm disease)
- Echinococcosis
- Foodborne trematodiases
- Human African trypanosomiasis (sleeping sickness)
- Leishmaniasis
- Leprosy (Hansen's disease)
- Lymphatic filariasis
- Mycetoma, chromoblastomycosis and other deep mycoses
- Onchocerciasis (river blindness)
- Rabies
- Scabies and other ectoparasites
- Schistosomiasis
- Soil-transmitted helminthiases
- Snakebite envenoming
- Taeniasis/Cysticercosis
- Trachoma
- Yaws (Endemic treponematoses)

Appendix B

List of public-private partnerships

Table B.1: Overview of public-private partnerships (Aerts et al., 2017 p.749)

Partnership(s) or Organization leading the partnership
WIPO Re:Search consortium
Drugs for Neglected Diseases Initiative (DNDi)
Novartis Institute of Tropical Disease (NITD)
The Pediatric Dengue Vaccine Initiative (PDVI)
The Dengue Prevention Program PHYTOCHIK
Stamp Out Sleeping Sickness (SOS)
HAT control program
The Special Program for Research and Training in Tropical Disease (TDR)
The Infectious Disease Research Institute (IDRI)
The German Leprosy Relief Association (GLRA)
The Global Program to Eliminate Lymphatic Filariasis (GPELF)
The Global Alliance for Elimination of Lymphatic Filariasis (GAELF)
The African Program for Onchocerciasis Control (APOC)
The Onchocerciasis Control Program (OCP)
The Onchocerciasis Elimination Program for the Americas (OEPA)
The Sabin Vaccine Institute with the New York Blood Center
TOVA (The Onchocerciasis Vaccine for Africa)
Institut Pasteur in Lille
The Sabin Vaccine Institute and the Oswaldo Cruz Foundation (FIOCRUZ)
The Sabin Vaccine Institute with Baylor College of Medicine
The Regional Network for Asian Schistosomiasis (RNAS)
The Human Hookworm Initiative (HHVI)
The International Trachoma Initiative (ITI)

Appendix C

Consideration of excluded PPPs

Table C.1: Exclusion of additional PPPs

PPP	ISGlobal	GAVI Alliance	TB Alliance	Medicines for Malaria Venture (MMV)
Public/private	yes	Yes	Yes	yes
Comment	Public-private	Public-private	product-development	product-development
Focus on NTDs	No	No	No	No
Conclusion	Excluded	Excluded	Excluded	Excluded
Sources	("ISGlobal", n.d.)	("GAVI Alliance", 2020)	("About TB Alliance", n.d.)	("MMV", n.d.)

Appendix D

Geocoding script

```
function myFunction() {
  var sheet = SpreadsheetApp.getActiveSheet();

  var range = sheet.getDataRange();
  var cells = range.getValues();

  var latitudes = [];
  var longitudes = [];

  for (var i = 0; i \textless cells.length; i++) {
    var address = cells[i][0];
    var geocoder = Maps.newGeocoder().geocode(address);
    var res = geocoder.results[0];

    var lat = lng = 0;
    if (res) {
      lat = res.geometry.location.lat;
      lng = res.geometry.location.lng;
    }

    latitudes.push([lat]);
    longitudes.push([lng]);
  }

  sheet.getRange('B1')
  .offset(0, 0, latitudes.length)
  .setValues(latitudes);
  sheet.getRange('C1')
  .offset(0, 0, longitudes.length)
  .setValues(longitudes);
}
```

Appendix E

Keywords for extracting institutional types

Keywords used for the institutional diversity

Keywords for Universities

UNIVERSITY, AL ZAEIM AL AZHARI,UNIVERSITIES, UC LONDON, UNIDERP, UFMG, UNIBUND, UPF, OST GRAD INSTITUTE,JABSOM,CAMBRIDGE-AFRICA, WIN NETWORK, BENEFIT, UNSAM, SNIS, UCSD, UNIV., SCHOOL, COLLEGE, BIOMALPAR, NELSON MANDELA, AFRICAN INSTITUTE SCI & TECHNOL, AFRICAN INSTITUTE BIOMED SCI & TECHNOL, UNCPBA,FAC PHARM MONASTIR, ECOLE, SRUC, MMUST, BUNDESWEHR, KNUST, POSTGRAD INSTITUTE, UNAM, ESCOLA NACL, ESCOLA ESTADUAL PAULINA ALUOTTO, GEOSPATIAL HEALTH, KARLSRUHE INSTITUTE TECHNOL, POSTGRADUATE INSTITUTE, KIGALI INSTITUTE SCI & TECHNOL, MANMOHAN MEM INSTITUTE HEALTH SCI, JOINT RESEARCH PROGRAMME, BERLIN INSTITUTE HEALTH, IRYCIS, ST JOHNS INNOVAT CENTER, HIGH INSTITUTE TRAINING & APPL RES, FASEH,, ECK INSTITUTE GLOBAL HEALTH, USTTB, INSTITUTE FED EDUC CIENCIA & TECNOL, CALTECH, CHAVD, FELIX HOUPHOUET BOIGNY, UHAS, ROYAL TROPICAL INSTITUTE, POB 3397, TECHNION, ARDEA, MALARIAGEN, UCLA, AGENCE UNIVERSITAIRE DE LA FRANCOPHONIE, ALL INDIA INSTITUTE MED SCI, SAMUEL FERNANDEZ POLICLIN, AFRICAN INSTITUTESCI & TECHNOL, EHESP, ROCHESTER INSTITUTE TECHNO, GLOBAL OBESITY PREVENTION CENTER, LSTM, AFRICAN INSTITUTE MATH SCI, BANGLADESH INSTITUTE CHILD HEALTH, ESCUELA TECN SALUD, INSTITUTE RESEARCH BIOMED, MLWT MALAWI, AKPS, IVO CARNERI, ROYAL INSTITUTE HEALTH SCI, BEIJING INSTITUTE MICROBIOL & EPIDEMIOL,JNCASR, UNPAD, IMPAACT, UC DAVIS, INSTITUTE AFRICAIN SANTE PUBL, SWISS FED INSTITUTE TECHNOL, JAWAHARLAL INSTITUTE POSTGRAD, CONSERVATOIRE, PAKISTAN INSTITUTE MED SCI, ACADEMICIAN V.I. SHUMAKOV,DIPARTIMENTO SCI & TECNOL FARM, THAILAND GRADUATE INSTITUTE, CASTILLA LA MANCHA SCI & TECHNOL PK, JKUAT, KYOTO INSTITUTE TECHNOL, ESCS, INSTITUTE MARIO GULICH, BIOSCI ASSOCIATES, YALE, THRIVE, TWAS, CENTER ALCOHOL POLICY RESEARCH, BLANTYRE INSTITUTE OF MANAGEMENT,UPCH, MAHATMA GANDHI INSTITUTE MED SCI, INSTITUTE BIOMED, CARACAS, FACULTY AWARD, HFSP, PUCP, COALITION FOR OPERATIONAL RESEARCH,INSTITUTE SUPER TECH MED, MIT,, IHMTIUNL, IHMTUNL , ROYAL INSTITUTE TECHNOL, RED DE ENFERMEDADES TROPICALES, INSTITUTE EFECTIVIDAD CLIN & SANITARIA, TGIST, BUCHS, BURNET INSTITUTE, CAMS, BURKE GLOBAL HEALTH FELLOWSHIP, PRINCETON ENVIRONMENT INSTITUTE,UCSF, NYU, ETH ZURICH, FAC MED LIMOGES, ACADEMY, DFG, PHD STUDENTSHIP, KITASATO, PACIET, MUSEUM NATIONAL HISTORY NATURAL PARIS,UGANDA MANAGEMENT INSTITUTE, PATAN DHOKA, NETROPICA, INSTITUTE POLITECN, GENETECH RESEARCH INSTITUTE, NTD SUPPORT CENTER,ENVIRONM SCI & COMMUNITY HEALTH, VIRGINIA TECH, SUNY BINGHAMTON, SUNY ALBANY,

