THE CENTER FOR POLICY IMPACT IN GLOBAL HEALTH

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Health and economic benefits of improving efficiencies in product development for neglected diseases, emerging infectious diseases, and maternal health

提高被忽视疾病、新发传染病和孕产妇保健产品开发效率的健康和经济获益

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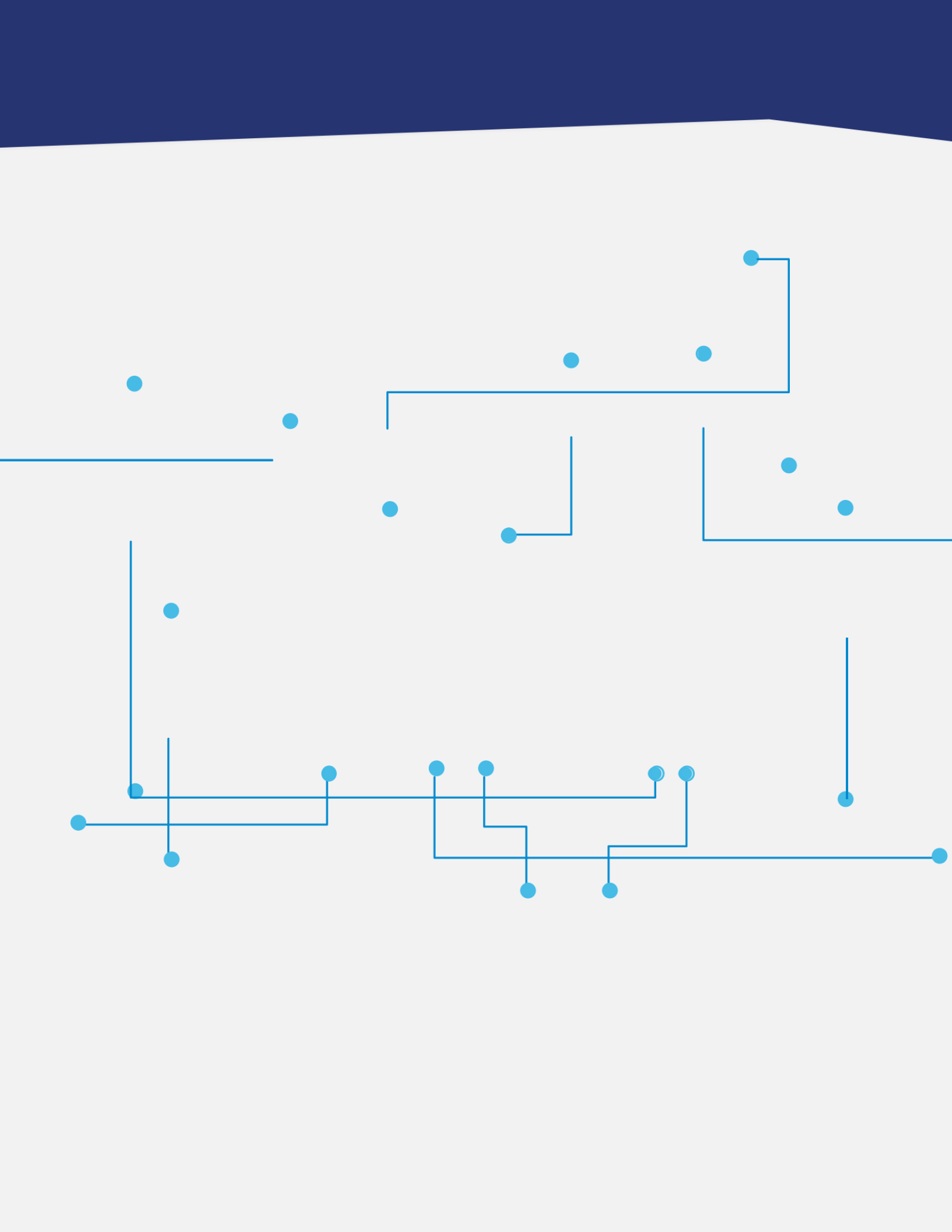


EXECUTIVE SUMMARY 执行摘要

Over the past 20 years, investments in global health research and development (R&D) have led to launches of many effective products that have saved lives in low- and middle-income countries. These investments have also led to a much more robust product development pipeline for neglected diseases (NDs), emerging infectious diseases (EIDs), and maternal health (MH). Twenty years ago, for example, we had no malaria vaccine, and the only available tuberculosis (TB) vaccine was of low efficacy—today, we have two malaria vaccines and three TB vaccine candidates are in phase 3 clinical trials.

在过去 20 年，全球医疗健康研发投资推出了多个有效产品，挽救了无数中低收入国家的生命。这些投资还使被忽视疾病（NDs）、新发传染病（EIDs）和孕产妇保健（MH）的产品开发管线更加健全。例如，20 年前，我们没有疟疾疫苗，唯一可用的结核病疫苗效力很低，而今天，我们有两种疟疾疫苗和三种结核病候选疫苗正在进行三期临床试验。

However, these successes are threatened in the post-COVID era by reduced availability of funds and increased competition for scarce global health resources. The good news is that recent innovations in the R&D ecosystem, such as artificial intelligence, smarter clinical trials, lower manufacturing costs, and faster market entry, could significantly improve the efficiency of global health product development over the next 20 years.

然而，在后新冠时代，可获得的资金减少，再加上对稀缺的全球医疗健康资源竞争加剧，捍卫这一硕果成为一大挑战。好消息是，研发生态系统中最近的创新，如人工智能、更智慧的临床试验、更低的制造成本和更快的市场准入，可能会在未来 20 年显著提高全球健康产品的开发效率。

In this study, we assessed the potential efficiency gains from these game-changing innovations in the global health product development ecosystem. We interviewed experts, policymakers, and other stakeholders to understand and quantify the expected changes to the R&D ecosystem (See accompanying report for details). We then developed quantitative models to assess the health and economic impact of these innovations.

在本研究中，我们评估了全球医疗健康产品开发生态系统中变革性创新所带来的潜在效率获益。我们采访了专家、政策制定者和其他利益相关者，以了解和量化研发生态系统的预期变化（详见随附报告）。接下来，我们开发了定量模型来评估这些创新对健康和经济的影响。

Our unit of analysis was the product portfolio. Adopting the disease categories used by Policy Cures Research's G-Finder online repository, and three product archetypes (vaccines, therapeutics, and diagnostics), we grouped the 1,498 candidate products in the current product pipeline into 153 product portfolios (38 ND vaccines portfolios, 38 ND therapeutics portfolios, 38 ND diagnostics portfolios, 9 EID vaccines portfolios, 9 EID therapeutics portfolios, 9 EID diagnostics portfolios, 6 MH therapeutics portfolios, and 6 MH diagnostics portfolios).

我们的分析单位是产品组合。采用 Policy Cures Research 的 G-Finder 在线存储库使用的疾病类别和三种产品原型（疫苗、治疗和诊断），我们将当前产品线中的 1,498 种候选产品分为 153 个产品组合（38

种 ND 疫苗组合、38 种 ND 治疗组合、38 种 ND 诊断组合、9 种 EID 疫苗组合、9 种 EID 治疗组合、9 种 EID 诊断组合、6 种 MH 治疗组合，以及 6 个 MH 诊断产品组合）。

We compared four alternative scenarios: (i) a reference case where investments in the current pipeline continue as usual, (ii) a coordinated investments scenario with targeted investments to guarantee at least one product launch in each product portfolio, (iii) an AI and smarter clinical trials scenario, and (iv) a shortened market entry and lower manufacturing costs scenario. We compared each scenario with a "do nothing" scenario to estimate the incremental costs and benefits from that scenario. We then compared these across all scenarios to assess which provided better net benefits.

我们比较了四种替代情景：（i）当前管线投资照常进行的参考情景，（ii）协调投资情景，即有针对性投资，以保证每个产品组合中至少有一种产品推出，（iii）有人工智能和更智慧的临床试验存在的情景，以及（iv）缩短市场准入和降低制造成本的情景。我们将每个情景与"无为"的情景比较，以评估该情景的增量成本和获益。然后，我们将这些情景与所有情景比较，以评估哪种情景能提供更好的净获益。

We adopted two perspectives for our analysis: a health systems perspective and a societal perspective. For both perspectives, we measured health gains as deaths averted and disability-adjusted life-years (DALYs) lost averted. The health system perspective included preclinical and clinical research costs, product procurement costs (manufacturing and delivery), and treatment costs. In contrast, the societal costs included all the costs from the health system's perspective and economic productivity loss. We computed costs and benefits over a 22-year period from 2023 to 2044. We compared scenarios using incremental cost ratio (ICER) per death averted, ICER per DALY averted, and net monetary benefits (NMBs).

我们采用了两种分析视角：医疗健康体系视角和社会视角。对于这两种观点，我们以避免的死亡和避免的伤残调整生命年（DALYs）损失来衡量健康获益。医疗健康体系视角包括临床前和临床研究成本、产品采购成本（制造和交付）以及治疗成本。相比之下，社会成本包括医疗健康体系视角的所有成本和经济生产力损失。我们计算了从 2023 年到 2044 年这 22 年期间的成本和获益。我们使用每例避免死亡的增量成本效果比（ICER）、每例避免 DALY 的增量成本效果比（ICER）和净货币收益（NMBs）来比较不同的情景。

Investments in the current product pipeline, assuming no efficiency improvements, will lead to successful launches from 59 product portfolios, leaving 94 product portfolios with no successful product launch. From these 59 portfolios with product launches, we expect 39 vaccines for NDs, 52 ND therapeutics, 148 ND diagnostics, 12 EID vaccines, 17 EID therapeutics, 64 EID diagnostics, 55 MH therapeutics, and 66 MH diagnostics. The 93 product portfolios without a successful launch include 31 ND vaccines portfolios, 33 ND therapeutics portfolios, 11 ND diagnostics portfolios, 6 EID vaccines portfolios, 5 EID therapeutics portfolios, 3 EID diagnostics portfolios, 2 MH therapeutics portfolios, and 3 MH diagnostics portfolios.

假设效率不变，对当前产品管线的投资将带来 59 个产品组合的成功发布，剩余 94 个产品组合没有成功的产品发布。在这 59 个已发布产品组合中，我们预计将有 39 种 ND 疫苗、52 种 ND 治疗药物、148 种 ND 诊断产品、12 种 EID 疫苗、17 种 EID 治疗药物、64 种 EID 诊断产品、55 种 MH 治疗药物和 66 种 MH 诊断产品。未成功上市的 93 个产品组合包括 31 个 ND 疫苗组合、33 个 ND 治疗组合、11 个 ND 诊断组合、6 个 EID 疫苗组合、5 个 EID 治疗组合、3 个 EID 诊断组合、2 个 MH 治疗组合和 3 个 MH 诊断组合。

Additional funding will be needed to guarantee at least one product launch from each product portfolio. To estimate this funding gap, we compared current annual funding to the estimated annual funding required to guarantee missing product launches. We assumed a best-case scenario where the current pipeline is replenished with simple candidate products and a worst-case scenario where the current pipeline is replenished with complex candidate products that take longer to develop, are more expensive, and have lower probabilities of success. Our estimates suggest that over the next ten years, an additional $1.4 billion to $7 billion will needed annually for product development, depending on the complexity of the product candidates. This will close the funding gap in the ND, EID, and MH product pipelines. This annual product development funding gap comprises $1.1 billion to $5.9 billion for NDs, $143 million to $794 million for EIDs, and $191 million to $256 million for MH products.

需要额外的资金来保证每个产品组合中至少有一个产品推出。为了估计这一资金缺口，我们比较了当前的年度资金和确保（前面说到的 94 个）没有一个产品成功发布的产品组合发布所需的年度资金。我们假设了最好的情景，即当前管线由简单的候选产品补充；及最坏的情景，即当前管线由复杂的候选产品补充，需要更长的开发时间、成本更高，且成功的概率更低。我们的估计表明，在未来十年，取决于候选产品的复杂性，每年将需要额外的 14 亿至 70 亿美元用于产品开发。这将弥补 ND、EID 和 MH 产品管线的资金缺口。年度产品开发资金缺口包括 NDs 产品的 11 亿至 59 亿美元，EID 产品的 1.43 亿至 7.94 亿美元，MH 产品的 1.91 亿至 2.56 亿美元。

Closing this funding gap will strengthen the current product pipeline and provide positive health and economic benefits to society. In addition to guaranteeing at least one successful product launch in each of the 94 portfolios with missing products, we expect the number of product portfolios yielding positive NMBs to society to increase from 42 to 106. ICER per DALY averted will be cost-saving for fifteen ND vaccines portfolios and one EID vaccines portfolio. In contrast, ICERs per DALY averted for the other portfolios will range from $6 for the tapeworm therapeutics portfolio to over $400 million for vaccines or therapeutics portfolios for mycetoma (a low-prevalence, low-mortality condition).

填补这一资金缺口将加强当前的产品线，并为社会带来积极的健康和经济获益。除了保证在没有成功产品发布的剩余 94 个产品组合中，每个组合至少有一个成功的产品发布外，我们预计对社会产生积极净货币收益（NMBs）的产品组合数量将从 42 个增加到 106 个。避免的每例 DALY 所带来的增量成本效果比（ICER）将为 15 种 ND 疫苗组合和 1 种 EID 疫苗组合带来成本节约。相比之下，其他投资组合每个避免的 DALY 所产生的 ICERs，从绦虫治疗组合的 6 美元到足菌肿（低流行率、低死亡率疾病）疫苗或治疗组合的 4 亿多美元不等。

We quantified gains from efficiency improvements as cost savings, reduction in average cost-per-launch (CPL), additional lives saved (deaths averted), and increase in the number of portfolios that provide positive NMBs to society. We estimated that advancements in AI and the adoption of smarter clinical trials will reduce the total cost of ND product development from $40.2 billion to $33.6 billion, EID development from $8.8 billion to $7.5 billion, and MH product development from $3.9 billion to $3.1 billion. These cost savings will translate to a 26% to 39% reduction in the average CPL across all product portfolios, with diagnostics portfolios seeing CPL reductions of up to $8 million, therapeutics portfolios up to $52 million, and vaccines portfolios up to $122 million.