Keywords for NGOs

CARTER CENTER, CHILDRENS HEARTLINK, BECKMAN YOUNG, MARCH OF DIMES,FONDATION MERIEUX,PRODEP,SBIR,GERMAN ACADEMIC EXCHANGE,CHILDREN'S HEART,IMA WORLD HEALTH, AMERICARES, STIFTELSE,LAKARESALLSKAPET,GATES CAMBRIDGE, GATES MALARIA,FUNDACAO ATAULPHO,SOCIETY,AMERICAN ASSOCIATION,HEART ASSOCIATION, EVANGEL, FINNISH PHYSICIANS, FONDATION DE RECHERCHE MED,PARKINSON COUNCIL,FOUNDATION,FUNDACIO,CLINTON HEALTH,TRASHER RESEARCH FUND, MISSIONARY, PHCDF, RESULTS DEV INSTITUTE, SUSTAINABLE SCI INSTITUTE, LIGUE NATIONALE, EPHA,ETHIOPIAN PUBL HEALTH ASSOC,ACT YOUTH & WOMEN NETWORK,CEIS,HUMAN VACCINES PROJECT, TRUST, PLAN INTERNATIONAL, KCCO, ILEP, MED MISSION INSTITUTE,CENTER INT VACUNAS, CHRISTOFFEL BLINDEN, CBM,, CBM INTERNATIONAL, DDCF, MALTALEP, CHARITY, NGDO, FHI 360,ASK APPL SCI, LIONS CLUB, SIGHTFIRST,ROYAL LIFE SAVING, OPC, RESEARCH ALLIANCE,KURATORIUM TB WELT EV,BLANTYRE INSTITUTE COMMUNITY OUTREACH,CHEM GESELL GOCH,RASD, TREATMENT ACT, HEALTH ALLIANCE INT, RTI INT, THE UNION, RED CROSS, LIGHT FOR THE WORLD, BLANTYRE INSTITUTE COMMUNITY, BARCODE OF LIFE, INDEPTH NETWORK,BIOMED RESEARCH & TRAINING INSTITUTE,PATH,HERD, MUNICIPALITIES,SOUTHERN AFRICAN CENTER INFECT DISEASE SURVEILLANCE, BALAJI UTTHAM, SCHISTOSOMIASIS CONTROL INITIATIVE, RICET, CBMGF, CENTER INFECT DISEASE RESEARCH ZAMBIA, ORG PREVENT CECITE,VICARIATO DE ESMERALDAS,PREVENT BLINDNESS UNION,NEPAL NETRA JYOTI,WE ACTX,CONSORTIUM,PEW, LEPROSY RELIEF, MIM, ASOCIAC BENEF,EURNEGVEG,APHRC,FAITH COMMUNITY,CERCA PROGRAMME,AFRICAN FIELD EPIDEMIOL NETWORK, INT AGENCY PREVENT BLINDNESS, BALAJI UTTHAN SANSTHA, ASSOC MEDECINS CAMPAGNE, AGNETHE LOVGREENS LEGAT, MC-KINNEY MOLLERS FOND,CHINA MED BOARD, COMMUNITY FUND, DEUTSCHE GESELLSCHAFT,PHILANTHROPIES,GLOBAL AIDS INTERFAITH ALLIANCE,SAVE CHILDREN, SAVE THE CHILDREN,PHILIPPINE NGO,BALAJI UTTHAN SANSTHAN, MAN MAY SEE, GLOBAL GOOD FUND, MITOSATH, MEDTRONIC,INTENDENCIA SALTO, IFPRI,BOMBAY LEPROSY PROJECT,PARTNERSHIP AFRICAN SOCIAL & GOVERNANCE RES,HEALTHNET TPO, INSTITUTE JUAN CESAR GARCIA, LEPROSY RESEARCH INITIATIVE, GLOPID-R, UNALEP,MAHERY,IFAKARA HEALTH INSTITUTE, AFRIKAFONDS,ENGENDER HLTH,FCRM,OPERAT CENTER BARCELONA,INT UNION TB & LUNG DIS,SIGHTSAVERS,EPICENTRE, CEGAA,NATIONAL PODOCONIOSIS ACT NETWORK,CANADA TROPICAL DISEASES,ROBIN HOOD,INT VACCINE INSTITUTE,NUFFIC,MANAGEMENT SCI HEALTH,ASIAN PACIFIC SOC CARDIOL,STUDI GISED,ADDICT INFO SWITZERLAND,BURROUGHS WELLCOME FUND,NAPAN, FIGHT FOR SIGHT, GDUPS, MOISES BERTONI,SOCIAL & HEALTH INEQUAL NETWORK,CHARITABLE,RISEAL NIGER,INSTITUTE PANAFRICAIN SANTE,ORG TROPICAL STUDIES, LMEP, AMREF, BBVA ARGENTINA,VOLUNTEERS,MISSION SAVE HELPLESS,CATHOLIC RELIEF SERV,STIFTUNG, - STIFTUNG,RESIDENCY R 109,WATER AID,LIGHT WORLD,PROVIDENCE, MARIO NEGRI, BRIEN HOLDEN, WORLD VISION, GATES EXPLORATION PROGRAM,LEPROSY MISSION,CENTER ROSARINO ESTUDIOS PERINATALES,ACT4TB HIV,COCHRANE SOUTH AFR, BDOM,

POPULAT SERV INT, MILDMAY INT,PACIEH,TB RESEARCH & PREVENT CENTER, MED ACTION, SANTE SUD, INT NEPAL FELLOWSHIP,AFRICAN INSTITUTE HEALTH & DEV, COMIC RELIEF,ALLIANCE PUBL HEALTH,INSTITUTE GULBENKIAN CIENCIAS, CRFILMT,ORBIS INT, MECTIZAN,IMA WORLDHEALTH, HEALTH & DEV SUPPORT PROGRAMME, WORLD VIS INT,AFRICAN POPULAT & HEALTH RESEARCH CENTER,KONGWA TRACHOMA PROJECT, LEAGUE,SABIN VACCINE,GLOBAL FUND, APHRC, SVENSKA LAKARESALLSKAPET, FUNDACAO ABC, GLOBAL CHAGAS DISEASE COALIT, POLICY CURES,CHARITIES, RPB, END , P3D, ORDER OF MALTA, GTMP GRANT, CANCER RESEARCH INSTITUTE, IAP,, PIERRE ELLIOTT TRUDEAU, FAYYAA INTEGRATED DEV ASSOC,CHRISTIAN BLIND MISSION, LEPROSY RESEARCH INITIAT,HELEN KELLER,MSF,SEACAT, FETZER INSTITUTE, SOCIOS EN SALUD SUCURSAL PERU, 3IE, DKT JANANI, MOLLERS FONDS, WANETAM,TASK FORCE GLOBAL HEALTH,SAMARTH, HEALTH CONNECT INT,CNHR, ICDDR B, WWARN, PASTEUR INSTITUTE, AGENCE DE MEDECINE PREVENTIVE,TNO QUAL LIFE,AURUM INSTITUTE, CALIF INSTITUTE BIOMED RESEARCH, MADIBENG CENTER RESEARCH,CERMEL,HANDICAP INT,INT LIVESTOCK RESEARCH INSTITUTE,FRED HUTCHINSON CANC RESEARCH CENTER, CENTER RECH MED LAMBARENE, SEIMC, CRUN,CUAMM, ICTC, ARCN, BUR DIOCESAIN OEUVRES MED, INPPAZ,FLEMING BIOMED,CEDIC,ONE WORLD HEALTH,CINVESTAV ,TEXAS BIOMED RESEARCH INSTITUTE, HOWARD HUGHES MED INSTITUTE, MED PATENT POOL, CARLOS SLIM HEALTH INSTITUTE, OPEN SOURCE MALARIA,MEDBIOTECH LABS, WISTAR INSTITUTE,PACIFIC INSTITUTE RESEARCH EVALUAT,SALK INSTITUTE,GRP 5 ANS,CANTAM NETWORK,AERAS,RESEARCH CENTER BORSTEL,GCP ALLIANCE EUROPE,ROTHAMSTED,INSTITUTE PASTEUR,DRUG SAFETY RESEARCH UNIT,ICIPE,MAX DELBRUCK CENTER, GORGAS MEMORIAL, HOWARD HUGHES MEDICAL INSTITUTE, CENTER HEALTH & SOCIAL SERV, ACCRA,CENTER RESEARCH INFECT DIS, J CRAIG VENTER INSTITUTE, NETHERLANDS CANC INSTITUTE,LEISHMANIASES RESEARCH UNIT,SEATTLE BIOMED,LINDSLEY F KIMBALL RESEARCH INSTITUTE,FRAUNHOFER, KUMASI CENTER,MED GENETICS PROV CENTER,WORLDWIDE ANTIMALARIAL RESISTANCE NETWORK, NEHCRI,SRI INT,MAX PLANCK INSTITUTE, WORLD HEPATITIS ALLIANCE, IRSS, CENTER LEPROSY RES,CISM

Keywords for governmental organizations

MINIST, MUNICIPAL COUNCIL, ANPCYT, CANADA RESEARCH CHAIRS, THE COHS, IRBA, TB COOPERATIVE AGREEMENT, CAISSE NATIONALE , NC3RS, NASA, CANTON,GENERALITAT, IPEV, ANEIS, PLAN NACIONAL, SAFEWORK AUSTRALIA, FUNDING COUNCIL,NATIONAL INSTITUTE, REGIONAL CENTER, ZONE ATELIER, ST LEONARDS, NATIONAL COMMISSION, COMMISSION ON HIGHER, AUTHORITY,FUNDACAO DE APOIO, GLOBAL HEALTH RESEARCH INITIATIVE, GLOBAL CHALLENGES RESEARCH FUND,FUNDACAO DE PESQUISA, TAATSREGIERUNG,GENCIA ESPANHOLA, DIVISION OF MALARIA, DIVISION OF VECTOR BORNE, AGENCE FRANCAISE,

JICA,CERTS, SPANISH, RESEARCH COUNCIL, FONDATION DE FRANCE, FRQNT, IRISH AID, FWO, GOVERNMENT, NATIONAL FDN,INSTITUTE LEONIDAS & MARIA DEANE, FIOCRUZ,BIOASTER, JOINT CLIN RESEARCH CENTER, CNAMTS, RESIDENCE AMBASSADEUR, CHINESE NATIONAL, MOHS , HEFCE, NATIONAL TUBERCULOSIS, SCIENTIFIC & TECHNOLOGICAL COOPERATION, INSTITUTE SALUD PUBL CHILE,CSIR,IPR,HEALTH RESOURCES & SERV ADM, ECONOMIC DEVELOPMENT BOARD,ICDDR, NTP, CNPQ, IDRC, NIH, ICREA, ZONE SANTE, DIRECTORATE, DIRECTOR GENERAL, BBSRC, GENERAL SECRETARIAT, MRC CENTRE , FAPESP, UNITED STATES DEPARTMENT OF DEFENSE, CDCH, DOHNCDPC, ISCIII, MUNICIPALITY, SATREPS, UCOST, ATOMIC ENERGY COMMISSION, NATIONAL SCIENCE FDN, CIOB,IFREMER, DRASS, COMIS NACL,PNLUB LP,INRA, SECYT, SFAR, INSTITUTO VENEZOLANO, MILITARY,GHANA HEALTH SERV, FUNDACAO ARAUCARIA,NATIONAL BLINDNESS PREVENT PROGRAM,CENTER ESTUDIOS SALUD,SECRETARIA SALUD, DANIDA, CIHR, STATE OF, STATE AMAZONAS, REG HEALTH BUR, STATE HEALTH BUR, SERV NACL,NATIONAL ONCHOCERCIASIS CONTROL,DIRECT REG SANTE,COCTU, SINGAPORE NATIONAL, SECRETARIA ESTADO, LEPROSY RESEARCH INITIATIVE, SAMRC, SHANGHAI LEADING ACADEMIC DISCIPLINE PROJECT, NATIONAL IMPORTANT PROJECT, NATIONAL S&T PROGRAM, CPQAM, PRINCE WALES,CNCV,NATIONAL EXPANDED, FONDATION SINGER-POLIGNAC, INDIAN COUNCIL,CONSEJERIA, PROGRAMA CHAGAS LA RIOJA,NATIONAL HEALTH INSTIT,NATIONAL CENTER, REGION OF, NATIONAL PROJECT , AGENCIA NACIONAL, SECRETARIA NACIONAL, VISION2020 SUPPORT PROGRAMME, VIS 2020 SUPPORT PROGRAMME, ANR, NATIONAL ONCHOCERCIASIS ELIMINATION, RMRCT, GOBIERNO, COORDINAC NACL CONTROL VECTORES,RED INVEST,ARMY,CALIF CANC REGISTRY, CONICYT,NHMRC, ASSOCIACAO BRASILEIRA, STRENGTHENING DECENTRALIZAT SYST,SDC, NATIONAL PRIMARY HEALTHCARE, NATIONAL SECRETARIAT, REGIONAL HEALTH, COMISION DE OPERACION, CONSELLERIA, DANMARKS GRUNDFORSKNINGSFOND, US DEPARTMENT OF, NRF, SOUTH AFRICAN, FCT, PROGRAM CHAGAS, CIBIR, EPSRC,DIRECT SOINS SANTE BASE, HARARE CITY HEALTH DEPARTMENT,FULBRIGHT,MLFD HQ, RWANDA BIOMED CENTER, SYNCHROTRON, BRITISH COUNCIL, COMUNIDAD DE,MSTP GRANT,DIV HYG MILIEU & ASSAINISSEMENT,SUSTAINABLE HEALTH SYST,DIV TSETSE CONTROL,PUBL HEALTH ENGLAND,MUNICIPAL HEALTH, TUBITAK, PROGRAMME OF THE NETHERLANDS, VENEZUELAN PROGRAMME, VENEZUELAN ENDEMIC, PICT, 01 BP 2938, REG DELEGAT PUBL HEALTH, OHEC, TANZANIA VET LAB AGENCY, DELEGAT REG, STAT SIERRA LEON, INSTITUTE GEOG VENEZUELA SIMON BOLIVAR,DEPARTAMENTO PREVENCION & CONTROL DE ENFERMEDADES,INSTITUTE SALUD ESTADO CHIAPAS,PRESIDENTS MALARIA INITIAT, DEPARTAMENT DE SALUT, EDUCATION COMMISSION, DEPARTMENT FOR INTERNATIONAL DEVELOPMENT, FRENCH DEVELOPMENT AGENCY, PROGRAMA CONTROL CHAGAS, NATIONAL DEPARTMENT HEALTH, CGIAR, FULBRIGHT-GARCIA,NSTDA,GLOBAL HEALTH POPULAT & NUTR,FONDO FINANCIERO,MULTIDIS SURVEILLANCE CENTER,EMBASSY,

POPULAT COUNCIL,FRENCH BLOOD SERV, DIST, DEPARTAMENTO DE CIENCIA, NORWEGIAN, DEPARTMENT OF HOMELAND SECURITY, NIMH, FINEP, PROVINCE, COMUNIDAD DE MADRID, SHANGHAI S T PROJECT,NIMR, NATIONAL TB,AGCY, SERV ESTATALES SALUD, AUSTRIAN SCIENCE FUND,TROPICAL DISEASE RESEARCH CENTER,EID MEDITERRANEE,SENEPA, NATIONAL IMMUNIZAT, SWEDISH INTERNATIONAL, AREF, DAAD, CHD, MISION CIENCIA, YAYASAN PENGEMBANGAN, NATIONAL ROTAVIRUS SURVEILLANCE, FEDERAL REPUBLIC, CITY OF, VET SERV, HARARE, LYON REGION, CSTC, UK ESRC, PROV TB CONTROL, CONCYTEC, UK MRC, NATIONAL TRACHOMA CONTROL, BRAC, NATIONAL PREVENTION OF BLINDNESS COMMITTEE, JIMMA ZONE HEALTH, AUDAID,SANITARIA NACL, CHINA NATIONAL SCIENCE RESEARCH, NIMBA COUNTY, TRAINING GRANT, VET SERV, DIV TSETSE CONTROL, QUAL CONTROL & SAFETY, AECID, USDA, US DOE, BRAZILIAN TB RESEARCH NETWORK, DUTCH ORGANIZATION, FEDERAL AGENCY, NATIONAL FORUM INDONESIA, UNITED STATES AGENCY FOR INTERNATIONAL DEVELOP, SARCHI, LANDESSTIFTUNG, VINNOVA, COMMISSIONER FOR HEALTH, DRDO INDIA, NATIONAL AIDS PROGRAMME, COPR, CNDR, IMSS OPORTUNIDADES, STATE LEPROSY OFF,, STATE LAB PUBL HEALTH, NTBLCP,NATIONAL EYE CARE PROGRAMME, DGDC BELGIUM, NHRMC, ITALIAN DEVELOPMENT, SERV SALUD, PROGRAMA NACL, SERV SALUD, QUEENSLAND HEALTH,ARS, FORT DE FRANCE, VACCINE FUND, UNITED KINGDOM, NATIONAL VACCINE PROGRAM, THSTI, NIMPE, VENI PROJECT, ACT GOUVERNANCE INTEGRAT REINFORCEMENT, NATIONAL DENGUE CONTROL, INDO-US VACCINE, TECHNOL INNOVAT AGENCY,QIMR, QUEENSLAND INSTITUTE MED RES, BERGHOFER MED RESEARCH INSTITUTE,DESERT MED RESEARCH CENTER,CIDEIM, CENTER SUISSE RECH, INSTITUTE RECH DEV, UGANDA AIDS COMMISS,POB OS-1905, ACCRA,SERV LUTTE PALUDISME, PRONEX, COLCIENCIAS, SNSF, NWO, VENI GRANT, FEDERAL OFFICE, PROGRAMME NATIONALE, AGAUR, SRFDP, DANISH INSTITUTE,OCEAC, ICMR, DIRECC SANIDAD, DIRECC GENERAL, DIRECT GEN, INSTITUTE NATIONAL, ADVISORY GRP, SCOTTISH ENTERPRISE, SIDA, ZELS, NATIONAL AGENCY, NATIONAL COUNSEL, NATIONAL COUNCIL,CONSEJO NACIONAL, CONSELHO NACIONAL, CONACYT, NSFC, UK NERC, AFOSR, PUBL HEALTH AGENCY CANADA, REG STATE, SCHISTOSOMIASIS CONTROL INITIAT,COOPERAT TECH ALLEMANDE, NATIONAL HAT CONTROL, PROV MALARIA ELIMINATION PROGRAM , MOL IMMUNOL CENTER CUBA, ARS, POINTE A PITRE, NATIONAL CONTROL PROGRAM,USAMMDA, NATIONAL PUBL HEALTH,ENTENTE INTERDEPT DEMOUSTICAT,PROSICS,CTY PUBL HEALTH, DIRECC PRIMER NIVEL ATENC, NATIONAL ENVIRONMENT AGENCY, NATIONAL HEALTH SERV,NIEHS,CDC,INT ORG MIGRAT,NEW YORK STATE, PUBL HEALTH AGCY CANADA, PREVENT BLINDNESS PROGRAM, NATIONAL STAT AGENCY, NATIONAL HEALTH MISSION, RESEARCH CENTER BORSTEL, INSTITUTE INFOCOMM RESEARCH I2R, ONCHOCERCIASIS CONTROL, BOUAKE, NLR,