我们将效率提高带来的获益量化为成本节约、每次发布平均成本（CPL）的降低、额外挽救的生命（避免的死亡），以及为社会提供积极 NMB 的投资组合数量的增加。我们估计，人工智能的进步和更智慧的临床试验将使 ND 产品开发的总成本从 402 亿美元降至 336 亿美元，EID 开发的总成本从 88 亿美元降至 75 亿美元，MH 产品开发的总成本从 39 亿美元降至 31 亿美元。这些成本节约将转化为所有产品组合的平均 CPL 减少 26%至 39%，其中诊断产品组合的 CPL 节约高达 800 万美元，治疗产品组合的 CPL 节约高达 5200 万美元，疫苗产品组合的 CPL 节约高达 1.22 亿美元。

To identify priority products for development, we used a multi-criteria approach that includes NMBs to assess economic efficiencies from a societal perspective and ICER per death averted and ICER per DALY averted to assess economic efficiencies from a health system perspective. Using these metrics, we found that investing in 15 ND vaccine portfolios and one EID vaccine portfolio will lead to cost savings for the health system and positive NMBs to society. These include portfolios for S. pneumoniae, multiple diarrheal diseases, typhoid and paratyphoid, P. falciparum, multiple/other malaria strains, tuberculosis, rotavirus, N. meningitidis, HIV/AIDS, dengue, hepatitis B, multiple Salmonella infections, Strongyloidiasis, cryptococcal meningitis, rheumatic fever, and Zika.

为确定优先开发的产品，我们使用了一种多标准方法，包括了 NMB，以便从社会角度评估经济效率，还包括了避免每例死亡的 ICER 和避免每例 DALY 的 ICER，以便从医疗健康体系的角度评估经济效率。利用这些指标，我们发现投资 15 种 ND 疫苗组合和 1 种 EID 疫苗组合将为医疗健康体系节省成本，并为社会带来积极的 NMB。这些组合包括肺炎链球菌、多种腹泻疾病、伤寒和副伤寒、恶性疟原虫、多种/其他疟疾菌株、结核病、轮状病毒、脑膜炎奈瑟菌、艾滋病毒/艾滋病、登革热、乙型肝炎、多种沙门氏菌感染、类圆线虫病、隐球菌性脑膜炎、风湿热和寨卡病毒。

In addition, 15 other ND vaccine portfolios, one other EID vaccine portfolio, 29 ND therapeutics portfolios, 30 ND diagnostic portfolios, and 3 EID diagnostic portfolios will have positive NMBs. All six MH therapeutics and six MH diagnostic portfolios will yield positive NMBs. We report the overall rankings and also rank products by disease category and product archetype.

此外，15 种其他 ND 疫苗组合、1 种其他 EID 疫苗组合、29 种 ND 治疗组合、30 种 ND 诊断组合和 3 种 EID 诊断组合将产生积极的 NMBs。所有六种 MH 治疗方法和六种 MH 诊断组合将产生积极的 NMBs。我们不仅报告了总体排名，也按疾病类别和产品原型对产品排名。

In our interactions with policymakers and other stakeholders, they were quick to highlight that factors beyond economic considerations influence their prioritization and decision-making process. These factors include equity considerations, political feasibility, national security, etc. Our rankings did not include these factors, thus our results should be interpreted strictly in economic terms. Nevertheless, our analysis presents a strong economic case for future investments in product portfolios that are both cost-saving to the health system and yield positive NMBs to society.

在我们与政策制定者和其他利益相关者的互动中，他们很快强调，经济之外的因素影响了他们对优先次序的选择和决策过程。这些因素包括公平性、政治可行性、国家安全等。我们的排名没有考虑这些因素，因此我们的结果应该严格从经济角度来

解释。然而，我们的分析从经济的角度强调了投资于未来产品组合的重要性，这些产品组合既可以为医疗健康体系节省成本，又可以为社会产生积极的 NMB。

SECTION

第二章

BACKGROUND 背景

In this working paper, we provide estimates of the potential health and economic benefits of investing in global health product development. We wstimated the health and economic benefit under different assumptions about the potential efficiency gains from various research and development (R&D) ecosystem shifts (e.g., trial networks and regulatory harmonization). We focused on three major categories of products:

在本工作文件中，我们评估了投资于全球医疗健康产品开发的潜在健康和经济获益。我们评估了在研发（R&D）生态系统变迁（例如试验网络和监管标准统一化）带来的潜在效率获益的不同假设下的健康和经济获益。

我们专注于三大类产品：

(i) neglected diseases neglected diseases (NDs),

被忽视的疾病（NDs），

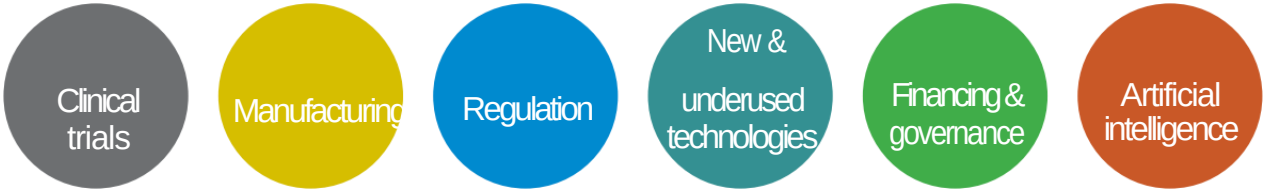
(ii) emerging infectious diseases (EIDs), 新发传染病（EIDs）

(ii) maternal health (MHs).

孕产妇保健（MH）

Our report builds on formative work detailed in our earlier working paper: “Reforming the research and development ecosystem for neglected diseases, emerging infectious diseases, and maternal health.” We adopted an analytic framework that included six key components of the R&D ecosystem:

我们的报告建立在我们早期工作文件中详细介绍的形成性工作的基础上：“改革被忽视疾病、新发传染病和孕产妇保健的研发生态系统”。我们采用了一个分析框架，其中包括研发生态系统的六个关键组成部分：



临床试验

制造

监管

新的和未充分使用的技术

金融和治理

人工智能

We conducted an extensive review of existing research on each topic, held a validation workshop to get inputs from over 30 policymakers, and conducted over 60 key informant interviews with experts worldwide.

我们广泛调查了每个领域的现有研究，举办了一次验证研讨会，听取了 30 多位政策制定者的意见，并与全球专家举行了 60 多次关键信息提供者访谈。

We found opportunities for major improvements inefficiencies across all six domains. For example, establishing trial networks and data sharing could reduce clinical trial costs by 20% – 40%; regulatory harmonization can reduce approval times from over three years to less than one year; artificial intelligence (AI) can significantly reduce discovery time and costs; and modular mRNA manufacturing can reduce manufacturing costs by over 60%.

我们在所有六个领域中都发现了改进效率的重大机会。例如，建立试验网络和共享数据可将临床试验成本降低 20% - 40%；统一监管标准可将审批时间从三年多减少到不到一年；人工智能（AI）可显著减少发现的时间和成本；模块化 mRNA 制造可降低 60%以上的制造成本。

To assess the health and economic benefits of these potential efficiency gains, we developed a reference case to model the current R&D ecosystem (i.e., without efficiencies from changing the R&D ecosystem). Then, we modeled three “efficiency gains” scenarios and compared the potential costs and benefits to the reference case. We provide details in the sections that follow. Section 2 describes our methods, including approaches to estimating costs and valuing health benefits. Section 3 describes the current pipeline with and without replenishments, Section 4 provides estimates of required costs and funding gap for product development, Section 5 describes the

Regulatory harmonization can reduce approval times from over three years to less than one year; artificial intelligence (AI) can significantly reduce discovery time and costs

监管标准统一可将审批时间从三年多减少到一年以下；人工智能（AI）可大幅减少发现的时间和成本

Establishing trial networks and data sharing could reduce clinical trial costs by 20% – 40%

建立试验网络和共享数据可将临床试验成本降低20% - 40%

health and economic benefits from successful product launches, Section 6 describes the potential costs and benefits of efficiency gains, and Section 7 discusses the top priority products based on value for money indicators from a health system and a societal perspective.

为评估这些潜在效率提升带来的健康和经济获益，我们开发了一个参考案例来模拟当前的研发生态系统（即未从研发生态系统改革中获得效率的情景）。然后，我们建立了三种“效率增益”情景模型，并将其潜在的成本和获益与参考案例进行了比较。我们将在接下来的章节中提供详细信息。第 2 章描述了我们的方法，包括估算成本和评估健康获益的方法。第 3 章描述了当前管线有和没有补充的情景，第 4 章提供了产品开发所需成本和对资金缺口的估计，第 5 章描述了成功产品发布的健康和经济获益，第 6 章描述了效率提升的潜在成本和获益，第 7 章讨论了基于医疗健康体系和社会角度的物有所值指标确定的享有最高优先级的产品。

SECTION

ANALYTIC APPROACH
分析方法

ANALYTIC APPROACH 分析方法

We conducted our analyses in two stages. In the first stage, we estimated the likely product launches from the product development pipeline and the costs of R&D to achieve these product launches. Then, in the second stage, we estimated the post-launch costs, health benefits, and economic benefits for product portfolios with a successful product launch.

我们分两个阶段进行分析。在第一阶段，我们从产品开发管线中估计可能的产品发布以及实现这些产品发布的研发成本。然后，在第二阶段，我们估计了成功推出产品组合的上市后成本、健康获益和经济效益。

Our unit of analysis was the product portfolio. Adopting the disease categories used by Policy Cures Research's

G-Finder online repository, and three product archetypes (vaccines, therapeutics, and diagnostics), we grouped the

1,498 candidate products in the current product pipeline into 153 product portfolios (38 ND vaccines portfolios, 38

ND therapeutics portfolios, 38 ND diagnostics portfolios, 9 EID vaccines portfolios, 9 EID therapeutics portfolios, 9 EID diagnostics portfolios, 6 MH therapeutics portfolios, and 6 MH diagnostics portfolios. The model structure, variables, and parameters used for the study can be found in Appendix section A1.

我们的分析单位是产品组合。采用 Policy Cures Research 的 G-Finder 在线存储库使用的疾病类别和三种产品原型(疫苗、治疗和诊断)，我们将当前产品线中的 1,498 种候选产品分为 153 个产品组合(38 种 ND 疫苗组合、38 种 ND 治疗组合、38 种 ND 诊断组合、9 种 EID 疫苗组合、9 种 EID 治疗组合、9 种 EID 诊断组合、6 种 MH 治疗组合)。6 个 MH 诊断产品组合。本研究使用的模型结构、变量和参数见附录 A1。

2.1 Analytic perspectives, time horizon, and discount rates 分析视角，时间范围和贴现率

We adopted two perspectives for our analysis: a societal perspective and a health systems perspective (Table 1).

We defined the societal perspective as the total costs and benefits that accrue to society from investments in the product-pipeline development value chain. We included preclinical research costs, clinical trial costs, manufacturing costs, and treatment costs. For benefits, we included the number of successful product launches, deaths averted

from a successful product launch, disability-adjusted life years (DALYs) averted from a successful product launch, and productivity benefits from deaths and DALYs averted.

我们采用了两种视角进行分析：社会视角和医疗保健系统视角（表 1）。

我们将社会视角定义为产品管线开发价值链中投资对社会产生的总成本和获益。对于总成本，我们纳入了临床前研究成本、临床试验成本、制造成本和治疗成本。对于获益，我们纳入了成功产品发布的数量、成功产品发布避免的死亡、成功产品发布避免的伤残调整生命年（DALYs），以及避免的死亡和 DALYs 带来的生产力的提升。

We defined the health systems perspective as the potential health benefits to society and financial benefits to the health system that result from investing health system funds in product pipeline R&D, manufacturing, delivery, and treatment of conditions. We included the costs of conducting preclinical research and clinical trials and the

cost of manufacturing successful products, costs of delivering new products, and costs of providing treatment for the condition. For benefits, we included the number of product launches and deaths/DALYs averted because of a successful product launch.

我们将医疗健康体系视角定义为将医疗健康体系的资金投资于产品管线的研发、制造、交付和疾病治疗，从而给社会带来的潜在健康获益和医疗保健系统带来的经济效益。对于成本，我们纳入了进行临床前研究和临床试验的成本，制造成功产品的成本，交付新产品的成本，以及提供治疗的成本。对于获益，我们纳入了产品发布的数量和由于产品成功发布而避免的死亡/DALYs。

Our analysis covered a 21-year period from 2023 to 2044, and we applied a 0% annual discount rate to costs.

我们的分析涵盖了从 2023 年到 2044 年的 21 年，我们对成本采用了 0%的年贴现率。

Table 1: Perspectives adopted

表 1：采用的视角

Perspective 视角	Costs included 纳入的成本	Benefits included* 纳入的获益*	Estimates reported 报告的估计
Societal perspective 社会视角	1. Preclinical and clinical trial costs. 临床前和临床试验成本。 2. Manufacturing costs.制造成本。 3. Product delivery/ administration costs. 产品交付/管理成本。 4. Treatment costs**治疗成本**	Product launches Health gains 产品发布带来的健康获益 1. Deaths averted.避免的死亡 2. DALYs averted. 避免的 DALYs Economic gains 经济效益 1. Productivity benefits from health gains.健康获益带来的生产力获益。	1. Net monetary benefits to society. 对社会的净货币收益。
Health systems perspective 医疗保健系统视角	1. Preclinical and clinical trial costs. 临床前和临床试验费用。 2. Manufacturing costs 制造成本	Launches Health gains 产品发布带来的健康获益 1. Deaths averted 避免的死亡	1. Incremental cost per death averted. 避免每例死亡的增量成本。 2. Incremental cost per DALY averted. 避免

	3. Product delivery/ administration costs 产品交付/管理成本 4. Treatment costs**. 治疗**	2. DALYs averted 避免的 DALYs	的每例 DALY 增量成本。

NOTES: 注:

* DALYs are disability-adjusted life years. DALYs 是残疾调整生命年。

** Treatment costs comprise the total cost of treating an episode of the disease; this includes drug costs, health worker fees, health facility fees, diagnostic costs, etc.

治疗费用包括治疗疾病发作的总费用，包括药费、医疗保健工作者的费用、医疗设施的费用、诊断费用等。

2.2 Analytics and assumptions 分析和假设

We adopted a portfolio-approach to model expected product launches from each product portfolio. The portfolio approach allows for modeling of several products in a single portfolio to assess the likelihood of a successful product launch, the expected number of product launches from each portfolio, and the expected launch year for each product launch. However, this approach cannot specify which particular products in the pipeline will be successful. Depending on the current location of each candidate product in the pipeline, progress to the next stage was determined by the product archetype, expected duration of clinical trial, and the expected probability of trial success. We considered a portfolio to have a successful launch if the value of expected product launches was greater than 1.

我们采用组合方法对每个产品组合中的预期产品发布建模。投资组合方法允许对单个投资组合中的多个产品建模，以评估每个投资组合中成功产品发布的可能性、产品发布的预期数量，以及每个产品发布的预期年份。然而，这种方法不能指定管线中的哪些特定产品将会成功。根据每个候选产品当前在管线中的位置，下一阶段的进展由产品原型、临床试验的预期持续时间和试验成功的预期概率决定。如果预期产品发布的价值大于 1，我们认为一个投资组合会有一个成功的发布。

We modelled the health and economic benefits of each product-portfolio. separately. For each scenario, we estimated costs and benefits from a health system's perspective and a societal perspective (Table 1). From a health system's perspective, we estimated the incremental cost-effectiveness ratios (ICERs) per death averted and per DALY averted. We calculated ICERs as the difference between investing in R&D and not investing in R&D (Appendix Table A2.1). From a societal perspective, we estimated net monetary benefits (NMBs) as a function of health benefits, gross domestic product per capita, costs of preclinical/clinical trials, manufacturing costs, and treatment costs (Appendix Table A2.1).