AMSTERDAM, NATL TB RESEARCH PROGRAMME SOUTH AFRICA,DIRECT NATIONAL,NATIONAL NEGLECTED TROPICAL DIS, CAMOES,NIAID, NATIONAL PROGRAM, GOVT,KARI,NATIONAL MALARIA,NATIONAL COUNSEL, NATIONAL SCIENCE COUNCIL, COSTECH, JST, MOHCC,MESRST, NIGMS UNDER THE MIDAS INITIATIVE, REPUBLIC OF, NATIONAL TRACHOMA PROGRAM, ADM NACL LAB, NATIONAL NTD CONTROL, ECUADORIAN ONCHOCERCIASIS PROGRAM, STRENGTHENING DECENTRALIZAT SYST, NATIONAL AIDS & STI CONTROL,MALARIA ELIMINAT PROGRAM,USAID, UK DFID, UK AID, US NAVAL, US NAVY, NATIONAL PREVENT BLINDNESS, CONSEIL REGIONAL, DEVELOPMENT AGENCY, GERMAN AGENCY, SSGCID, COUNTY COUNCIL, JAPAN AGENCY, BMBF, CONICET, NATIONAL PRIMARY HEALTH, JAPAN INSTITUTE, DMR,,NATIONAL SCH & ADOLESCENT HEALTH PROGRAM, DGHS,PROCUREMENT UNIT,INSP,DIRECT ETUD & RECH, ECRETARIA MUNICIPAL, ANSTO, ARMED FORCES, DGIS, CAPES, BEREDSKAP, DEFENCE, US DEFENSE, NATIONAL BLOOD SERV, NACCAP, MAPAQ, PEOPLE'S REPUBLIC, OFF NATIONAL, IIDP, NATIONAL EYE HEALTH, NATIONAL ONCHOCERCIASIS SUBPROGRAM, REG DELEGATE,NUC NIGERIA,NATIONAL COMMUNICABLE DISEASE CONTROL,NATIONAL BILHARZIA & SOILTRANSMITTED,NATIONAL DISEASE CONTROL, NATIONAL DEPARTMENT FOR MALARIA, COUNCIL SCI & IND RES, (AMAD),JAPANESE PROGRAM,KOICA,HEALTH OFF,ETHIOPIAN PUBL HEALTH INSTITUTE,INSTITUTE VEILLE SANIT,JIANGSU,NIGERIAN INSTITUTE MED RESEARCH,SINGAPORE IMMUNOL NETWORK,CENCET,SCI INSTITUTE PUBL HEALTH,CENTER NATIONAL RECH FORMAT PALULDISME, CENTRE DE RECHERCHE PUBLIC,BRUSSELS, SACEMA, SINGAPORE IMMUNOLOGY NETWORK, SINGAPORE TISSUE NETWORK,VICTORIAN INFECTIOUS DISEASES REFERENCE LABORATORY, NATIVE AMERICAN RESEARCH, CSIC,CENTER MURAZ,WALTER REED, RESEARCH INSTITUTE FOR TROPICAL MEDICINE OF THE PHILIPPINES, INSTITUTE CONMEMORAT,US FDA,NSTITUTO NACIONAL, IMBEB,CENTER HYG EPIDEMIOL & MICROBIOL,HEALTH RESEARCH CENTER ANGOLA, NATIONAL CENTRE, NATIONAL DRUG, INTS PARIS, OFFICE OF RESEARCH INFRASTRUCTURE PROGRAMS,INSTITUTE EPIDEMIOL DISEASE CONTROL & RES,IEDCR, CDDR,RAJENDRA MEM RESEARCH INSTITUTE MED SCI,KEMRI,INSERM,INSTITUTE PERUANO, INISAV, INSTITUTE MED TROPICAL MANAUS,ICGES,ATOM ENERGY RESEARCH INSTITUTE, ACTG, ATOM ENERGY COMMISS, FAPEAM, FAP-DF, CENTER VACCINE DEV, NHLS, JIANGXI PROV INSTITUTE, FAPESC, NATIONAL ONCHO TEAM,FREETOWN,INCT,NIPSOM,LLIN,LAB REG DIAGNOST,MWANZA MED RESEARCH CENTER,INSTITUTE HIMALAYAN BIORESOURCE TECHNOL, CENETROP, NRC,, NATIONAL REFERENCE, FAPEMIG, FOGARTY,PAPUA NEW GUINEA INSTITUTE MED RES,TROPICAL PESTICIDES RESEARCH INSTITUTE,CIRAD,NATIONAL RESEARCH, RENE RACHOU,

NATIONAL TRANSFUS CENTER,UK HEALTH PROTECTION AGENCY,STATENS SERUM INSTITUTE,SOUTHERN AFRICAN CENTRE, RMRIMS, NIGERIAN INSTITUTE TRYPANOSOMIASIS RES,NCR BIOTECH SCI CLUSTER, NATIONAL KEY LAB, CRILA, NAVAL MED RESEARCH CENTER, USAMRU K, MED GENET PROV CENTER CUBA,HUBEI PROV INSTITUTE,AUSTRALIAN,ANHUI,CENTRE FOR HOST-PARASITE INTERACTION, CENTER NATIONAL APPUIA LUTTE MALADIE,CENTER INVEST PLAGAS & INSECTICIDA,ARMEES,INSTITUTE PESQUISA PATOL TROPICAL RONDONIA,DZIF,CISA, CPQRR, LAB BIOMETRIE & BIOL EVOLUT, ETHIOPIAN HEALTH & NUTRITION RESEARCH INSTITUTE,LAB REFERENCE MYCOBACTERIES, NATIONAL MICROBIOL REFERENCE LAB,COCOA RESEARCH INSTITUTE,CENTER REFERENCIA PROF HELIO FRAGA,IST SUPER SANITA, AUSAID, NIGERIA INSTITUTE TROPICAL DISEASE,SCI & PRACT CENTER SANIT,GERMAN CANC RESEARCH CENTER, CHAVI, MED RESEARCH STN,YUNNAN INSTITUTE PARASIT DIS,CIBE,NATIONAL PUBLIC HEALTH,UK COMMONWEALTH OFFICE,WINDBER RESEARCH INSTITUTE,NATIONAL VIROL LAB,DANGTU INSTITUTE SCHISTOSOMIASIS CONTROL,TTRI,INSTITUTE NACL, NATIONAL VECTOR, CENTER DEV VACCINS, KISTI,DANISH BILHARZIOSIS LABORATORY,CRP SANTE,LAB REFERENCIA DEPARTEMENT SALUD,CEA,STATUM SERUM INSTITUTE,INSTITUTE PATOL EXPT,MRC CLINICAL TRIALS UNIT, CENTER PUBL HEALTH RESEARCH,VALENCIA,BUTANTAN INSTITUTE,CIDRE,HUNAN INSTITUTE PARASIT DIS, INSTITUTO NACL LABS SALUD,SYNCHROTRON SOLEIL,MRC GROUP,MED RESEARCH INSTITUTE, COLOMBO,CENTER INFECT DISEASE PREPAREDNESS, HEALTH PROTECT & RESEARCH ORG,KAZAKH INSTITUTE ONCOL & RADIOL,INDICASAT AIP,LUXEMBOURG INSTITUTE HEALTH,PUBL RESEARCH CENTER HEALTH,INDIAN INSTITUTE,JALMA INSTITUTE,INSTITUTE INVEST CIENT & SERV ALTA TECNOL,CENTER RECH PUBLI SANTE,BIOMED RESEARCH NETWORK,MWANZA RESEARCH CENTER,LAB NACL VIROL INSTITUTE BIOTECHNOL,PUBL HEALTH & INFECT DISEASE RESEARCH CENTER,KINTAMPO HEALTH RESEARCH CENTER,TIBA ,JILIN CITY TB INSTITUTE,FAPERJ,FUNDACAO NACIONAL,TROPICAL MEDICINE RESEARCH STN,LAB NATIONAL SANTE,ONTARIO GENOMICS INSTITUTE,FUNDACAO ESTADUAL PROD & PESQUISA SAUDE,FEPPS,MED ENTOMOL RESEARCH & TRAINING UNIT GUATEMALA,AFRIMS,BUTANTAN INSTITUTE,NATIONAL HIST MUSEUM LONDON,ONDERSTEPOORT VET INS,LAB PESQUISA DOENCA CHAGAS,LAB NATIONAL SANTE PUBL,VICTORIAN INFECT DISEASE REFERENCE LAB,ONCHOCERCIASIS MOL LAB,BLDG & RD RESEARCH INSTITUTE,NIOSH,MRC HEARING & COMMUN GRP, CENAVECE, MIVEGEC,CENTER NATIONAL FORMAT,INLASA,PAKISTAN INSTITUTE COMMUNITY OPHTHALMOL,RIKEN,NATIONAL LAB,MRC HAEARING & COMMUN GRP,CENTER SUIVI ECOL,NAVRONGO HEALTH RESEARCH CENTER,CENTER NACL,FUNDAMENTAL RESEARCH GRANT SCHEME (FRGS),KENYA TRYPANOSOMIASIS RESEARCH INSTITUTE,IMPM,UGANDA VIRUS RESEARCH INSTITUTE,DODOWA HEALTH RESEARCH CENTER,NATIONAL COMMISS DEV INDIGENOUS PEOPLES,TB RESEARCH CENTER,DIV OFF,EVANDRO CHAGAS,INEI,CHINESE CENTER TROPICAL DISEASE RES,