我们对每个产品组合的医疗健康和经济获益建模。对于每种情景，我们从医疗健康体系的视角和社会的视角评估了成本和获益（表 1）。从医疗健康体系的角度，我们评估了每例避免死亡和每例避免 DALY 的增量成本获益比（ICERs）。我们将 ICERs 计算为投资研发与不投资研发之间的差异（附录表 A2.1）。从社会视角来看，我们估计净货币收益（NMB）是健康获益、人均国内生产总值、临床前/临床试验成本、制造成本和治疗成本的函数（附录表 A2.1）。

To enable easy comparison across product archetypes and disease categories, we made a few simplifying assumptions about the effect of each product archetype. We assume that vaccines reduce incidence, therapeutics reduce mortality and disease duration when treated, and diagnostics increase treatment uptake. We also assume that vaccine coverage at baseline is 0% for all disease/conditions.

为便于在产品原型和疾病类别之间比较，我们对每种产品原型的影响做了一些简化的假设。我们假设疫苗可以降低发病率，治疗方法可以减少经过治疗后的死亡率、缩短疾病病程，而诊断方法可以增加治疗的数量。我们还假设所有疾病/病症的基线疫苗覆盖率为 0%。

Upon successful launch of a product, we assume a three-year delay before market entry, and then a 5 percentage point increase in product uptake per year, up to a maximum of 95% uptake, over the period of our analysis.

在成功推出产品后，我们假设在进入市场之前有三年延迟，之后在我们的分析期间，每年增加 5 个百分点的产品接受度，最高可达 95%的接受度。

For scenarios where we assume a replenishment of the pipeline to guarantee a product launch, we calculated the number of products needed for replenishment using the current probabilities of success for clinical trials.

对于为保证有一个产品发布而需要补充管线的情景，我们使用当前临床试验成功的概率来计算补充所需的产品数量。

Costs were estimated and adjusted to 2023 USD. Pre-clinical and clinical trial costs data were obtained from P2I, while product manufacturing, product delivery, and treat cost data were obtained from expert interviews and published peer-reviewed papers.

成本以 2023 年的美元价值计算。临床前和临床试验成本数据来自 P2I，而产品制造、产品交付和治疗成本数据来自专家访谈和发表的同行评议论文。

To assess efficiency gains, we compared ICERs and NMBs across all four scenarios. We considered any scenario with more successful launches with a positive NMB than the reference group as an efficiency gain from a societal perspective (See section 6).

为评估效率的提升，我们比较了所有四种情景下的 ICERs 和 NMBs。从社会视角来看，我们认为任何净货币收益为正的成功发布的情景都比参考组更能提高效率（参见第 6 节）。

We used a multicriteria approach, using three measures, to rank candidate product portfolios:

我们采用了对候选产品组合排名的三种方法，即多重标准法：

(i) NMBs,	(ii) ICER/避免的DALY，以及	(iii) ICER/避免的死亡。

NMBs are able to quantify the overall value of benefits to the society. ICERs per DALY averted can assess efficiency, but this metric favors conditions that affect younger age groups. ICERs per death averted are not age-biased but do not quantify non-fatal benefits. Combining all three measures allowed us to take advantage of the strengths of each measure. Candidates that ranked in the top five for all three were considered higher priority based on the metrics selected (See section 7).

NMB 能够量化社会获益的整体价值。每例避免的 DALY 所取得的 ICER 可以用来评估效率，但这一指标倾向于较年轻的一组。每例避免死亡所取得的 ICERs 没有年龄偏差，但没有量化非致命带来的获益。将这三种方法结合起来使我们能够利用每种方法的优势。根据所选择的衡量标准，在所有三个方面排名前五的候选产品被认为具有更高的研发优先级（参见第 7 节）。

SECTION 13

CURRENT PRODUCT DEVELOPMENT PIPELINE当前的产品研发管线

Our analysis included all 1,498 candidate products in the current pipeline for NDs, EIDs, and MHTs (Table 2). There are 691 candidate products in the ND pipeline: 38% (264) are vaccines, 37% (255) are therapeutics, and 25% (172) are diagnostics. Two hundred and forty-two candidate products are in the preclinical phase, 158 in Phase 1, 175 in Phase 2, and 116 in Phase 3.There are 278 candidate products in the EID pipeline; 40% (110) are vaccines, 33% (92) are therapeutics, and 27% (96) are diagnostics. Of these candidate products, 177 are in the preclinical phase, 35 in Phase 1, 19 in Phase 2, and 47 in Phase 3.

我们的分析包括了当前 NDs、EIDs 和 MHTs 产品线中所有 1498 种候选产品（表 2）。NDs 产品线中有 691 种候选产品：38%（264 种）是疫苗，37%（255 种）是治疗产品，25%（172 种）是诊断产品。242 种候选产品处于临床前阶段，158 种处于 I 期，175 种处于 II 期，116 种处于 III 期。EID 管线中有 278 个候选产品；40%（110）是疫苗，33%（92）是治疗产品，27%（96）是诊断产品。在这些候选产品中，177 个处于临床前阶段，35 个处于 I 期，19 个处于 II 期，47 个处于 III 期。

There are 529 candidate products in the MHT pipeline; 65% (346) are therapeutics, and 35% (183) are diagnostics. Of these products, 342 are in the preclinical phase, 23 in Phase 1, 108 in Phase 2, and 55 in Phase 3.

MHT 产品线中有 529 种候选产品；65%（346）是治疗产品，35%（183）是诊断药物。

在这些产品中，342 个处于临床前阶段，23 个处于 I 期，108 个处于 II 期，55 个处于 III 期。

Table 2. Current candidate product pipeline

表 2　当前候选产品管线

Disease-product-archetype* 疾病-产品-原型*	Preclinical 临床前	Phase 1 I 期	Phase 2 II 期	Phase 3 III 期	All phases 所有阶段
ND vaccines ND 疫苗	113	85	45	21	264
ND therapeutics ND 治疗产品	78	62	92	23	255
ND diagnostics ND 诊断产品	51	11	38	72	172
All ND products **所有 ND 产品**	**242**	**158**	**175**	**116**	**691**
EID vaccines EID 疫苗	73	27	7	3	110

EID therapeutics EID 治疗产品	80	8	3	1	92
EID diagnostics EID 诊断产品	24	0	9	43	76
All EID products 所有 EID 产品	177	35	19	47	278
MH therapeutics MH 治疗产品	183	23	85	55	346
MH diagnostics MH 诊断产品	160	0	23	0	183
All MH products** 所有 MH 产品**	343	23	108	55	529

NOTES:注:

* There are no vaccines in the maternal health technologies category. 孕产妇保健技术类别中没有疫苗。

** We did not include nutritional products in the maternal health technologies category. 我们没有将营养产品纳入孕产妇保健技术类别。

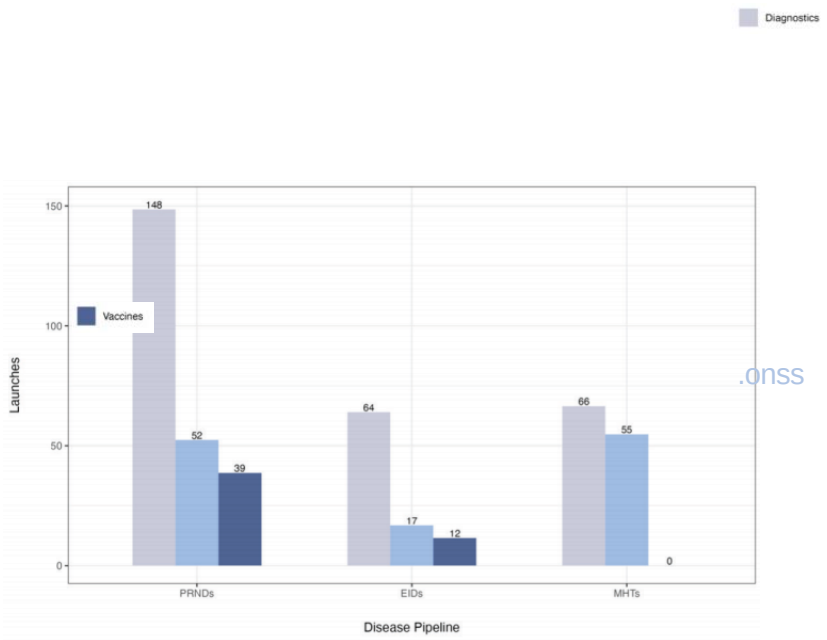
3.1 Expected product launches 预计产品发布

Investing in R&D to advance the current candidates in the product pipeline would yield 453 successful launches from 42 product portfolios over the period 2023 to 2024. (Fig. 1).

在 2023 年至 2024 年期间，通过研发投资推进现有产品线中候选产品的研发，将使 42 个产品组合中的 453 个产品成功上市。(图 1)。

Figure 1. Distribution of potential product launches from the current product development (2023 to 2044), assuming no replenishment

图 1 所示。从当前产品开发(2023 年至 2044 年)开始的潜在产品发布分布，假设没有补充



Across all three health/disease conditions, there would be more diagnostic launches, followed by therapeutics, while vaccines would have the fewest launches. Our model predicts that there will be successful launches of 39 vaccines for NDs, 52 ND therapeutics, 148 ND diagnostics, 12 EID vaccines, 17 EID therapeutics, 64 EID diagnostics, 55 MH therapeutics, and 66 MH diagnostics. All three major categories (NDs,

EIDs, and MH) are expected to have at least one successful product launch by 2028.

在所有三种医疗健康/疾病类别中，诊断产品的发布将更多，其次是治疗产品，而疫苗的发布最少。我们的模型预测，将成功推出 39 种 ND 疫苗、52 种 ND 治疗药物、148 种 ND 诊断药物、12 种 EID 疫苗、17 种 EID 治疗药物、64 种 EID 诊断药物、55 种 MH 治疗药物和 66 种 MH 诊断药物。到 2028 年，所有三个主要类别（NDs, EIDs 和 MH）预计分别至少有一个成功的产品发布。

In the NDs category, six diseases would account for over half of the successful launches: tuberculosis (49), malaria (38), HIV (22), dengue (15),and typhoid/paratyphoid (11) (Appendix A3.1). In the EID category, two-thirds of the product launches would befor Ebola (26), chikungunya (18), and Lassa fever (17) (Appendix A3.2). In the MHT category, 93% of the launches would be for three diseases/conditions: preeclampsia/eclampsia (50), preterm labor and birth (39), and intrauterine growth restriction (24) (Appendix A3.3).

在 NDs 类别中，六种疾病将占成功发布产品的一半以上：结核病（49）、疟疾（38）、艾滋病毒（22）、登革热（15）和伤寒/副伤寒（11）（附录 A3.1）。在 EID 类别中，三分之二的产品发布将用于埃博拉（26）、基孔肯雅热（18）和拉沙热（17）（附录 A3.2）。在 MHT 类别中，93%的发布将针对三种疾病/病症：先兆子痫/子痫（50 例）、早产和分娩（39 例）和宫内生长受限（24 例）（附录 A3.3）。

3.2 Missing product launches 无产品发布的管线

If only the candidate products in the current pipeline are funded (without replenishment), there would be no successful product launches for 94 product portfolios including 31 ND vaccines portfolios, 33 ND therapeutics portfolios, 11 ND diagnostics portfolios, 6 EID vaccines portfolios, 5 EID therapeutics portfolios, 3 EID diagnostics portfolios, 2 MH therapeutics portfolios, and 3 MH diagnostics portfolios (Table 3).

如果只有目前管线中的候选产品获得资助（没有补充），则 94 个产品组合将没有成功的产品上市，这包括了 31 个 ND 疫苗组合、33 个 ND 治疗组合、11 个 ND 诊断组合、6 个 EID 疫苗组合、5 个 EID 治疗组合、3 个 EID 诊断组合、2 个 MH 治疗组合和 3 个 MH 诊断组合（表 3）。

Viewed from a disease perspective rather than a product portfolio perspective, it appears that some diseases are more “neglected” than others. For example, 10 NDs, cryptococcal meningitis, cryptosporidiosis, ETEC, hookworm, multiple salmonella infections, multiple helminth infections, mycetoma, NTS, rheumatic fever, and trachoma, will have no successful vaccine, therapeutic, or diagnostic launch (Appendix Table A3.4). Similarly, 18 NDs will have at least one diagnostic product launch but no launch of a vaccine or a therapeutic candidate.

从疾病的角度而不是从产品组合的角度来看，有些疾病似乎比其他疾病更容易“被忽视”。例如，隐球菌性脑膜炎、隐孢子虫病、ETEC、钩虫、多种沙门氏菌感染、多种蠕虫感染、足菌肿、NTS、风湿热和沙眼等 10 种 NDs 将没有成功的疫苗、治疗或诊断产品上市（附录表 A3.4）。同样，18 个 NDs 将至少推出一种诊断产品，但没有推出疫苗或候选治疗药物。

In the EID category, there would be no successful launch of a vaccine, therapeutic, or diagnostic for Nipah and Zika. There will be successful launches of diagnostics for Crimean-Congo Hemorrhagic Fever, Ebola, and Marburg, but no successful launch of a vaccine or therapeutic. For MHT, there are no expected launches of a diagnostic or therapeutic for both fetal distress and maternal deficiency anemia (Appendix Table A3.4).

在 EID 类别中，将没有针对尼帕病毒和寨卡病毒的疫苗、治疗或诊断产品推出。

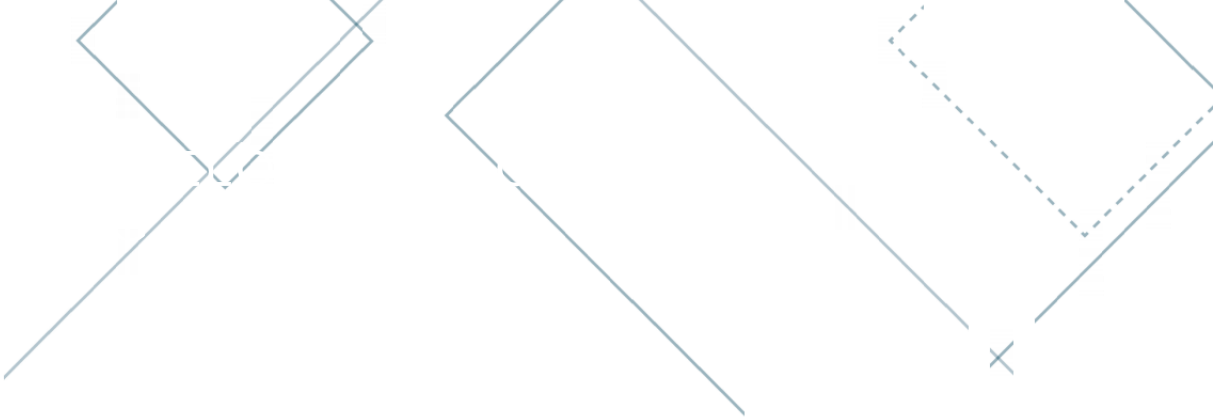
将成功推出针对克里米亚-刚果出血热、埃博拉和马尔堡病毒的诊断产品，但没有成功推出的疫苗或治疗产品。对于 MHT，预期没有针对胎儿窘迫和产妇缺铁性贫血的诊断或治疗产品推出（附录表 A3.4）。

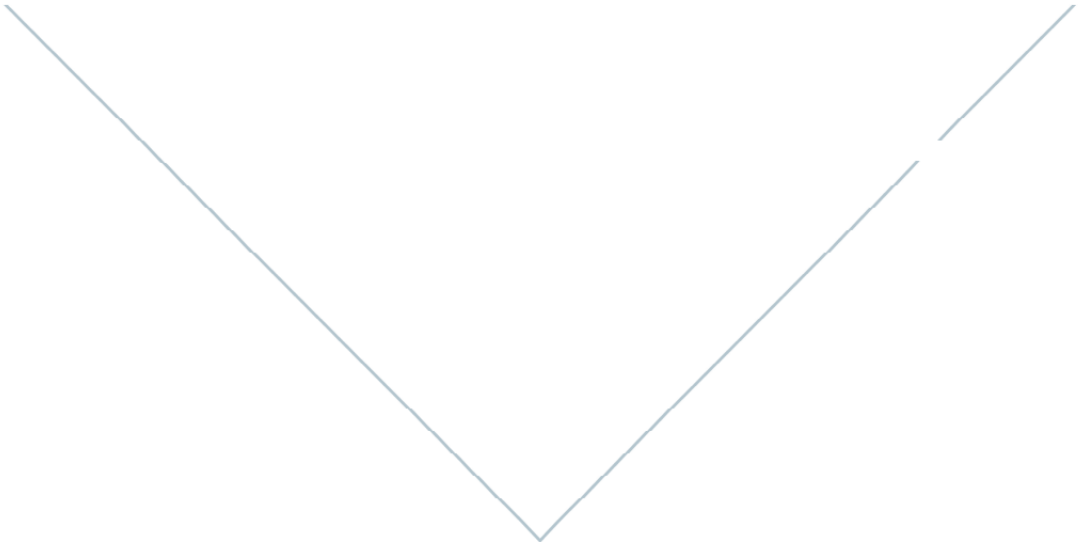
Table 3. Disease categories that will not have successful product launches without replenishment of the current product pipeline

表 3　如果不补充现有产品线，将无法成功推出产品的疾病类别

Disease-product-archetype[1] 疾病-产品-原型[1]	Diseases/Conditions without a launch 无产品发布的疾病/病症
ND vaccines ND 疫苗	Buruli ulcer, chagas disease, cholera, cryptococcal meningitis, cryptosporidiosis, dengue, ETEC, hepatitis B, hepatitis C, histoplasmosis, hookworm, leishmaniasis, leprosy, leptospirosis, lymphatic filariasis, multiple/other malaria strains, multiple salmonella infections, multiple diarrheal diseases, multiple helminth infections, mycetoma, NTS, onchocerciasis, P. vivax, rheumatic fever, scabies, schistosomiasis, shigella, sleeping sickness, strongyloidiasis, tapeworm, trachoma (31 product portfolios) 布鲁里溃疡、恰加斯病、霍乱、隐球菌性脑膜炎、隐孢子虫病、登革热、ETEC、乙型肝炎、丙型肝炎、组织浆虫病、钩虫病、利什曼病、麻风病、钩端螺旋体病、淋巴丝虫病、多种/其他疟疾菌株、多种沙门氏菌感染、多种腹泻病、多种寄生虫感染、足菌肿、NTS、盘尾丝虫病、间日疟原虫、风湿热、疥疮、血吸虫病、志贺氏菌、昏睡病、圆线虫病、绦虫、沙眼（31 个产品组合）
ND therapeutics ND 治疗产品	Buruli ulcer, chagas disease, cholera, cryptococcal meningitis, cryptosporidiosis, dengue, ETEC, histoplasmosis, hookworm, leishmaniasis, leprosy, leptospirosis, lymphatic filariasis, multiple salmonella infections, multiple diarrheal diseases, multiple helminth infections, mycetoma, N. meningitidis, NTS, onchocerciasis, P. falciparum, P. vivax, rheumatic fever, S. pneumoniae, scabies, schistosomiasis, shigella, sleeping sickness, strongyloidiasis, tapeworm, rotavirus, trachoma, typhoid and paratyphoid (33 product portfolios) 布鲁里溃疡、恰加斯病、霍乱、隐球菌性脑膜炎、隐孢子虫病、登革热、ETEC、组织浆体病、钩虫病、利什曼病、麻风病、钩端螺旋体病、淋巴丝虫病、多种沙门氏菌感染、多种腹泻病、多种寄生虫感染、足菌肿、脑膜炎奈瑟菌、NTS、盘尾丝虫病、恶性疟原虫、间日疟原虫、风湿热、肺炎链球菌、疥疮、血吸虫病、志贺氏菌、昏睡病、圆线虫病、绦虫、轮状病毒、沙眼、伤寒及副伤寒（33 个产品组合）
ND diagnostics ND 诊断产品	Cryptococcal meningitis, cryptosporidiosis, ETEC, hookworm, multiple salmonella infections, multiple helminth infections, mycetoma, NTS, rheumatic fever, rotavirus, trachoma (11 product portfolios) 隐球菌性脑膜炎、隐孢子虫病、ETEC、钩虫、多种沙门氏菌感染、多种蠕虫感染、足菌肿、NTS、风湿热、轮状病毒、沙眼（11 个产品组合）
EID vaccines EID 疫苗	Crimean-Congo Hemorrhagic Fever, Ebola, Marburg, Nipah, Rift Valley Fever, Zika (6 product portfolios) 克里米亚-刚果出血热、埃博拉、马尔堡、尼帕、裂谷热、寨卡（6 个产品组合）
EID therapeutics EID 治疗产品	Crimean-Congo Hemorrhagic Fever, Ebola, Marburg, Nipah, Zika (5 product portfolios) 克里米亚-刚果出血热、埃博拉病毒、马尔堡病毒、尼帕病毒、寨卡病毒（5 个产品组合）
EID diagnostics EID 诊断产品	Middle East Respiratory Syndrome, Nipah, Zika (3 product portfolios) 中东呼吸综合征、尼帕病毒、寨卡病毒（3 个产品组合）
MH therapeutics MH 治疗产品	Fetal distress, maternal iron deficiency anemia (2 product portfolios) 胎儿窘迫，产妇缺铁性贫血（2 个产品组合）
MH diagnostics MH 诊断产品	Fetal distress, maternal enteric microbiome, maternal iron deficiency anemia (3 product portfolios) 胎儿窘迫、孕产妇肠道微生物群、产妇缺铁性贫血（3 个产品组合）

SECTION 4





The research and development costs of advancing all candidates in the product development pipeline include costs of preclinical research and clinical trial phases 1, 2, and 3. We estimated these costs for the current pipeline and compared them to the current annual funding for each disease-product-archetype to get a funding gap.

在产品开发管线中推进所有候选药物的研发成本包括临床前研究和临床试验 I、II 和 III 期的成本。我们估计了当前管线的这些成本，并将它们与当前每种疾病-产品-原型获得的年度资金比较，以计算资金缺口。

4.1 Research and development costs 研发成本

Almost thirty billion US dollars will be needed for research and development to advance the candidate products in the current product development pipeline. Of these costs, NDs will require about $21 billion, EIDs $5.9 billion, and MHTs $3 billion. Further breakdown of ND costs shows that $12.6 billion, $6.1 billion, and 2.3 billion will be needed for ND vaccines, ND therapeutics, and ND diagnostics, respectively. For EIDs, $3.4 billion will be needed for EID vaccines, $2.3 billion for EID therapeutics, and $170 million for EID diagnostics. MH therapeutics will require $2.4 billion while MH diagnostics will require $597 million (Fig. 2)

将需要近 300 亿美元用于研发，以推进当前产品研发管线中的候选产品。在这些成本中，NDs 将需要约 210 亿美元，EID 需要 59 亿美元，MHT 需要 30 亿美元。对 ND 成本的进一步细分显示，ND 疫苗、ND 治疗和 ND 诊断将分别需要 126 亿美元、61 亿美元和 23 亿美元。对于 EID，将需要 34 亿美元用于 EID 疫苗，23 亿美元用于 EID 治疗，1.7 亿美元用于 EID 诊断的开发。MH 治疗产品开发将需要 24 亿美元，而 MH 诊断产品开发将需要 5.97 亿美元（图 2）。

Figure 2. Breakdown of research and development costs for the current product development pipeline (no replenishment for missing product launches). Costs are in million USD.

图 2 当前产品研发管线的研发成本细分（未对无产品发布的管线补充）。成本单位为百万美元。

210.17 亿美元 **58.62 亿美元** **29.94 亿美元**

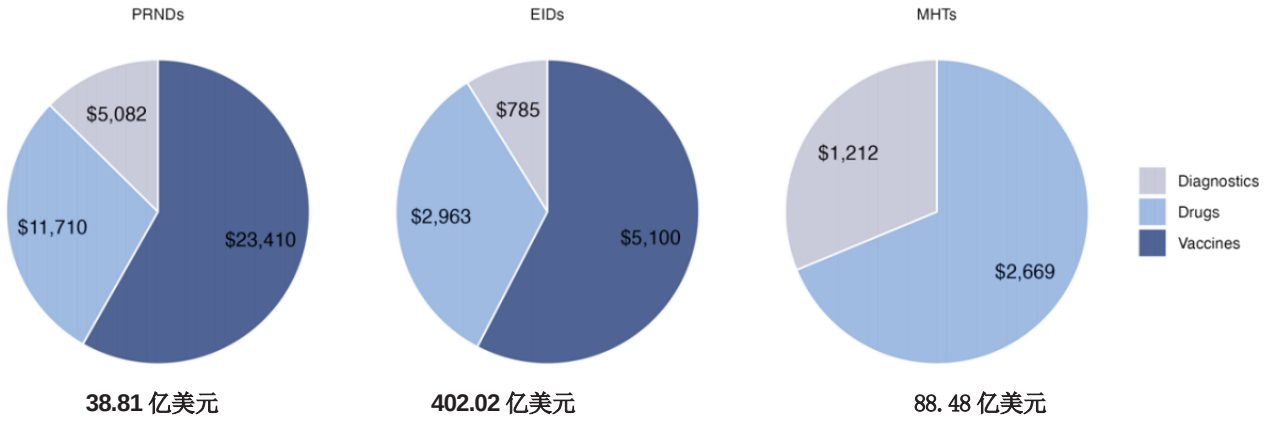
If the current pipeline is replenished through coordinated targeted investments to guarantee at least one product launch in each product portfolio, the total costs needed for product development increases to $52.9 billion. NDs will require $40.2 billion, which includes $23.4 billion for ND vaccines development, $11.7 billion for the development of

ND therapeutics, and $5.1 billion for the development of ND diagnostics. EIDs will require $8.8 billion, with EID vaccines needing $5.1 billion, EID therapeutics needing $3 billion, and EID diagnostics needing $785 million. MH products will require about $3.9 billion, with MH therapeutics needing $2.7 billion and MH diagnostics needing $1.2 billion.(Figure 3).

如果通过协调有针对性的投资补充现有管线，保证每个产品组合中至少有一种产品推出，那么产品研发所需的总成本将增加至 529 亿美元。ND 将需要 402 亿美元，其中 234 亿美元用于 ND 疫苗开发，117 亿美元用于 ND 治疗开发，51 亿美元用于 ND 诊断开发。EID 将需要 88 亿美元，51 亿美元用于 EID 疫苗，30 亿美元用于 EID 治疗，7.85 亿美元用于 EID 诊断。MH 产品将需要约 39 亿美元，其中 MH 治疗需要 27 亿美元，MH 诊断需要 12 亿美元。(图 3)。

Figure 3. Breakdown of research and development costs with coordinated investments to replenish current pipeline for missing product launches. Costs are in million USD"

图 3　补充目前无产品发布的管线所需研发投资的成本细分。成本单位为百万美元。"



38.81 亿美元　　**402.02** 亿美元　　88. 48 亿美元

4.2 Annual research and development funding gap 年度研发资金缺口

We assessed the annual funding gaps for three scenarios:

我们评估了三种情景下的年度资金缺口：

(i) the current pipeline without replenishment, 未得到补充的当前管线，

(ii) a best-case replenishment scenario, where the current pipeline is replenished with simple product candidates to guarantee a product launch in each product portfolio, and 最佳管线补充情景：当前管线用简单的候选产品补充，以保证每个产品组合有产品推出，

(iii) worst-case replenishment scenario, where the current pipeline is replenished with enough complex product candidates, to guarantee a product launch in each product portfolio. 最差管线补充情景：当前管线用足够复杂的候选产品补充，以保证每个产品组合有产品推出。

On average, complex product candidates have lower probabilities of success, longer clinical trial durations, and higher clinical trial costs. Therefore, the required costs for product development will be higher for complex products than for simple product.

平均而言，复杂的候选产品具有较低的成功概率，较长的临床试验持续时间和较高的临床试验成本。因此，复杂产品所需的产品开发成本将高于简单产品。

To estimate the annual funding gap, we assumed that based on the current rates at which products advance along the product development pipeline, most product development costs will be incurred in the first 10 years. So, we divided the total costs needed for development over the period by 10 years to arrive at annual costs, which we compared with the current annual funding reported in the G-Finder database for the portfolios included in our analysis.[1]

为估计年度资金缺口，我们假设基于产品沿着开发管线进展的当前速度，大多数产品的开发成本已在前 10 年发生。因此，我们将开发所需的总成本除以 10 年，得出年度成本，并将其与 G-Finder 数据库中报告的当前年度资金比较。[1]

Over the next 10 years, an additional $1.4 billion to $7 billion will needed annually for product development, depending on the complexity of the product candidates .

未来 10 年，根据候选产品的复杂程度，每年将需要额外投入 14 亿至 70 亿美元用于产品研发。

Table 4 summarizes the annual funding gap, while Appendix Table A4.1 provides details by disease-product-archetype category. The current annual funding for all ND products included in our analysis is $2.9 billion, for EID products is $742 million, and for MH products is $197 million. Although current annual funding projected to the future might cover product development costs for ND and EID if the current pipeline is not replenished, an additional $102 million will be needed annually for maternal health product development of the current pipeline without replenishment.