INSTITUTE VENEZOLANO INVEST CIENT,MIGEVEC,INRSP,CREC,NATIONAL NUCL RESEARCH INSTITUTE,FORTH,MRC LABS,,ARMAUER HANSEN,CENTRE RECHERCHE PUBLIQUE SANTE,CICVYA INTA,SMITHSONIAN,NATIONAL LIVESTOCK RESOURCES RESEARCH INSTITUTE,ARMED FORCES RESEARCH INSTITUTE, DEF FORCE, CERVE, WESTERN AUSTRALIAN MUSEUM,INGEBI, IQUIR,PROGRAMME NATIONAL, PIRBRIGHT INSTITUTE, VECTOR & VECTOR BORNE DISEASE CENTER,ILSL,SAO PAULO, INH MOROCCO,IRD, SALUD CARLOS, INSTITUTE SALUD DR CARLOS,MRC UNIT,BPRC, EHNRI, CENTER INVEST BIOMED, MED & AROMAT PLANTS RESEARCH INSTITUTE,CNR,CENTER NATIONAL RECH SCI,VIB,FUNDACAO EZEQUIEL DIAS,KNAW, USAMRIID, CENTER NATIONAL FORMAT, NATIONAL HIST MUSEUM,NAVAL MED RESEARCH UNIT,DSO NATIONAL LABS,INSTITUTE LOUIS MALARDE,MED RESEARCH INST, COLOMBO, NATIONAL MUSEUMS KENYA,INSTITUTE BUTANTAN, DOE JOINT,CENTER NATIONAL APPUI LUTTE MALAD, UGANADA EXPANDED PROGRAMME, LAB REFERENCIA DEPARTMENT SALUD, EIJKMAN,MRC CENTER,GENOME INSTITUTE OF SINGAPORE, NATIONAL INSTITUE, IIPH B, SWAZILAND HEALTH LAB SERV, NATIONAL CANCER INSTITUTE,CDFD,AFRICA HEALTH RESEARCH INSTITUTE,CENTER NATIONAL RECH & FORMAT PALUDISME,CNRFP,KOCH INSTITUTE,BPPT,BERNHARD NOCHT INSTITUTE, AGENCE NATIONAL SECUR SANIT,TROPICAL MEDICINE RESEARCH STN,KUMBA, INSTITUTE COCHIN,CENTER GENOM REGULAT CRG,ASTAR

Keywords for hospitals and medical centers

HOSPITAL, CABRINI HEALTH, NATIONAL OBSTET FISTULA CENTER,CHRU FRANCE,ALFREDO,FUNDACAO MED TROP, INSTITUTE CARDIOL CORRIENTES JUANA FRANCISCA,HUNTER NEW ENGLAND POPULAT HEALTH,CENTER SALUD SOCRATES FLORES, NATIONAL EYE CENTER, , RIGSHOSP, KABAROLE HEALTH SERV, NUFFIELD, GAMMA IMAGING & THYROID CENTER,CLIN ABOOD SHAIO,NATIONAL HEALTH LAB, EYE INSTITUTE, ST PAULOS GEN SPECIALI,INSTITUTE CIENCIAS NEUROL,POLYCLIN,HEALTH CARE SYS, FAMILY MED CALGARY, KAISER PERMANENTE, TERR HEALTH SERV,INSTITUTE OBSTET & GYNAECOL, DR ABDU HIGHER EYE CLIN,BETTY COWAN RESEARCH & INNOVAT CENTER, CAMBRIDGE HEALTH ALLIANCE,VOLUNTARY HEALTH, PARTNERS HEALTH, LEGACY HEALTH SYST,EMORY EYE, CENTER ADDICT & MENTAL HEALTH, ULTRASCAN, VIMALA DERMATOL CENTER MAHARASHTRA,ARAB HEALTH CENTER, CMA ST CAMILLE NANORO,WENSHAN INSTITUTE DERMATOL, KFMC,KING FAHAD MED CITY,MAYO CLIN, LEONARD WOOD MEM CENTER TB & LEPROSY RESEARCH,FUNDACAO ATAULPHO PAIVA, SANTA CASA BELO HORIZONTE, PAKISTAN INSTITUTE MEDSCI, FORT PORTAL, KHANH HOA HEALTH SERV, PRESBYTERIAN HEALTH SERV, MED COMPLEX,INSTITUTE DERMATOL RUBEN D AZULAY,IST ZOOPROFILATT,ASOCIAC PROFAMILIA,UMDNJ, HEALTH CANADA, EUROSALUD, DENVER INFECT DISEASE CONSULTANTS,BURLO GAROFOLO, NEW YORK BLOOD CENTER,

MONTREAL CHEST INSTITUTE, INSTITUTE MED FLORESTA, CARACAS,CENTER DISEASE ANAL,TURNING POINT ALCOHOL & DRUG CENTER,HOLLYWOOD ORTHOPAED, MED CENTER,KYENJOJO HEALTH SERV, FORSYTH INSTITUTE,MC SLOTERVAART,CENTER MED CARACAS, UMC, DANA FARBER CANC INSTITUTE ,PEDRO KOURI,CHARITE,MEDICAL CENTER, WESTERN SYDNEY SEXUAL HEALTH CENTER,IDIBAPS, BARCELONA, HUSM,JIPMER,POPULATION HEALTH, RIGSHOSP, HARVARD PILGRIM HEALTH CARE, BAMRASNARADURA INFECT DISEASE INSTITUTE,KAROLINSKA INSTITUTE, PNG EYE CARE, NUCLEO DOENCAS INFECCIOSAS,CHU DE LILLE, INDIRA GANDHI INSTITUTE, HEALTHCARE SERV, COMMUNITY HEALTH SERV CENTER,DANA FARBER CANC CENTER, MED UNIT,CABRINI INSTITUTE, AMRITA INSTITUTE MED SCI, DHAKA MED COLL,UNI KLINIKUM,ALZHEIMERS DISEASE CENTER,STENO DIABET CENTER,CHUL,KUNMING MED COLL, VADU RURAL HEALTH PROGRAMME, SRI RAMCHANDRA MED COLL,JOHNS HOPKINS MED, BP KOIRALA INSTITUTE,SETH GS MED COLL,CALIXTO GARCIA,NATIONAL HANSENS DISEASE PROGRAMS,INSTITUTE GUSTAVE ROUSSY, NIDCH, URBAN HEALTH CENTER, MEM SLOAN KETTERING CANC CENTER,CNHU HKM

Keywords for Industry

CORPORATION,KALANET,CHIRON VACCINES,REGENERON,CHAN ZUCKERBERG,BECTON DICKINSON, UNIEURO, TOTAL OIL, A/S , ZOETIS, DUTY FREE AMERICAS, TIBOTEC, PIERRE FABRE, CEVA,DEVELOPMENT BANK,ACHILLION PHARMACEUTICALS,PALADIN LABS, SAVIENT, TOSHIBA, VIFOR,GOIZPER GROUP,BANK FOMENT,HEALTHBAYER AG,ALLERGAN,BERLIN HEART, BOEHRINGER,URL PHARMA,BAYERBAYER AG,INC,SANOFI,ALCON,SIGHTCARE INT,CYTOS BIOTECHNOL, GENEURO, NECSA, SIGMA TAU ,TMRC, BUNGE Y BORN, MEDIVIR AB,INPHANNA CONSULTANCY,LUMIERE HEALTH RESEARCH CONSULTING,JANSSEN PHARMACEUT,SWISS BIOQUANT,OUROFINO SAUDE ANIMAL,NOVO NORDISK,ABBVIEABBOTT LABORATORIES, BRUNO SCHERRER CONSEIL,VECTOR HEALTH INT,HUMABS BIOMED, WENNER-GREN,IPCA PHARMACEUTICALS,SOLUT,INTEGRAL MOL,FARMFOREST RES,CONSULTANCY SERV,INT CONSULTING,PROT AI,FREELANCE CONSULTANT,VII PN,FMD K&L,GSK,PLC,INTELLECTUAL VENTURES, CB&I,SOLINA HEALTH,NOVAVAX,SENERGUES CONSULT,LEEISA,MERZ ASIA PACIFIC, TATA, WYETH,DIRECT CONSULTING & LOGIST,NOVARTIS HORSHAM,ARTEMIS PHARMACEUT RESEARCH,LONDON BIOSCI INNOVAT CENTER,DDL DIAGNOST,ROCHE AG, ROCHE, ELI LILLY CANADA,BAYER S.A.S.,ENVIRONMENTAL SCIENCE,CO RE PLA,NEXGEN PATHOL,ACCELERA SRL,NOVUM PHARMACEUT,BIOSTAT CONSULTANT,BVBA,AG,,BIOCON BRISTOL,BRISTOL MYERS,CAECPLA,SWISS PHARMA NIGERIA,RTM ASSOCIATES,SENERGUES CONSULT,LIMMATECH BIOLOGICS AG,NOVARTIS PHARMACEUT,LA FONDATION VEUVE EMILE METZ-TESCH,MERCK,TRS LABS,

PACIFIC INSTITUTE,KFW,UCB PHARMA,MSD (JAPAN),BIOMERIEUX,CHEMBIO,MITSUI CHEMICALS,SUMITOMO CHEMICAL,SHANGHAI CHEMPARTNER,NEGMA-LERADS,ELLIPSE PHARMACEUT,TELECOMUNICACOES BRASIL,TSGE CONSULTING,GRAS,GLOBAL DATA,EYE CARE CONSULTANCY,RANBAXY RESEARCH LABS,LTD,SRL,PHINC,ORYGEN BIOTECNOL,ADURO, ICONZ, VERTEX,ASTRAZENECA,SOSEC,INDEPENDENT CONSULTANT,NEW MOUNTAIN INNOVATIONS,GENES DIFFUSION,PUBL HEALTH & TB CONSULTANCY,SYNGENTA,SAS,,COMMUNITY EYE HEALTH CONSULTANCY,TROPIQ HEALTH SCI, INDEPENDENT TB,PHARM CONSULTING,IKARE,MURTAGH GRP,MERCACHEM BV, GMBH,TOXICONSEIL, DELOITTE CONSULTING,PHTB CONSULT,LLC,NOVARTIS CONSUMER, BIOSTAT CONSULTING, STRATEG DEV CONSULTANTS, BIOFOCUS, PRANA BIOTECHNOLOGY, GODREJ GRP, EMBEDDED CONSULTANT AVIGNON, INFYN BIOMARKERS, SKIN & GU MED CLIN, OTECI, ONC BIO, NEWCREST MINING, NANOIMAGING SERV, FARSIGHT CONSULTING SERV EUROPE, OUROFINO AGRONEGOCIO,PFIZER,NOVARTIS INSTITUTE BIOMED RES,SGS, NOVARTIS AG, GENOSCREEN, SYNCOM BV, NOVEXEL)