表 4 总结了年度资金缺口，附录表 A4.1 按疾病-产品-原型类别提供了详细信息。目前，我们分析中所有 ND 产品的年度资金为 29 亿美元，EID 产品为 7.42 亿美元，MH 产品为 1.97 亿美元。预计目前到未

来的年度资金也许能在当前管线没有得到补充的情况下，覆盖 ND 和 EID 的产品研发成本；孕产妇保健产品开发在没有得到管线补充的情况下，将需要额外每年 1.02 亿美元来覆盖研发成本。

For the replenishment scenarios, over the next 10 years, an additional $1.4 billion to $7 billion will needed annually for product development, depending on the complexity of the product candidates. This will close the funding gap needed to advance the ND, EID, and maternal health product pipeline. This annual product development funding gap comprises $1.1 billion to $5.9 billion for NDs, $143 million to $794 million for

EIDs, and $191 million to $256 million for maternal health products.

就补充情景而言，在今后 10 年，每年将需要额外的 14 亿至 70 亿美元用于产品研发，视候选产品的复杂性而定。这将填补推进 ND、EID 和孕产妇保健产品管线所需的资金缺口。年度产品开发资金缺口包括：NDs 需要 11 亿至 59 亿美元，EID 需要 1.43 亿至 7.94 亿美元，孕产妇保健产品需要 1.91 亿至 2.56 亿美元。

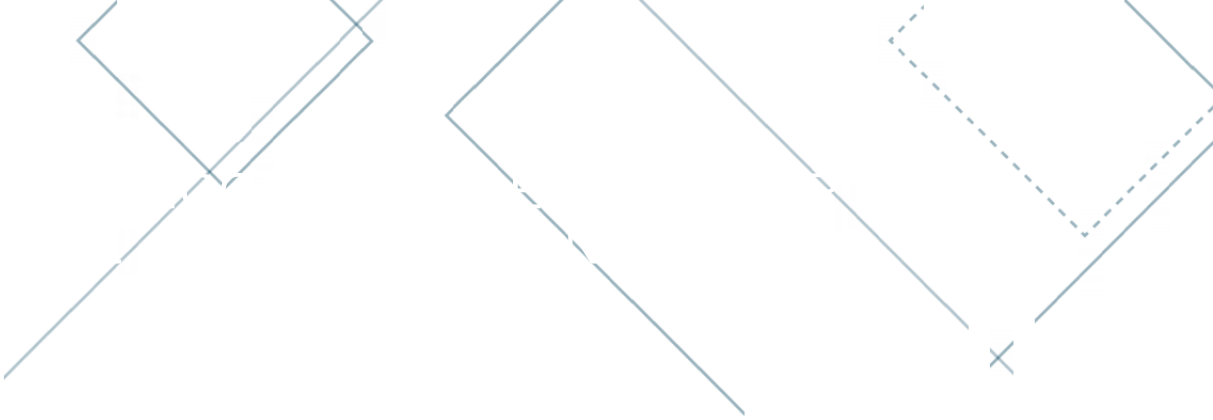
Table 4. Annual funding gap by disease archetype, over next 10 years

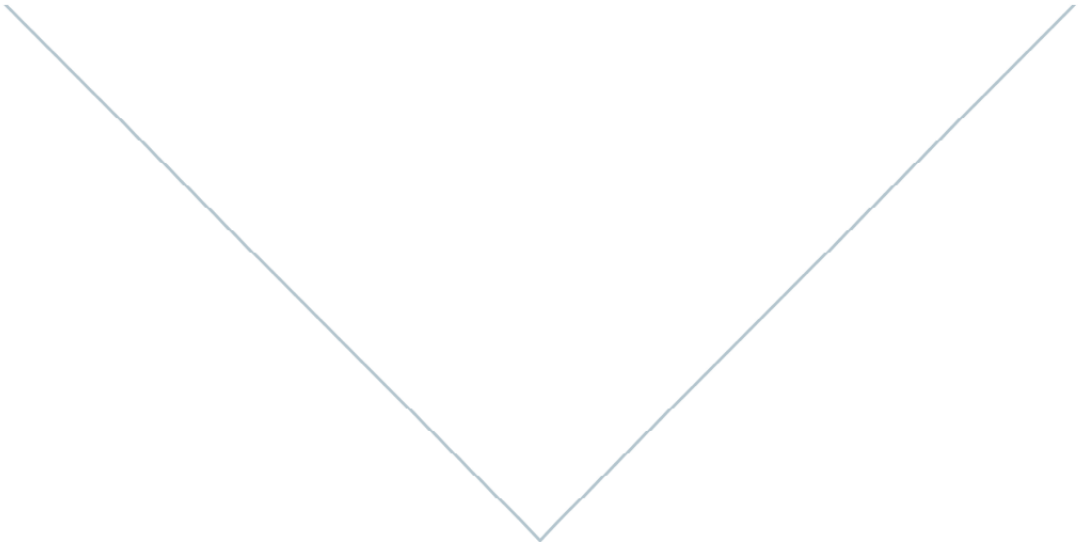
表 4　未来 10 年，按疾病类型划分的年度资金缺口

Disease-product-archetype 疾病-产品-原型	Available funding (in million USD) 可获得的资金（百万美元）	Funding of current pipeline **without replenishment (in million USD)** **未得到补充的当前管线的资金（百万美元）**		Best-case replenishment: funding with replenishment of pipeline with simple products (in million USD) 最佳管线补充情景：以简单产品的研发资金补充（百万美元）		Worst-case replenishment: funding with eplenishment of pipeline with complex products 最差管线补充情景：以复杂产品的研发资金补充（百万美金）	
		Annual need	Funding gap	Annual need	Funding gap	Annual need	Funding gap
All ND products 所有 ND 产品	$2,908	$2,102	-$806	$4,020	$1,112	$8,841	$5,933
All EID products 所有 EID 产品	$742	$586	-$156	$885	$143	$1,536	$794
All MH products **所有 MH 产品**	**$197**	**$299**	**$102**	**$388**	**$191**	**$453**	**$256**
All products **所有产品**	**$3,847**	**$2,987**	**-$860**	**$5,293**	**$1,446**	**$10,830**	**$6,983**

* Negative values indicate that needed funding is met, thus no funding gap exists 负值表示所需资金得到满足，因此不存在资金缺口

SECTION 5





HEALTH AND ECONOMIC BENEFITS FROM SUCCESSFUL PRODUCT LAUNCHES

产品成功上市的健康和经济获益

Each successful product launch is expected to have a health and economic impact on the population. We considered each product portfolio as independent and so we estimated the potential health and economic impacts separately. Therefore, our results mayshow the independent effect of a malaria vaccine launch or a malaria therapeutic launch, but not the joint effect of both launches.

每一项成功的产品发布预计都会对人口的健康和经济产生影响。我们认为每个产品组合都是独立的，因此我们分别评估了潜在的健康和经济影响。因此，我们的研究结果可能显示疟疾疫苗或疟疾治疗药物的独立效应，而不是两者的联合效应。

5.1 Distribution of disease-product-archetypes by net monetary contributions to society

根据对社会的净货币收益贡献的疾病-产品-原型分布

Net monetary benefits (NMB) were calculated as the difference between the economic value of the health benefits from a successful product launch and the incremental costs associated with launching and getting the launched products to people who need them (Appendix section A1). The incremental costs include R&D costs, product manufacturing costs, and treatment costs. A positive NMB indicates that the economic benefits to society from a successful product launch are larger than the incremental costs society has to bear to achieve the product launch. By contrast, a negative NMB indicates that the economic benefits to society from a successful product launch are smaller than the incremental costs society bears to achieve that launch.

净货币收益（NMB）的计算方法是，成功推出产品所带来的健康获益的经济价值与推出并将推出的产品送到有需要的人手中相关的增量成本之间的差额（附录 A1 节）。增量成本包括研发成本、产品制造成本和治疗成本。正值的 NMB 表明，成功的产品发布给社会带来的经济效益大于社会为实现产品发布而承担的增量成本。相反，负值的 NMB 表明，成功的产品发布给社会带来的经济效益小于社会为实现该产品发布所承担的增量成本。

If the current product development pipeline is replenished in order to guarantee at least one product launch in each product portfolio, 30 of 38 ND vaccine portfolios would yield positive NMBs and eight negative NMBs (Table 5).

如果目前的产品开发管线得到补充，以保证每个产品组合中至少有一种产品上市，38 个 ND 疫苗组合中的 30 个将产生正值

的 NMB, 8 个将产生负值的 NMB（表 5）。

Similarly, ND therapeutics and ND diagnostics will have more portfolios yielding positive NMBs than negative NMBs. ND

therapeutics will have 29 portfolios with a positive NMB and nine portfolios with a negative NMB, while ND diagnostics will have 30 portfolios with a positive NMB and eight with a negative NMB.

同样，ND 治疗和 ND 诊断，产生正值 NMB 的组合将超过负值 NMB 的组合。ND 治疗将产生 29 个正值的 NMB 组合和 9 个负值的 NMB 组合，而 ND 诊断将产生 30 个正值的 NMB 组合和 8 个负值的 NMB 组合。

Two EID vaccine portfolios would have positive NMBs, while seven will have negative NMBs. Three EID diagnostic portfolios will have a positive NMB, while six will have a negative NMB. No EID therapeutics portfolio would have a positive NMB.

All six maternal health therapeutics and maternal health diagnostics portfolios will have positive NMBs (Table 5).

两个 EID 疫苗组合将产生正值的 NMB，而七个将产生负值的 NMB。三个 EID 诊断组合将产生正值的 NMB，而六个将产生负值的 NMB。

EID 治疗组合都将无法产生正值的 NMB。

所有六种孕产妇保健疗法和诊断组合将产生正值的 NMB （表 5）。

Table 5. Distribution of product portfolios with at least one product launch by net monetary benefits to society 表 5　产品组合的分布，其中至少有一种产品的推出对社会有净货币收益

Product portfolios 产品组合	Net monetary benefits[1] 净货币收益 [1]	
	正值 [2]	负值 [3]
ND vaccines ND 疫苗	30	8
ND therapeutics ND 治疗	29	9
ND diagnostics ND 诊断	30	8
EID vaccines EID 疫苗	**2**	**7**
EID therapeutics EID 治疗	**0**	**9**
EID diagnostics EID 诊断	**3**	**6**
MH therapeutics MH 治疗	**6**	**0**
MH diagnostics MH 诊断	**6**	**0**

NOTES

1. The unit of analysis is the disease group, as listed

inG-Finder. We included 153 product portfolios in our

analysis. Net monetary benefits (NMB) were calculated as the economic value of health benefits minus the sum of R&D costs, manufacturing costs, and treatment costs. See Section 2.4. 如 G-Finder 中所列，分析单位是疾病组。我们在分析中包括 153 个产品组合。净货币收益（NMB）计算为健康获益的经济价值减去研发成本、制造成本和治疗成本的总和。参见第 2.4 节。

2. A positive NMB implies that if health benefits are

translated into monetary terms, society will benefit from the investment. 正值的 NMB 表明，如果健康获益转化为货币，社会将从投资中受益。

3. A negative NMB implies that if health benefits are

translated to monetary terms, society will lose more from the investment, than it will gain. This could occur if there are investments in clinical trials that do not lead to a successful product launch, or there are investments that lead to a successful launch but the economic value of the health benefits gained are less than the value of the investments.

负值的 NMB 表明，如果健康获益转化为货币，投资将导致社会得不偿失。如果临床试验无法带来成功的产品发布，或即使临床试验带来了成功的产品发布，但其带来的健康获益的经济价值不及投资的价值，这种情况就会发生。

5.2 Cost-effectiveness of investing in the current pipeline with replenishment to guarantee at least one product launch in each product portfolio

补充投资当前管线的成本效益，以保证每个产品组合中至少有一个产品推出

The health and economic benefits that would accrue from investing in research and development to advance the current product pipeline over the period 2023 to 2044 are summarized in Table 6. Fifteen ND vaccine portfolios will be cost-saving from a health systems perspective, while the ICERs of the other 23 ND vaccine portfolios ranged from $128 for the Shigella vaccines portfolio to $472 million for mycetoma vaccines portfolio, a low-prevalence, low-mortality condition. ICERs for ND therapeutics and ND diagnostics ranged from $6 (Tapeworm) to $413 million (Mycetoma), and $24 (Typhoid and paratyphoid) to $73 million (Mycetoma). NMBs for ND vaccines, therapeutics, and diagnostics ranged from -$177 billion to 48,700 billion.

表 6 总结了在 2023 年至 2044 年期间投资于研发以推进现有产品管线将产生的健康和经济获益。从医疗健康系统的角度来看，15 种 ND 疫苗组合将节省成本，而其他 23 种 ND 疫苗组合的 ICERs 从志贺菌疫苗组合的 128 美元到足菌肿疫苗组合的 4.72 亿美元不等，后者是一种低流行率、低死亡率的情况。ND 治疗和 ND 诊断的 ICERs 从 6 美元（绦虫）到 4.13 亿美元（足菌肿），以及 24 美元（伤寒和副伤寒）到 7300 万美元（足菌肿）不等。ND 疫苗、治疗和诊断的 NMBs 从- 1770 亿美元到 48.7 万亿美元不等。

Fifteen ND vaccines will be cost-saving from a health systems perspective.

从医疗健康系统的角度来看，15种新城疫疫苗将节省成本。

In the EID category, investments in the Zika vaccine portfolio would be cost-saving, while ICERs per DALY averted for the other vaccine portfolios range from $3,000 to $15,000. Other ICERs per DALY averted ranged from $4,800 to $5 million for EID therapeutics and $600 to $4 million for EID diagnostics. In both EID therapeutics and diagnostic categories, Lassa fever had the lowest ICERs, while Zika had the highest ICERs. NMBs for all EID products ranged from -$5.4 billion to $0.6 billion.

在 EID 类别中，对寨卡疫苗组合的投资将节省成本，而其他疫苗组合每例避免 DALY 所产生的 ICERs 从 3000 美元到 24.5 万美元不等。在 EID 治疗方面，每例避免 DALY 所产生的其他 ICERs 为 4,800 至 500 万美元不等，在 EID 诊断方面，为 600 至 400 万美元不等。在 EID 治疗和诊断类别中，拉沙热产生的 ICERs 最低，而寨卡产生的 ICERs 最高。所有 EID 产品的 NMBs 从- 54 亿美元到 6 亿美元不等。

ICERs per DALY averted for maternal health therapeutics ranged from $23 for preeclampsia/eclampsia to $117 for maternal enteric microbiome, while for maternal health diagnostics, ICERs ranged from$25 for preeclampsia/eclampsia to $148 for maternal enteric microbiome. NMBs for maternal health products were all positive. NMBs for maternal health therapeutics ranged from $24 billion for fetal distress to $550 billion for preeclampsia/eclampsia, while NMBs for maternal health diagnostics ranged from $52 billion for intrauterine growth restriction to $481 billion for maternal iron deficiency anemia.

孕产妇保健治疗每年避免的 ICERs 从子痫前期/子痫 23 美元到产妇肠道微生物群 117 美元不等，而孕产妇保健诊断的 ICERs 从子痫前期/子痫 25 美元到产妇肠道微生物群 148 美元不等。孕产妇保健产品的 NMBs 均为正值。用于孕产妇保健治疗的 NMBs 从用于胎儿窘迫的 240 亿美元到用于子痫前期/子痫的 5500 亿美元不等，而用于孕产妇保健诊断的 NMBs 从用于宫内生长限制的 520 亿美元到用于产妇缺铁性贫血的 4810 亿美元不等。

Table 6. Economic value of investing in product portfolios, assessed from the health systems and societal perspectives.

表 6　投资于产品组合的经济价值，从医疗健康体系和社会角度评估。

	医疗健康体系视角（最低到最高）[1] Health systems perspective (lowest to highest)[1]	社会视角（最低到最高）[2] Societal perspective (lowest to highest)[2]
Disease-product-archetype 疾病-产品-原型	增量成本/避免的 DALY（以美元计）	Net monetary benefits (range in billion USD) 净货币获（以美元计）
ND vaccines ND 疫苗	Cost-saving（for 15 vaccines）to $472 million（Mycetoma） 节省成本（15 种疫苗）达 4.72 亿美元（足菌肿）	-$3（Scabies）to $48,700（S. pneumoniae） - 3 美元（疥疮）至 48,700 美元（肺炎链球菌）
ND therapeutics ND 治疗	$6（Tapeworm）to $413 million（Mycetoma） 6 美元（绦虫）至 4.13 亿美元（足菌肿）	-$43（Tuberculosis）to $6,000（Multiple diarrheal diseases） - 43 美元（结核病）至 6,000 美元（多重腹泻病）
ND diagnostics ND 诊断	$24（Typhoid and paratyphoid）to $73 million（Mycetoma） 24 美元（伤寒及副伤寒）至 7300 万美元（足菌肿）	-$177（Scabies）to $24,000（Multiple diarrheal diseases） - 177 美元（疥疮）至 24,000 美元（多重腹泻病）
EID vaccines **EID 疫苗**	Cost-saving（Zika）to $245,000（MERS） 节约成本（寨卡病毒）至 24.5 万美美元（中东呼吸综合征）	-$0.50（Ebola）to $0.25（Zika） -0.5 美美元（埃博拉病毒）到 0.25 美元（寨卡病毒）
EID therapeutics **EID 治疗**	$4,800（Lassa fever）to $5 million（Zika） 4800 美元（拉沙热）到 500 万美元（寨卡病毒）	-$2.35（Zika）to -$0.02（Lassa fever） - 2.35 美元（寨卡病毒）到- 0.02 美元（拉沙热）
EID diagnostics **EID 诊断**	$600（Lassa fever）to 4 million（Zika） 600 美元（拉沙热）到 400 万美元（寨卡病毒）	-$5.4（Zika）to $0.6（Lassa fever） - 5.4 美元（寨卡病毒）至 0.6 美元（拉沙热）

MH therapeutics **MH 治疗**	$23 （Preeclampsia/eclampsia） to $117 （Maternal enteric microbiome） 23 美元（子痫前期/子痫）至 117 美元（孕妇肠道微生物群）	$24 B （Fetal distress） to $550 B （Preeclampsia/eclampsia） 240 亿美元（胎儿窘迫）至 550 亿美元（子痫前期/子痫）
MH diagnostics **MH 诊断**	$25 （Preeclampsia/eclampsia） to $148 （Maternal enteric microbiome） 25 美元（子痫前期/子痫）至 148 美元（孕妇肠道微生物群）	$52 （Intrauterine growth restriction） to $481 （Maternal iron deficiency anemia） 52 美元（宫内生长限制）至 481 美元（产妇缺铁性贫血）

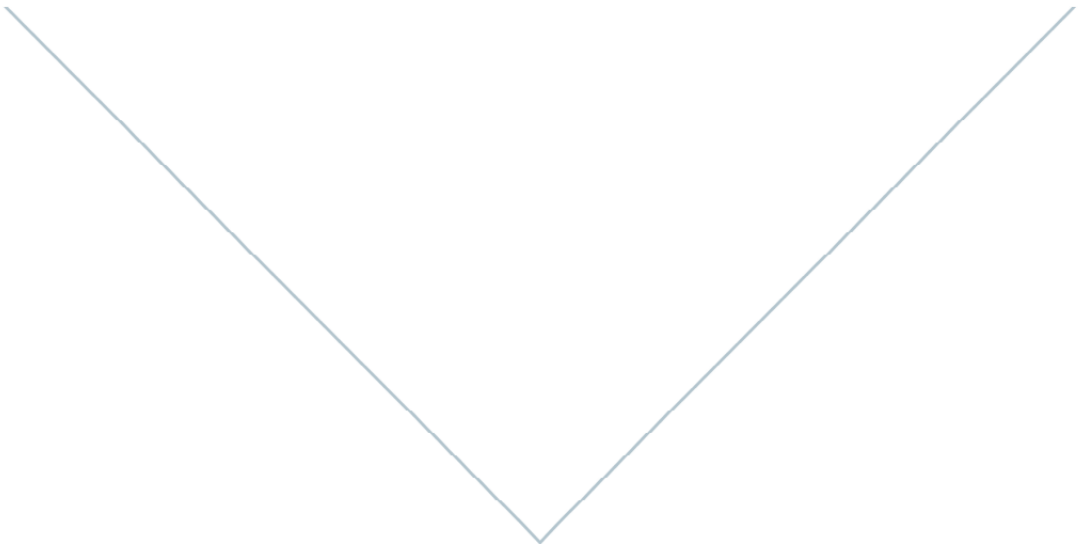
NOTES:注:

1. Lower incremental cost-effectiveness ratios (ICERs) are preferred as they indicate more health benefits per dollar spent and, thus, more efficient resource use. Negative ICERs indicate that in addition to an increase in benefits, there is also a cost saving. 较低的增量成本效果比（ICERs）是更好的，因为它表明每一美元支出带来更多的健康获益，因此资源利用率更高。负值的 ICERs 表明，除了增加获益外，还节省了成本。

2. Higher net monetary benefits (NMBs) are preferred as they indicate that society benefits more (or loses less, in the case of negative NMBs) from the intervention.

较高的净货币收益（NMB）是首选，因为它表明社会从干预中获益更多（或在负值 NMB 的情况下，损失更少，）。

SECTION 6



Against the backdrop of inadequate resources for product development and decreasing frequencies of successful product launches, several recent innovations promise positive shifts in the R&D landscape for ND's EIDs and maternal health technologies. In our accompanying report, we described these shifts in detail. Here, we provide quantitative estimates for some of these shifts.[2]

在产品研发资源不足和产品成功发布频率下降的背景下，最近的几项创新将推动在被忽视疾病中的新发传染病和孕产妇保健技术的研发进展。在我们所附的报告中，我们详细描述了这些变化。在这里，我们对其中一些变化提供了定量估计。[2]

6.1 Reference case and efficiency gains scenarios 参考案例和效率提升的情景

We modeled four scenarios: a reference case and three efficiency gains scenarios (Table 7). In the first scenario (our reference case), we assumed that candidate products in the current pipeline would be funded with no replenishments; we included pre-clinical and clinical trial costs; and we assumed that success rates would be similar to the success rates in the P2I model, time to market introduction would be three years post-launch, and production costs would reflect current estimates.

我们对四种情景建模：一个参考案例和三个效率提升的情景（表 7）。在第一个情景（我们的参考案例）中，我们假设当前管线中的候选产品将在没有管线补充的情况下获得资金；我们纳入了临床前和临床试验的成本；我们假设成功率与 P2I 模式的成功率相似，上市时间为发布后三年，生产成本将反映当前的估计。

In the second scenario, we modeled coordinated investments in missing products; we assumed that costs, success rates, and market entry would mirror the reference case, and we modeled coordinated investment in the pipeline to guarantee at least one launch for each product portfolio.

在第二个情景中，我们对无产品发布管线的协调投资建模；我们假设成本、成功率和市场准入将与参考案例一致，并且我们对管线中的协调投资建模，以确保每个产品组合至少有一个产品发布。

In the third scenario, we modeled improved clinical trial efficiencies from artificial intelligence and smarter clinical trials. We assumed similar parameters to the second scenario. In addition, based on advise from experts, we also assumed a 60% reduction in pre-clinical research costs, a 25% reduction in clinical trial costs, and a 10-percentage point increase in trial success rates. The fourth scenario was similar to the third scenario, but in addition, we assumed market entry was shortened from three years to one year, and production costs were reduced by 20%.

在第三个情景中，我们通过人工智能和更智慧的临床试验来提高临床试验效率。我们假设了与第二个情景类似的参数。此外，根据专家的建议，我们还假设临床前研究成本降低 60%，临床试验成本降低 25%，试验

成功率提高 10 个百分点。第四个情景与第三个情景类似，但在第三个情景的基础上，我们假设市场准入时间从三年缩短到一年，生产成本降低 20%。

We assumed a uniform baseline “do-nothing” for all scenarios in which no further investments in product-pipeline R&D occur after 2023. Therefore, the estimated health and economic benefits for each scenario are the difference between that scenario and the assumed baseline.

我们假设了 “什么都不做” 的统一基线，即在所有情景下，2023 年之后没有进一步的产品研发投资。因此，每种情景估计的健康和经济获益是该情景与假定基线之间的差额。

Table 7. Description of the reference case and efficiency gains scenarios included in the analyses

表 7　分析中所包含的参考案例和效率提升情景

情景 [1] Scenario[1]	管线填充 [2] Pipeline replenishment[2]	临床前和临床试验成本 [3] Pre-clinical and clinical trial research costs[3]	持续时间和成功率 [4] Phase time and success rates[4]	LMIC 市场准入 [5]（发布后年数） LMIC market introduction[5] (In years post-launch)	生产成本 [6] Production costs[6]
0. Reference case 参考案例	No 否	P2I 估计 [7] P2I estimates[7]	P2I 估计 [7] P2I estimates[7]	3 years 三年	Current costs 当前成本
1. Coordinated investments in missing products 对无产品发布管线的协调投资	Yes 是	P2I 估计 [7] P2I estimates[7]	P2I 估计 [7] P2I estimates[7]	3 years 三年	Current costs 当前成本
2. #1 plus improved clinical trial efficiencies #1 叠加提升的临床试验效率	Yes 是	60% reduction in preclinical research costs[8] 临床前试验成本降低 60%[8] 临床试验成本降低 25%[9] 25% reduction in clinical trial costs[9]	10%-point increase in success rates10 成功率提高 10%[10]	3 years 三年	Current costs 当前成本
3. #2 plus shortened market entry and lower production costs #2 叠加缩短的市场准入和更低的生产成本	Yes 是	临床前试验成本降低 60%[8] 临床试验成本降低 25%[9] 60% reduction in preclinical research costs[8]	成功率提高 10%[10] 10%-point increase in success rates[10]	1 year 一年	20% reduction 降低 20%

		25% reduction in clinical trial costs[9]			

NOTES: 注:

1. We did not include the investment costs needed to achieve the efficiency gains. 我们没有包括实现效率提升所需的投资成本。

2. We expect coordinated R&D investment to address pipeline gaps and key missing products. We also expect that AI will lower costs and time for discovery and preclinical research, leading to a more robust pipeline. 我们希望通过协调研发投资来弥补管线的不足和缺失的产品，也希望 AI 能够降低发现和临床前研究的成本，让研发管线更强大。

3. Lower R&D costs will result from smarter trial designs, synthetic control arms, better prediction of trial failures, and the use of AI. 更智慧的试验设计、合成对照组、对试验失败有更强的预测以及人工智能的使用将降低研发成本。

4. Using AI to conduct comprehensive screening of candidates will yield better quality of candidates and shorten phase times. 利用人工智能对候选药品全面筛选，将提高候选药品的质量，缩短临床试验时间。

5. Regulatory harmonization in low and middle income countries (LMICs) could reduce market-entry delays from three years to one-year post-launch. 中低收入国家（LMICs）的监管标准一致化可将市场准入的延迟时间从上市后的三年减少到一年。

6. Opportunities for production cost savings include the use of modular sites, optimized mRNA production, and market shaping. 可通过使用模块化中心、优化 mRNA 生产和市场准备来降低生产成本。

7.The P2I model assumes clinical trial costs of $3M - $21.6M for preclinical research, $2M - $100Mfor phase 1, $3M - $13.9Mfor phase 2, and $17.6M - $133.3M for phase 3 clinical trials. It also assumes an average phase length of 1-3.4 years for preclinical research, 1.3-2.5 years for phase 1, 1.3-4.2 years for phase 2, and 2.1-3.5 years for phase 3 clinical trials. For success rates, P2I assumes 41%-77% for preclinical research, 50%-100% for phase 1, 19.7%-100% for phase 2, and 40.3%-70.92% for phase 3 clinical trials. Details can be found in the appendix. P2I 模型假定临床试验的临床前研究费用为 300 万至 2160 万美元，Ⅰ期为 200 万至 1 亿美元，Ⅱ期为 300 万至 1390 万美元，Ⅲ期临床试验为 1760 万至 1.333 亿美元。它还假设临床前研究需要 1-3.4 年，Ⅰ期需要 1.3-2.5 年，Ⅱ期需要 1.3-4.2 年，Ⅲ期需要 2.1-3.5 年。对于成功率，P2I 假设临床前研究为 41%-77%，Ⅰ期为 50%-100%，Ⅱ期为 19.7%-100%，Ⅲ期临床试验为 40.3%-70.92%。详情见附录。

8. Rationale for selecting 60% reduction was based on expert opinion. 选择临床前试验成本降低 60%是基于专家的意见。

9. Rationale for selecting 25% reduction was based on expert opinion. 选择临床试验成本降低 25%是基于专家的意见。

10. Rationale for selecting 10%-point increase in success rates was based on expert opinion. 选择成功率提高 10%是基于专家的意见。

We measured the gains from efficiency using several indicators including, cost savings, reductions in average cost per launch (CPL) of a successful candidate, increase in the number of product launches, and shift in the number of product portfolios that yield positive net monetary benefits.

我们使用几个指标来衡量效率的提升，包括成本节约，成功候选产品的每次发布平均成本（CPL）的减少，产品发布数量的增加，以及产生积极净货币效益的产品组合数量的变化。

6.2 Combined efficiency gains: Better returns on investments across different product portfolios 组合效率提升：不同产品组合的投资回报率均提升

We assessed combined efficiency gains by estimating the difference in the number of product portfolios that yield a positive NMB in an "efficiency gains" scenario compared to the reference case. Table 8 summarizes the results of the NMB comparisons.