Keywords for PPPs

KALACORE,ISGLOBAL,PDVI, INTERNATIONAL TRACHOMA INITIATIVE, ENVISION, GAELF, ESPEN, APOC,GAVI,TB ALLIANCE, GLRA, GHIT, TI PHARMA, IAVI, GPELF, PDC, OEPA, DNDI, OCP, TOP INSTITUTE PHARMA, GDAC, NITD, LILLY TB DRUG DISCOVERY INITIATIVE,MMV, TDR, CPTR, HHVI, STAMP OUT SLEEPING SICKNESS, PENDA,EUROPEAN VACCINE INITIATIVE,IDRI, GRAND CHALLENGES,GARDP , CRICK INSTITUTE

Keywords for IGOs

UNICEF, INTERNATIONAL ATOMIC AGENCY, UNITAID, AHPSR, WORLD FOOD, WORLD MENTAL, INNOVATIVE MEDICINES INITIATIVE, EUROPEAN, OPEC, CNAG, OAS, WORLD BANK,FIND, WEST AFRICA HEALTH ORG,IAEA,EMBL, SASSCAL, CONCAWE, WESTERN PACIFIC REG OFF, SOUTH EAST ASIA OFF, EPIC,FAO-IAEA, FAO-ECTAD, ECTAD-FAO, EAST AFRICAN HEALTH RESEARCH COMMISS, EDCTP,UNESCO, CEFIC, EMRO, MERCOSUR, JHA, NORAD, EU ENLACE, ASIA PACIFIC MALARIA ELIMINATION NETWORK, RECTAL ARTESUNATE PROJECT, FERCAP, UNITED NATION, ICGEB,MALARIA VECTOR CONTROL WORKING GRP, SOUTH CENTRE, UNECA, MARIE SKLODOWSKA-CURIE GRANT, EU ERASMUS MUNDUS, CERN,WHO,PNLTHA, PAHO, CENTRAL EMERGENCY RESPONSE FUND, AFRICAN UNION, EASTERN MEDITERRANEAN REG ALLIANCE, ICC,, UNDP, DLCO-EA)

Appendix F

Validation of missing entries

Table F.1: First 20 missing affiliations

	V1
PFI	6
TROPICAL PROJECTS, HITCHIN	6
FUNDACAO E	3
INGEROD, BRASTAD	3
120 RUE CAMPANULES, ORNEX	2
AGENCY, KHLONG LUANG 12120	1
AREA OPERAT LV, SALTA	1
ASAREN 01BP3916, OUAGADOUGOU 01	1
BP 2938, OUAGADOUGOU 01	1
BP 3841, LOME 01	1
C	1
CBM	1
CENTER ETUD SANTE, LUXEMBOURG	1
CENTER OPERAT RESEARCH, LUXEMBOURG	1
CITY CENTER KOLKATA 700064, WEST BENGAL	1
COMMUNITY VIS INITIAT, ABUJA	1
CTP, MTN	1
DEPARTMENT FORENS BIOL	1
ENVIRONMENT SCI & COMMUNITY HEALTH, RAMALLAH	1
FAC FARM, NATAL	1

Table F.2: First 20 missing funders

	V1
GENEVA	10
GERMANY	4
UK	4
DEPARTMENT OF SCIENCE AND TECHNOLOGY	3
36 COMPANIES	2
CHAI	2
CZECH REPUBLIC	2
DEPARTMENT FOR INFECTIOUS DISEASES	2
DEPARTMENT OF RHEUMATOLOGY	2
FRANCE	2
GHS INSTITUTION	2
INTERNATIONAL)	2
NETHERLANDS	2
SPAIN)	2
ACADEMIC RESEARCH FUND	1
ACCION INTEGRADA	1
AD FUTURA	1
AN APW CONTRACT	1
AN OPERATION CENTER	1
ANNA FULLER FELLOWSHIP	1

Table F.3: Random set of missing funders

	RandomMissFunders	Freq
1	ACCION INTEGRADA	1
2	AN APW CONTRACT	1
3	BASF	1
4	BRAC	1
5	CENTRE FOR RESPIRATORY INFECTION	1
6	DEPARTMENT FOR INFECTIOUS DISEASES	1
7	DEPARTMENT OF SCIENCE AND TECHNOLOGY	1
8	ETHETH ZURICH	1
9	FONDATION PRO VICTIMIS	1
10	HEALTH ECONOMICS AND POLICY NETWORK IN AFRICA	1
11	NDI	1
12	NETHERLANDS	1
13	OFFICE OF VICE-CHANCELLOR FOR RESEARCH	1
14	PROCOPE	1
15	RESEARCH ON THEIR SYMBIONTS"	1
16	SA AIDS CONFERENCE	1
17	SHANGHAI S T	1
18	CHU	1
19	DIRECTOR'S INITIATIVE GRANT	1
20	FIGHT FOR SIGHT	1

Table F.4: Random set of missing affiliations

	RandomMissAffil	Freq
1	AL NEELAIN	1
2	BAHIR DAR	1
3	COLOMBO	1
4	DMR	1
5	EMORY	1
6	FAC SAUDE & ECOL HUMANA FASEH VESPASIA	1
7	FILARIASIS RESEARCH CENTER	1
8	GEORGE WASHINGTON	1
9	HERBARIUM	1
10	ILLINOIS	1
11	INGEROD	1
12	KYOTO	1
13	LAB REFERENCIA	1
14	MAC	1
15	MARYLAND	1
16	NO ARIZONA	1
17	NORTE	1
18	NOTRE DAME	1
19	PARIS	1
20	SAN CARLOS	1

Appendix G

R code for applying Haversine formula

```
library(data.table)
library(tidyverse)
library(spatialrisk)
library(optiRum)

grid <- function(x){
  Temporary_geo <- x[, lat, lon]
  optiRum::CJ.dt(Temporary_geo, Temporary_geo)
}

dist_Temporary_geo <- data.table(Temporary_geo) %>%
  split(.$id) %>%
  map_dfr(grid, .id = "id") %>%
  mutate(distm = spatialrisk::haversine(lat, lon, i.lat, i.lon)) %>%
  filter(distm > 0) %>%
  group_by(id) %>%
  summarize(distm_mean = (mean(distm))/1000)
```

Appendix H

Summaries of the public-private partnerships

WIPO Re:Search consortium

The WIPO Re:Search consortium is a collaboration between the public organization WIPO (World Intellectual Property Organization), BIO Ventures for Global Health (BVGH), and 31 funding members ("About WIPO Re:Search", n.d.). BVGH is an NGO and WIPO is a specialized agency of the UN and therefore is considered an independent international organization ("Funds, Programmes, Specialized Agencies and Others", n.d.; "Stop TB Partnership: Partners' Directory", n.d.).

The scope of the WIPO Re:Search Consortium spans across multiple transboundary diseases. A list of these diseases can be found on page 30 in the strategic plan of 2017-2021 ("WIPO Re:Search Strategic Plan 2017–2021", 2017, p. 5).

WIPO Re:Search consortium consists of over 120 Members from 35 countries and aims at constructing innovative research partnerships and R&D collaborations. The PPP is nested within WIPO, which acts as a secretariat and BVGH manages the partnership hub, proactively connecting potential users and licensees of WIPO Re:Search and creating research collaborations ("About WIPO Re:Search", n.d.).

Regarding its strategic choices, WIPO Re:Search carried out a comprehensive communication and advocacy program and has funded and undertaken capacity-building for developing country scientists. Funding is being received from the funding members as well as external funders like the governments of Australia and Japan ("WIPO Re:Search Strategic Plan 2017–2021", 2017, p. 8).

Drugs for Neglected Diseases Initiative (DNDi)

The Drugs for Neglected Diseases Initiative (DNDi) is an independent, not-for-profit foundation aimed at developing new treatments for neglected diseases ("About Us: DNDi", 2019; "Charter, DNDi", 2003). DNDi has been founded in 2003 by seven key stakeholders consisting of both public as well as private organizations ("Founding Partners", n.d.). In 2018, DNDi conducted clinical trials in 7 disease areas at 50 sites in 16 countries. Five of these diseases are considered NTDs and DNDi currently has 20 new chemical entities' in their drug development pipeline ("2018 DNDi Annual Report", 2019, p. 8, 27).

Considering the internal structure of DNDi, it consisted of 183 partners in 2018 ("2018 DNDi Annual Report", 2019, p. 6). Furthermore, it operates through a virtual model whereby all of its R&D activities are outsourced ("DNDi Partnership", 2019). Since its establishment in 2003, DNDi has been engaged in building research capacity in disease endemic countries. DNDi has been improving infrastructure at clinical sites, training health staff, sharing knowledge among researchers, and coordinating multi- country studies through regional disease-specific research platforms ("2018 DNDi Annual Report", 2019, p. 32). DNDi receives funding from public institutions, private institutions as well as resources from their own founders ("2018 DNDi Annual Report", 2019, p. 43).