我们通过评估与参考案例相比，在"效率提高"方案中产生正 NMB 的产品组合数量的差异来评估综合效率提高。表 8 总结了 NMB 比较的结果。

Table 8. Efficiency gains from across scenarios, measured as the number of disease-product-archetype portfolios that shift from negative to positive net monetary benefits

表 8 跨情景的效率提高，以净货币效益从负向正转变的疾病产品原型组合的数量来衡量

Disease-product-archetype 疾病-产品-原型	正值的净货币收益 [1] Positive net monetary benefits[1]			
	#1	#2	#3	#4
	Reference case 参考案例	#1 + Coordinated investments to include missing products[2] Number (Difference, #2 – #1) #1 +协调投资以纳入缺失的产品 [2] 数量（差异，#2 - #1）	#2 + Improved efficiency of preclinical/clinical trials[3] Number (Difference, #3 – #1) #2 + 提高临床前/临床试验效率 [3] 数量（差异，#3 - #1）	#3 + shortened market entry and decreased production costs[4] Number (Difference, #4 – #1) #3 + 缩短市场准入时间，降低生产成本 [4] 数字（差异，#4 - #1）
ND vaccines ND 疫苗	7	30 (23)	32 (25)	34 (27)

ND therapeutics ND 治疗	3	29 (26)	30 (27)	31 (28)
ND diagnostics ND 诊断	21	30 (9)	30 (9)	30 (9)
EID vaccines EID 疫苗	1	2 (1)	2 (1)	4 (3)
EID therapeutics EID 治疗	0	0 (0)	1 (1)	1 (1)
EID diagnostics EID 诊断	3	3 (0)	3 (0)	3 (0)
MH therapeutics MH 治疗	4	6 (2)	6 (2)	6 (2)
MH diagnostics MH 诊断	3	6 (3)	6 (3)	6 (3)

NOTES:注:

1. The unit of analysis is the disease group, as listed inG-Finder. We included 38 NDs and 9 EIDs in our analysis. Net monetary benefits (NMB)were calculated as the economic value of health benefits minus the sum of R&D costs, manufacturing costs, and treatment costs. See Section 2.4. 如 G-Finder 所列，分析单位是疾病组。我们在分析中纳入了 38 个 ND 和 9 个 EID。净货币收益（NMB）计算为健康获益的经济价值减去研发成本、制造成本和治疗成本的总和。参见第 2.4 节。

2. Coordinated investments comprise replenishment of pipeline at preclinical phase to ensure at least one launch for products without a launch in the reference case. 协调投资包括在临床前阶段补充管线，以确保在参考病例中没有推出的产品至少有一例推出。

3. Includes a 60% reduction in preclinical research costs, a 25% reduction in clinical research costs, a 10 percentage point increase in preclinical and clinical success rates, and a reduction in preclinical phase duration to 1.5 years. 包括临床前试验成本降低 60%，临床试验成本降低 25%，临床前和临床成功率提高 10 个百分点，临床前阶段持续时间缩短至 1.5 年。

4. Includes decrease in LMIC market introduction from 3 years post-launch to 1.5 years post-launch, 20% reduction in vaccine unit cost, and 10% reduction in disease treatment unit cost. 包括将 LMIC 市场准入从上市后 3 年减少到上市后 1.5 年，疫苗单位成本降低 20%，疾病治疗单位成本降低 10%。

When compared to the reference case, all three “efficiency gains” scenarios will increase the number of product portfolios that yield positive NMBs for ND vaccines, ND therapeutics, and ND diagnostics. The coordinated investments for the missing products scenario (#2 in Table 8) will increase the number ofND vaccine portfolios with positive NMBs by 23, the number of positive NMB ND therapeutics portfolios by 26, and the number of positive NMB ND diagnostic portfolios by 9. Similarly, the improved efficiencies scenario (#3 in Table 8) will increase the number of positive NMB ND vaccine portfolios by 25, the number of positive NMB ND therapeutics portfolios by 27, and the number of positive NMB ND diagnostic portfolios by 9. Also, the shortened market entry and decreased production costs scenario (#4 in Table 8) will increase the number of positive NMB ND vaccine portfolios by 27, the number of positive NMB ND therapeutics portfolios by 28, and the number of positive NMB ND diagnostic portfolios by nine.

与参考案例相比，所有三种“效率提升”的情景都将增加对 ND 疫苗、ND 治疗和 ND 诊断产生正值 NMB 的产品组合的数量。针对缺失产品情景（表 8 中#2）的协调投资将使产生正值 NMB 的 ND 疫苗组合数量增加

23 个、ND 治疗组合数量增加 26 个、ND 诊断组合数量增加 9 个。同样，提高效率的方案（表 8 中的#3）将使产生正值 NMB 的 ND 疫苗组合的数量增加 25 个、ND 治疗组合的数量增加 27 个、ND 诊断组合的数量增加 9 个。此外，市场准入时间缩短和生产成本降低的情景（表 8 中的#4）将使产生正值 NMB 的 ND 疫苗组合的数量增加 27 个、ND 治疗组合的数量增加 28 个、ND 诊断组合的数量增加 9 个。

The efficiency gains are less promising for EIDs. Our coordinated investments for missing products scenario will increase the number of positive EID vaccine portfolios by one, but will not make any EID therapeutics or EID diagnostics portfolios become positive. The improved clinical trial efficiencies and shortened market entry scenarios will make one and three additional EID vaccine portfolios yield positive NMBs, respectively. In addition, both scenarios will make one additional EID therapeutics portfolio yield positive NMBs but no EID diagnostics portfolio.

效率提升对 EIDs 的作用不那么显著。我们对缺失产品管线的协调投资将使产生正值 NMB 的 EID 疫苗组合的数量增加一个，但不会使任何 EID 治疗或 EID 诊断组合的 NMB 变为正值。临床试验效率提升和市场准入时间缩短将使另外一种和三种 EID 疫苗组合分别产生正值的 NMBs。此外，这两种情况都将使一个额外的 EID 治疗组合产生正值的 NMBs，但不包括 EID 诊断组合。

For maternal health portfolios, all three efficiency gains scenarios have similar positive effects compared to the reference case. They increase the number of positive NMB therapeutic portfolios by two and the number of positive NMB diagnostics portfolios by two.

就孕产妇保健组合而言，与参考案例相比，所有三种效率提升的情景都具有类似的积极影响：将正值的 NMB 治疗组合和诊断组合的数量分别增加了两个。

In addition to the shifts from negative to positive NMBs that occur for all scenarios, specific benefits occur within the product-pipeline development stage that increase the number of product launches and reduce costs. We describe these in the following sections under efficiency-gains scenarios #1 & #2.

除所有情景的 NMBs 都从负值转为正值外，在产品管线开发阶段，通过增加产品发布的数量并降低成本，还能带来特定的获益。我们将在效率提升情景#1 和#2 中详细阐述。

6.4 Efficiency gains scenario #1: Increase in the number of successful product launches 效率提升情景#1：增加产品成功发布的数量

Compared to the reference case, the number of successful product launches with coordinated investments will increase. In previous work, we showed that coordinated investment mechanisms such as pooled funding for late-stage clinical trials can be cost-effective both at the global and country levels.[3,4] In this analysis, we focused on the increase in the number of portfolios with a product launch.

与参考案例相比，协调投资带来的成功产品发布数量将增加。在之前的报告中，我们说明了协调投资机制（如为后期临床试验而准备的资金池）在全球和国家层面都具有成本效益。[3,4] 在这个分析中，我们关注的是随着产品发布而增加的投资组合数量。

In the reference case, 10 NDs will have no successful vaccine, therapeutic, or diagnostic launch. Eighteen NDs will have successful diagnostic launches but no successful launches of a vaccine or a therapeutic

candidate. In the EID category, there would be no successful launch of a vaccine, therapeutic, or diagnostic for Nipah and Zika. There will be successful launches of diagnostics for Crimean-Congo Hemorrhagic Fever, Ebola,and Marburg, but no successful launches of vaccines or therapeutics. For MHT, there are no expected launches of a diagnostic or therapeutic for both fetal distress and maternal deficiency anemia.

These gaps will be filled through coordinated investment strategies.

在参考案例中，10 个 NDs 项目将没有成功的疫苗、治疗或诊断产品上市。18 个 NDs 项目将有成功的诊断产品推出，但没有成功疫苗或治疗候选产品推出。在 EID 类别中，没有针对尼帕病毒和塞卡病毒的疫苗、治疗或诊断产品推出。将有针对克里米亚-刚果出血热、埃博拉和马尔堡病毒的诊断产品推出，但没有成功的疫苗或治疗方法推出。对于 MHT，目前还没有针对胎儿窘迫和产妇缺铁性贫血的诊断或治疗的预期产品推出。

6.5 Efficiency gains scenario #2: Cost savings and reductions in cost per launch (CPL) from artificial intelligence and smarter clinical trials

情景#2：通过人工智能和更智慧的临床试验，降低每次发布平均成本（CPL）

AI and clinical trial innovations are driving significant positive shifts in the product development ecosystem. We have provided details in the accompanying report. To summarize, we expect that AI will lower costs and time for discovery and preclinical research, leading to a more robust pipeline. We also expect that AI will help conduct comprehensive screening of candidates, yielding better quality of candidates and shortening phase times. Using smarter trial designs, such as synthetic control arms and better prediction of trial failures (also influenced by AI), will lead to lower R&D costs.

人工智能和临床试验创新正在推动产品开发生态系统的重大积极转变。我们在随附的报告中提供了详细信息。总而言之，我们预计人工智能将降低发现和临床前研究的成本、缩短时间，从而使管线更强大。我们还希望人工智能协助全面筛选候选产品，提高候选产品的质量，缩短临床各阶段的时间。使用更智慧的试验设计，如合成对照组和更好地预测试验失败（也得益于人工智能），也将降低研发成本。

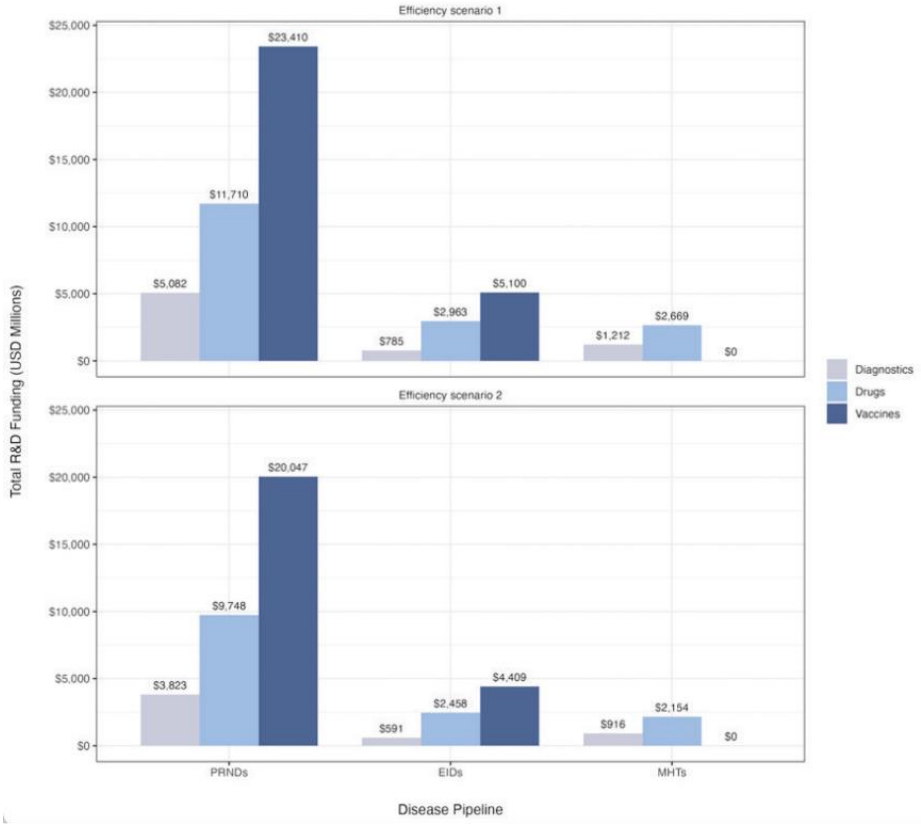
Based on expert opinion, we assume that AI and smarter clinical trial designs will reduce preclinical research costs by up to 60%, reduce clinical trial costs by up to 25%, and increase clinical trial success rates by up to 10 percentage points.

根据专家意见，我们假设人工智能和更智慧的临床试验设计将使临床前研究成本降低高达 60%，将临床试验成本降低高达 25%，并将临床试验成功率提高 10 个百分点。

The reductions in average cost per launch (CPL) from AI and smarter clinical trials will range from 3 million to 8 million for diagnostics portfolios, and will exceed 100 million for ND vaccines and EID vaccines portfolios.
通过人工智能和更智慧的临床试验，诊断产品组合的每次发布平均成本（CPL）将减少300万至800万美元，ND疫苗和EID疫苗组合将减少超过1亿美元。

Figure 5. Camparison of product development costs for effciency gains scenarios #2 and #3.

图 5　效率提升方案#2 和#3 的产品开发成本比较。



Our results show that AI and smarter clinical trials will significantly reduce product development costs for candidate products, including candidates in the current pipeline and replenishments (Fig. 5). The total cost of ND development will reduce from $40.2 billion to $33.6 billion, EID development from $8.8 billion to $7.5 billion, and maternal health product development from $3.9 billion to $3.1 billion. Vaccines, followed by therapeutics, will see the largest cost savings, while diagnostics will see the least.