Novartis Institute of Tropical Disease (NITD)

NITD is a public-private partnership between Novartis and the Singapore Economic Development Board. The PPP was established in 2003 and is part of the Novartis Institutes for BioMedical Research (NIBR) ("Novartis Institute for Tropical Diseases", n.d.). NITD's research currently focuses on five parasitic diseases of which three are considered NTDs. The PPP has a geographical focus on Ghana, South-Africa, Tanzania, Zambia, Thailand and Vietnam ("Novartis Institute for Tropical Diseases", n.d.; "Novartis Institute for Tropical Diseases (NITD)", n.d.).

Next to the founding agencies, the PPP has six partners, consisting of academia/research institutes, Global NGOs, Private foundations/development organizations and a product development partnership ("Novartis Institute for Tropical Diseases (NITD)", n.d.). Located in the Biopolis in Singapore, NITD is home to 100 researchers and business associates. Even though they also collaborate on R&D projects with other organizations, their main R&D is conducted in-house. As part of the larger Novartis network, it shares the resources of the Novartis libraries (Herrling, 2006).

In regards to capacity building, NITD contributes to the education of scientists from developing and developed countries that are interested in drug discovery sciences for neglected diseases. Additionally, NITD organises symposia in endemic regions bringing together top researchers in tropical diseases, local doctors, scientists and health officials to better understand the local conditions of patients (Herrling, 2006). No information can be found with regards to NITD's funding model.

The Pediatric Dengue Vaccine Initiative ((P)DVI)

DVI, successor of PDVI, is a consortium of the International Vaccine Institute, World Health Organization, Sabin Vaccine Institute, and the Johns Hopkins University's International Vaccine Access Center. It is led by the International Vaccine Institute, which is an independent non-profit organization. It has been discontinued in 2016 and is resuming in a different partnership, namely GDAC ("Dengue Vaccine Initiative", n.d.). (P)DVI focuses solely on Dengue, but does not maintain a geographical focus. Additionally, it focuses on vaccines as medicinal type ("Why a Vaccine", n.d.). Concerning its Internal Structure, nothing can be found on the number of employees working at PDVI. Besides the consortium partners mentioned above, there are no other members or partners mentioned. The PPP worked under three objectives, relating to the development of evidence for decision

making, creating an enabling environment for the introduction of dengue vaccines and enabling decision making for countries interested in early adoption. The PPP supported the development of dengue vaccines by local manufacturers in endemic regions rather than developing the vaccines themselves ("Dengue Vaccine Initiative", n.d.; "Dengue Vaccine Initiative awarded grant from Germany for development of new dengue vaccines in Brazil and Vietnam", 1970).

The PPP participates in capacity building by strengthening local clinical testing sites (Aparecida Sperança, 2017). Lastly, the PPP has received funding from the Bill & Melinda Gates foundation, as well as the German federal government. The funding from Gates was granted at the launch of the PPP ("Dengue Vaccine Initiative awarded grant from Germany for development of new dengue vaccines in Brazil and Vietnam", 1970).

The Dengue Prevention Program (PHYTOCHIK)

Not a lot of information is available on the PHYTOCHIK project. What is known is that it was aimed at the discovery of natural compounds active against the chikungunya virus in Indian Ocean territory. The project was selected by the Centre de Recherche et de Veille des maladies émergentes dans l'Océan Indian (CRVOI) for financial support, began in March 2009 and ended in December 2011. It consisted of a collaborative network between three Indian Ocean island institutes/laboratories, two French laboratories and one Belgian laboratory (Gurib-Fakim, 2014).

Stamp Out Sleeping Sickness (SOS)

The Stamp Out Sleeping sickness (SOS) campaign is a public private partnership launched in Uganda in October 2006. The SOS partnership founding stakeholders are Ceva Santé Animale, the Centre for Infectious Diseases at the University of Edinburgh , IK Investment Partners/IKARE and the Makerere University. The PPP was formed in response to an emergency situation arising in a number of districts in Northern Uganda where the two strains of Human African Trypanosomiasis (HAT), also known as sleeping sickness, threatened to converge. Cattle in the emergency regions were treated with isometamidium chloride. In the remaining SOS areas cattle were treated with diminazene aceturate. Furthermore, all animals were sprayed with also sprayed with a deltamethrin based insecticide.

The PPP has engaged in building a platform for sustainability through appointing veterinary students from the Makerere University to treat the cattle and educating farmers and key stakeholders on sleeping sickness and the close links between animal health and human health and economic development ("Introduction to the stamp out sleeping sickness campaign", n.d.). Concerning the financial support, Phase 1 of the SOS campaign was financed by donations from CEVA Santé Animal and IK Investment Partners. Together with research inputs from the World Health Organisation, The Wellcome Trust and Department for International Development (DFID) Animal Health Programme, Stamp Out Sleeping Sickness represents a combined investment of more than 900.000 US dollars("Stamp Out Sleeping Sickness", 2019).

HAT control program

The HAT control program is a WHO-led control and surveillance program launched to strengthen support to endemic countries for control activities and ensure wider access to HAT treatments available free of charge. It was established in the early 2000s as a WHO public–private partnership with Sanofi and Bayer HealthCare. WHO ensures the distribution of the donated anti-trypanosomal medicines to endemic countries through this partnership with Sanofi (for pentamidine, melarsoprol and eflornithine) and with Bayer HealthCare (for suramin and nifurtimox) ("Progress on eliminating sleeping sickness as a public health problem", 2019). WHO's approach consisted of helping national programs assess local situations, identify suitable techniques and methodologies, design appropriate structures, develop adapted strategies and implement capacity building activities ("Human African trypanosomiasis", 2016)

The Special Program for Research and Training in Tropical Disease (TDR)

TDR is a program hosted at the World Health Organization (WHO) in Geneva, Switzerland, and is sponsored by the United Nations Children's Fund (UNICEF), the United Nations Development Program (UNDP),the World Bank and WHO (TDR, 2016). TDR focuses on 12 diseases and 8 of these are considered NTDs (TDR, n.d.-a). TDR does not maintain a specific geographical focus and supports the development of research instead of conducting R&D themselves. In 2019 the PPP consisted of 32 employees and 24 contributors/co-sponsors (TDR, n.d.-b).

One of its three main objectives is 'strengthening health research capacity in low- and middle income countries' putting an extensive focus on capacity building (TDR, 2016). In 2019 TDR received funding from its founders as well as external governments and international institutions (funders, n.d.).

Global Dengue & Aedes-Transmitted Diseases Consortium (GDAC))

The Global Dengue & Aedes-Transmitted Diseases Consortium (GDAC) was launched in 2016 and is a consortium of the Partnership for Dengue Control (PDC), the International Vaccine Institute, the International Vaccine Access Center (IVAC) at the Johns Hopkins Bloomberg School of Public Health, and the Duke-NUS Medical School ("About us", n.d.). GDAC brings together the Dengue Vaccine Initiative (DVI) and the Partnership for Dengue Control (PDC) ("DVI and Partnership for Dengue Control (PDC) Launch GDAC", 2016).

GDAC's key objectives are to accelerate innovation and application of vaccines, vector control, antivirals, clinical management, therapeutics, diagnostics and surveillance, licensure and post-marketing oversight of vaccines("Dengue and Aedes-transmitted Diseases", n.d.). In contrast to (P)DVI, GDAC expands its expertise in dengue to other Aedes-transmitted diseases including Zika, chikungunya and yellow fever("DVI and Partnership for Dengue Control (PDC) Launch GDAC", 2016).

Additional to its main activities, GDAC focuses on strengthening social mobilization, advocacy and capacity building("Dengue and Aedes-transmitted Diseases", n.d.).GDAC is funded in part by drug-makers that works closely with WHO and furthermore states that they work closely with international funders("DVI and Part-

nership for Dengue Control (PDC) Launch GDAC", 2016; Steenhuysen, 2019). It is not clear if the other part is funded by the consortium members themselves or depends fully on external funds.

Partnership for Dengue Control (PDC)

PDC was created in 2013 to spearhead an integrated approach to seasonably control and prevent dengue. As a multi-sponsored, independent and non-profit foundation, it brings together experts in the dengue-prevention community from different fields to address key issues, with an emphasis on combining vector control and vaccination strategies ("Partnership for Dengue Control (PDC)", 2013).

PDC seeks to build synergies among the many new and innovative tools in the development pipeline. Its approach is developed through workshops, multidisciplinary task forces, research agenda, advocacy and other initiatives. Hosted by the Mérieux Foundation, PDC is led by an independent board and currently participates in the GDAC consortium ("About us", n.d.). PDC has received funding from several NGOs and industrial partners (vaccines and insecticides manufacturers) (Gubler, 2015).

The Infectious Disease Research Institute (IDRI)

IDRI was established in 1994 as a not-for-profit, non-governmental, US scientific organization to develop vaccines, therapeutics and diagnostics for a range of diseases of the developing world.("International Trachoma Initiative (ITI)", n.d.). IDRI scientists collaborate with academic, government, nonprofit, and industry partners to translate research into new drugs, vaccines, adjuvants, and diagnostics. Diseases of interest to IDRI include leishmaniasis, leprosy, malaria and tuberculosis. The institute does not maintain a geographical focus ("Infectious Disease Research Institute", n.d.; "Infectious Disease Research Institute (IDRI)", n.d.).

IDRI has its own facilities where it conducts R&D. Additionally, the organization has 125 employees headquartered in Seattle with nearly 100 partners/collaborators around the world and is funded by donations (BioSpace, 2016; "Infectious Disease Research Institute", n.d.).Lastly, IDRI is engaged in supporting other countries to produce their own vaccines through exchanging antigens and collaborating (EurekAlert, 2019).

The German Leprosy Relief Association (GLRA)

GLRA, also known as Deutsche Lepra und Tuberkulosehilfe e.V. is an independent non governmental organisation, founded in 1957. Their disease scope consists of 7 NTDs and tuberculosis, treating bacteria, parasites and protozoa all over the globe ("DAHW: Annual report 2018", 2019).

In 2018, a total of 154 GLRA employees worked in 83 projects in 21 countries in Africa, Asia and Latin America. The PPP includes a large network of over 40 partners. Concerning their R&D activities, they support research conducted in the interests of improving prevention, diagnostics, therapy and medical-social rehabilitation for their target groups. GLRA aims at encouraging sustainability and build local skills and is fully funded by external donations ("DAHW: Annual report 2018", 2019).

The Global Program to Eliminate Lymphatic Filariasis (GPELF)

GPELF is a WHO program launched in 2000. The program's aim is to implement Mass drug administration (MDA)for the treatment of lymphatic disease. The necessary drugs were donated by GlaxoSmithKline (GSK) and Merck & Co., Inc (Gustavsen et al., 2009). In 2015 a cumulative total of 5.62 billion treatments were delivered by GPELF to ¿1 billion people from across the globe ("Weekly epidemiological record", 2015). Currently the program is still in operation and encompasses a large network of partners, which include individual national programs and NGOs ("Lymphatic filariasis", n.d.).

In the 2003-2005 strategic plan of GPELF, it is stated that inter-county workshops and national level training's were conducted to strengthen the local capacities and knowledge on lymphatic filariasis. Initial funding for the implementation of GPELF was provided by a number of concerned bilateral aid agencies (governments of the UK, Japan and U.S.) and foundations (Bill & Melinda Gates Foundation, Arab Fund for Economic and Social Development) (Ichimori & Ottesen, 2011).

The Global Alliance for Elimination of Lymphatic Filariasis (GAELF)

GAELF is a public-private partnership created in 2000 between two pharmaceutical companies, an university and the WHO to assist GPELF in advocacy, resource mobilisation and programme implementation. It is focused on eliminating Lymphatic Filariasis for which it employs anti-parasitic drugs. The PPP has around 150 global partners

GlaxoSmithKline, Merck & Co Inc. and Eisai Co. Ltd. have pledged albendazole, Mectizan® and diethylcarbamazine (DEC) respectively and the secretariat of GAELF is provided by the Liverpool School of Tropical Medicine (Lee & Fang, 2013).

GAELF encourages country-level resource mobilisation by providing training and materials for country programmes to mobilise support from local companies and non-governmental organisation. The PPP is funded by governments as well as private foundations and benefits from donations by its private founders (Lee & Fang, 2013).

The African Programme for Onchocerciasis Control (APOC)

APOC is the second creation of a group of 15 NonGovernmental Development Organizations (NGDO) and sponsoring agencies, the first being the Onchocerciasis Control Program (OCP). APOC was launched in 1995 to combat the rest of Africa 's river blindness. The programme includes the active involvement of the Ministries of Health and their affected communities, several international and local NGDOs, the private sector (Merck & Co., Inc.), donor countries and UN agencies. The World Bank is the Fiscal Agent of the Programme and WHO is the Executing Agency of the Programme. APOC ended in 2015 ("African Programme for Onchocerciasis Control (APOC)", 2018).

The PPP focuses on Community-Directed Treatment with Ivermectin (CDTI), which is donated by founders from the private sector. Additionally the PPP empowers local communities to fight river blindness in their own villages, relieving

suffering and slowing transmission. APOC is funded entirely from voluntary contributions given to founders or received from external parties ("African Programme for Onchocerciasis Control (APOC)", 2018; "Funding", 2010).

The Onchocerciasis Control Program (OCP)

The OCP is an collaboration between the World Health Organization, the World Bank, the United Nations Development Programme (UNDP) and Food and Agriculture Organization (FAO). These UN agencies constitute the sponsoring agencies of OCP. The program stretches over 11 countries and included 11 participating countries ("Onchocerciasis Control Programme (OCP)", 2018).

At the beginning the PPP's operations were exclusively based on the spray of insecticides by aircrafts, but following the donation of Mectizan® (ivermectin) by Merck & Co., Inc. in 1987, control operations changed from exclusive vector control to larviciding combined with ivermectin treatment or, in some areas, to ivermectin treatment alone. OCP was officially closed in December 2002 ("Onchocerciasis Control Programme (OCP)", 2018; Tekle et al., 2016).

The Onchocerciasis Elimination Program for the Americas (OEPA)

OEPA is a regional initiative, created in 1993, with the goal of eliminating morbidity and interrupting transmission of Onchocerciasis/river blindness in six endemic countries in the Americas. The PPP is a multinational, multi-agency coalition that includes the endemic countries, PAHO, The Carter Center, Lions Clubs, the United States Centers for Disease Control and Prevention, The Bill and Melinda Gates Foundation, Merck & Co., Inc., and other partners(Sauerbrey et al., 2018).

OEPA has received funding from country governments as well as OEPA partners. Currently, OEPA has reached its goal as there are no new cases of blindness attributable to Onchocerciasis in the American region (Sauerbrey et al., 2018).

The Onchocerciasis Vaccine for Africa (TOVA)

The Sabin Vaccine Institute Product Development Partnership has established The Onchocerciasis Vaccine for Africa (TOVA) Initiative, together with more than 10 universities from Africa, America and Europe to pursue the development of an onchocerciasis vaccine (Hotez et al., 2015). TOVA has its origins in the Onchocerciasis vaccine program of the Edna McConnell Clark Foundation. When the programme ended, the 14 collaborating laboratories had developed three animal models and identified a portfolio of 15 O volvulus vaccine candidates. Currently TOVA has set its goal to take at least one vaccine candidate through Phase I trials by 2025 and Phase II trials by 2030 ("Origins of TOVA", n.d.; "TOVA — The Partners", n.d.).

The Regional Network for Asian Schistosomiasis (RNAS)

RNAS was facilitated by an initiating collaborative research grant from WHO/TDR in 1999 and started in 2000 as a small schistosomiasis action network in the Philippines and China (Zhou et al., 2002). In 2009 the network had been expanded to RNAS+ and operated in nine countries and targeted several helminth diseases in addition to schistosomiasis. The tasks undertaken by the RNAS+ were also expanded to include training, GIS mapping and advocacy.

The RNAS+ is supported by a number of international institutions, particularly the Queensland Institute of Medical Research (QIMR), the Danish Bilharziasis Laboratory (DBL) and the Swiss Tropical Institute (STI). The RNAS+ also receives support from the WHO. RNAS+ collaborates with more then 10 partners to provide training courses with the aim of research capacity building (Yang et al., 2010).

The Human Hookworm Initiative (HHVI)

HHVI is a partnership between the Sabin Vaccine Institute and the Texas Children's Hospital Center for Vaccine Development at Baylor College of Medicine in Houston. The partnership lasted from 2010 until 2017 and was aimed at developing safe, effective and low-cost vaccines to prevent moderate to severe hookworm infection in children living in endemic areas. The initiative has been supported by the Bill & Melinda Gates Foundation, Dutch Ministry of Foreign Affairs, European Commission Framework Programme 7, Government of Brazil and the Michelson Medical Research Foundation ("Hookworm", n.d.).

The International Trachoma Initiative (ITI)

ITI was co-established in 1998 by Pfizer and the Edna McConnell Clark Foundation. It is an independent not-for-profit organization dedicated to eliminating trachoma. Currently the PPP is housed at the Task Force for Global Health and manages Pfizer's donation of the antibiotic, Zithromax® (azithromycin). ITI collaborates with more than 10 governmental and nongovernmental agencies at local, national, and international levels to implement the World Health Organization (WHO) recommended SAFE strategy for trachoma control ("International Trachoma Initiative", n.d.; "International Trachoma Initiative (ITI)", n.d.).

The PPP has received financial support from the Bill & Melinda Gates foundation and the U.K. Department for International Development, in addition to financial support from its founders Pfizer and EMCF (Ekola, n.d.).

ENVISION

ENVISION is a temporary project funded by the U.S. Agency for International Development (USAID) and aimed at providing assistance to national NTD control programs for the control and elimination of seven targeted NTDs: lymphatic filariasis, trachoma, onchocerciasis, schistosomiasis, and three soil-transmitted helminths (roundworm, hookworm, whipworm) ("ENVISION", 2017; "USAID extends RTI International-led project to eliminate neglected tropical diseases", 2015).

ENVISION was implemented by RTI International in partnership with CBM

International, The Carter Center, Fred Hollows Foundation, Helen Keller International, IMA World Health, Light for the World, Sightsavers, and World Vision. The period of performance for ENVISION was September 30, 2011 through September 30, 2019 ("ENVISION", 2017).

ENVISION strengthened the capacity of nearly 4,000 trainees across 17 countries by providing training on skills related to Monitoring & Evaluation. Additionally, ENVISION coordinated between national NTD and drug donation programs from private companies, helping to track applications, approvals, and shipments of donated drugs ("The ENVISION impact — Final Report", 2019).