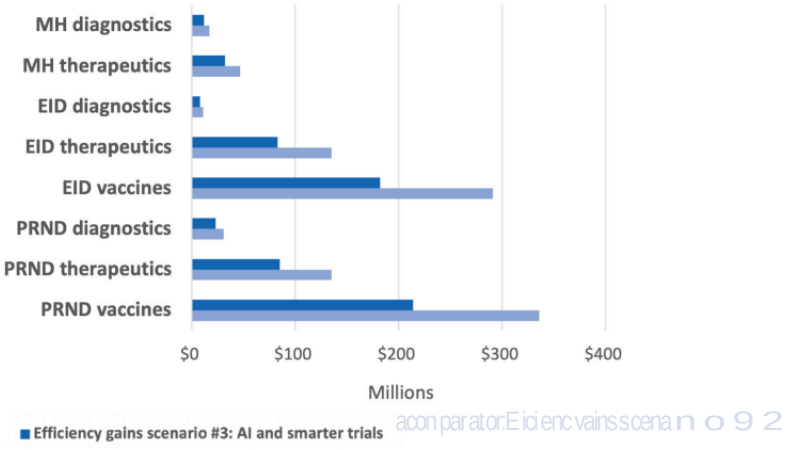
我们的研究结果表明，人工智能和更智慧的临床试验将显著降低候选产品的研发成本，包括当前管线中的候选产品和补充产品（图 5）。ND 研发的总成本将从 402 亿美元降至 336 亿美元，EID 研发的总成本将从 88 亿美元降至 75 亿美元，孕产妇保健产品研发的总成本将从 39 亿美元降至 31 亿美元。疫苗将节省最多的成本，其次是治疗方法，而诊断方法节省的成本最少。

The abovementioned cost savings will translate to significant reductions in CPL (Fig 6). In absolute terms, the reductions in average cost per launch (CPL) from AI and smarter clinical trials will range from 3 million to 8 million for diagnostics portfolios, and will exceed 100 million for ND vaccines and EID vaccines portfolios. (Fig 4,and Appendix Table A6.1). CPL for ND therapeutics and EID therapeutics will reduce by $50 to $52 million. In percentage terms, we expect CPL to reduce by 26 to 39 percent (Appendix Table A6.1. The smallest percentage reductions will be seen in the diagnostics categories (26 to 29% reductions), while the largest percentage reductions will be seen in the vaccines and therapeutics categories (32 to 39% reductions).

上述成本节约将转化为 CPL 的显著降低（图 6）。从绝对值来看，在人工智能和更智慧的临床试验的推动下，诊断组合的每次发布平均成本（CPL）降低将在 300 万至 800 万美元之间，ND 疫苗和 EID 疫苗组合的每次发布平均成本（CPL）降低将超过 1 亿美元（图 4 和附录表 A6.1）。ND 治疗和 EID 治疗的 CPL 将减少 5000 万至 5200 万美元。按百分比计算，我们预计 CPL 将减少 26%至 39%（附录表 A6.1. 诊断类减少的百分比最低（减少 26%至 29%），而疫苗和治疗类减少的百分比最高（减少 32%至 39%）。

Figure 6. Product development costs per successful launch

图 6　每次成功发布的产品研发成本



SECTION

We ranked all products included in our analysis using three value-for-money indicators: ICER per death averted, ICER per DALY averted,and incremental NMB. We ranked products from a global and three regional perspectives (Africa, Asia, and LatinAmerica and the Caribbeans). Global rankings assume a global burden of disease, and a global distribution of costs and benefits, while regional rankings assume a regional burden of disease and regional distribution of costs and benefits.

我们使用三个物有所值指标对分析中包含的所有产品排名：每例避免死亡的 ICER、每例避免 DALY 的 ICER 和增量 NMB。我们从全球和三个地区（非洲、亚洲、拉丁美洲和加勒比地区）的角度对产品排名。全球排名考虑的是全球疾病负担以及成本和获益的全球分布，而区域排名考虑的是区域疾病负担以及成本和获益的区域分布。

Although our prioritization emphasizes economic value, investors, policymakers, and other stakeholders use additional prioritization criteria such as equity, political feasibility, national security, and duration of investment. We did not include these in our prioritization, and we note that they are important. Thus, our prioritization should only be interpreted in financial/economic terms.

虽然我们的优先顺序强调经济价值，但投资者、政策制定者和其他利益相关者使用其他优先标准，如公平性、政治可行性、国家安全和投资期限。我们没有把这些列入我们优先级的考虑范畴，但我们注意到它们的重要性。因此，我们的优先顺序应只从金融/经济角度来解释。

We present the overall top products and the top five for each category in this section and include the full rank list in Appendix Tables A5.1, A5.2,and A5.3.

我们在本章中列出了所有高优先级产品和每个类别的前五名，并在附录表 A5.1、A5.2 和 A5.3 中列出了完整的排名列表。

7.1 Overall top products for global prioritization 占有全球优先级的头部产品

Of all the product portfolios included in our analysis, sixteen vaccine portfolios (fifteen ND vaccines portfolios and one EID vaccines portfolio) will be cost-saving from a health systems perspective and yield positive NMBs (Table 9). They include vaccine portfolios for S. pneumoniae, multiple diarrhoeal diseases, typhoid and paratyphoid, P. falciparum, multiple/ other malaria strains, tuberculosis, rotavirus, N. meningitidis, HIV/AIDS, dengue, hepatitis B, multiple Salmonella infections, Strongyloidiasis and other, cryptococcal meningitis, rheumatic fever, and Zika. The NMBs for

these product portfolios range from $0.25 billion to $48,679 billion and are expected to accrue over the period 2023 to 2044.

在我们分析的所有产品组合中，从医疗健康体系的视角来看，16 种疫苗组合（15 种 ND 疫苗组合和 1 种 EID 疫苗组合）将节省成本，并产生正值的 NMBs（表 9）。

它们包括肺炎链球菌、多种腹泻病、伤寒和副伤寒、恶性疟原虫、多种/其他疟疾菌株、结核病、轮状病毒、脑膜炎奈瑟菌、艾滋病毒/艾滋病、登革热、乙型肝炎、多种沙门氏菌感染、圆线虫病和其他、隐球菌性脑膜炎、风湿热和寨卡病毒的疫苗组合。这些产品组合的 NMBs 从 2.5 亿美元到 48679 亿美元不等，预计将在 2023 年至 2044 年期间累积。

Table 9. Disease-product-archetype portfolios that are cost-saving to the health system and will yield positive net monetary benefits to society

表 9　可为医疗健康系统节省成本并将为社会带来积极净货币收益的疾病-产品-原型组合

Societal perspective (Positive net monetary benefits) 社会视角（正值的净货币收益）	
Rank 排名	Disease Portfolio (Vaccines) 疾病组合（疫苗）
1	S. pneumoniae vaccine ($48,679 B) 肺炎链球菌疫苗（48.679 万亿美元）
2	Multiple diarrheal diseases vaccine ($6,518 B) 多种腹泻病疫苗（6.518 万亿美元）
3	Typhoid and paratyphoid vaccine ($2,740 B) 伤寒及副伤寒疫苗（2.74 万亿美元）
4	P. falciparum vaccine ($311 B) 恶性疟原虫疫苗（3110 亿美元）
5	Multiple / other malaria strains vaccine ($126 B) 多种/其他疟疾毒株疫苗（1260 亿美元）
6	Tuberculosis vaccine ($118 B) 结核病疫苗（1180 亿美元）
7	Rotavirus vaccine ($96 B) 轮状病毒疫苗（960 亿美元）
8	N. meningitidis vaccine ($63 B) 脑膜炎奈瑟菌疫苗（630 亿美元）
9	HIV/AIDS vaccine ($53 B) HIV/AIDS 疫苗（530 亿美元）
10	Dengue vaccine ($39 B) 登革热疫苗（390 亿美元）
11	Hepatitis B vaccine ($28 B) 乙型肝炎疫苗（280 亿美元）
12	Multiple Salmonella infections vaccine ($17 B) 多种沙门氏菌感染疫苗（170 亿美元）
13	Strongyloidiasis and other vaccine ($15 B) 类圆线虫病和其他疫苗（150 亿美元）

14	Cryptococcal meningitis ($9 B) 隐球菌脑膜炎（90 亿美元）
15	Rheumatic fever ($7 B) 风湿热（70 亿美元）
16	Zika ($0.25 B) 寨卡病毒（2.5 亿美元）

NOTE: All product portfolios listed in this table are cost-saving from the health system perspective.

注:从医疗健康体系的视角来看，本表中列出的所有产品组合都是节省成本的。

7.2 Top five ND products for global prioritization 占有全球最高优先级的五款 ND 产品

Table 10 lists the top five product portfolios for each ND product archetype, ranked by highest contributors to NMB, and the best ICERs per death averted and ICERs per DALY averted. From a societal perspective, the top five ND vaccines portfolios with the potential for the highest NMBs to society are S. pneumoniae ($48,679 B), multiple diarrheal diseases ($6,518 B), typhoid and paratyphoid ($2,740 B),P.falciparum ($311 B),and multiple/other malaria strains ($126 B). However, from a health systems perspective, the top five that will lead to the most cost-saving are tuberculosis, N. meningitidis, multiple Salmonella infections, dengue, and HIV/AIDS. All these also contribute positive NMB to society but do not rankin the top 5 positive NMBs.

表 10 列出了每种 ND 产品原型的前五大产品组合，按 NMB 的最高贡献者，以及每例避免死亡产生的最佳 ICERs 和避免每 DALY 产生的最佳 ICERs 来排名。从社会视角来看，对社会具有最高 NMBs 贡献潜力的前五大 ND 疫苗组合是肺炎链球菌（48.679 万亿美元）、多种腹泻病（6.518 万亿美元）、伤寒和副伤寒（2.74 万亿美元）、恶性疟原虫（3110 亿美元）和多种/其他疟疾菌株（1260 亿美元）。然而，从医疗健康体系的视角来看，最能节省成本的前五大疫苗组合是结核病、脑膜炎奈索菌、多种沙门氏菌感染、登革热和 HIV/AIDS。所有这些都对社会做出了正值的 NMB 贡献，但没有排在前 5 位。

Table 10. Top five priority ND product portfolios for each product-archetype

表 10　每个产品原型的前五个优先级 ND 产品组合

Incremental cost per death averted (in USD) 避免每例死亡的增量成本（以美元计）	Incremental cost per DALY averted (in USD) 避免每 DALY 的增量成本（以美元计）	Net monetary benefits (in billion USD) 净货币收益
Vaccines **疫苗**		
1. Tuberculosis (cost-saving) 2. N. meningitidis (cost-saving) 3. Multiple Salmonella infections (cost-saving) 4. HIV/AIDS (cost-saving 5. Dengue (cost-saving) 1. 肺结核（节约成本） 2. 脑膜炎奈瑟菌（节约成本） 3. 多重沙门氏菌感染（节约成本） 4. HIV/AIDS（节约成本） 5. 登革热（节约成本）	1. Tuberculosis (cost-saving) 2. N. meningitidis (cost-saving) 3. Multiple Salmonella infections (cost-saving) 4. Dengue (cost-saving) 5. HIV/AIDS (cost-saving) 1. 肺结核（节约成本） 2. 脑膜炎奈瑟菌（节约成本） 3. 多重沙门氏菌感染（节约成本） 4. 登革热（节约成本） 5. HIV/AIDS（节约成本）	1. S. pneumoniae ($48,679 B) 2. Multiple diarrheal diseases ($6,518 B) 3. Typhoid and paratyphoid ($2,740 B) 4. P. falciparum ($311 B) 5. Multiple / other malaria strains ($126 B) 1. 肺炎链球菌（48.679 万亿美元） 2. 多重腹泻病（6.518 万亿美元） 3. 伤寒及副伤寒（2.74 万亿美元） 4. 恶性疟原虫（3110 亿美元） 5. 多种/其他疟疾菌株（1260 亿美元）
Therapeutics **治疗**		

1. Tapeworm ($315) 2. S. pneumoniae ($1,137) 3. Typhoid and paratyphoid ($1,350) 4. P. vivax ($4,790) 5. Cholera ($5,767) 1. 绦虫（315 美元） 2. 肺炎链球菌（1,137 美元） 3. 伤寒及副伤寒（1,350 美元） 4. 间日疟（4,790 美元） 5. 霍乱（5,767 美元）	1. Tapeworm ($6) 2. Multiple helminth infections ($8 3. Schistosomiasis ($19) 4. Hookworm ($22) 5. Typhoid and paratyphoid ($24) 1. 绦虫（6 美元） 2. 多重寄生虫感染（8 美元） 3. 血吸虫病（19 美元） 4. 钩虫（22 美元） 5. 伤寒及副伤寒（24 美元）	1. Multiple diarrhoeal diseases ($6,002 B) 2. S. pneumoniae ($3,354 B) 3. Multiple / other malaria strains ($840 B 4. Typhoid and paratyphoid ($761 B) 5. HIV/AIDS ($460 B) 1. 多种腹泻病（6.002 万亿美元） 2. 肺炎链球菌（3.354 万亿美元） 3. 多种/其他疟疾菌株（8400 亿美元） 4. 伤寒及副伤寒（ 7,610 亿美元） 5. HIV/AIDS （4600 亿美元）
Diagnostics **诊断**		
1. Typhoid and paratyphoid ($1,333 2. Tapeworm ($1,350) 3. Cholera ($1,998) 4. S. pneumoniae ($2,506) 5. P. vivax ($3,366) 1. 伤寒和副伤寒（1,333 美元） 2. 绦虫（1,350 美元） 3. 霍乱（1,998 美元） 4. 肺炎链球菌（2,506 美元） 5. 间日疟（3,366 美元）	1. Typhoid and paratyphoid ($24) 2. Tapeworm ($27) 3. Cholera ($48) 4. Schistosomiasis ($68) 5. P. vivax ($73) 1. 伤寒及副伤寒（24 美元） 2. 绦虫（27 美元） 3. 霍乱（48 美元） 4. 血吸虫病（68 美元） 5. 间日疟（$73）	1. Multiple diarrhoeal diseases ($24,296 B) 2. S. pneumoniae ($17,075 B) 3. Typhoid and paratyphoid ($3,748 B) 4. Multiple / other malaria strains ($1,655 B) 5. P. falciparum ($1,194 B) 1. 多种腹泻病（24.296 万亿美元） 2. 肺炎链球菌（17.075 万亿美元） 3. 伤寒及副伤寒（3.748 万亿美元） 4. 多种/其他疟疾菌株（1655 亿美元） 5. 恶性疟原虫（1.194 万亿美元）

The top five ND therapeutics portfolios with the potential for the highest NMBs to society are multiple diarrheal diseases ($6,002 B), S. pneumoniae ($3,354 B), multiple/other malaria strains ($840 B), typhoid and paratyphoid ($761 B),and HIV/AIDS ($460 B). Of these, only typhoid and paratyphoid ranks in the top five for ICERs per death averted and ICERs per DALY averted. S. pneumonia ranks in the top five of ICERs per death averted but not ICERs per DALY averted.

对社会 NMB 贡献最高的前五大 ND 治疗组合是多种腹泻病（6.002 万亿美元）、肺炎链球菌（3.354 万亿美元）、多种/其他疟疾菌株（8400 亿美元）、伤寒和副伤寒（7610 亿美元）和 HIV/AIDS（4600 亿美元）。其中，只有伤寒和副伤寒在每例避免死亡产生的 ICERs 和避免每 DALY 产生的 ICERs 中排名前五。肺炎链球菌在每例避免死亡产生的 ICERs 中排名前五，但不排在避免每 DALY 产生的 ICERs 的前列。

The top five ND diagnostics portfolios with the potential for the highest NMBs to society are multiple diarrheal diseases ($24,296 B), S. pneumoniae ($17,075 B), typhoid and paratyphoid ($3,748 B), multiple/other malaria strains ($1,655 B), and P. falciparum ($1,194 B). Of these, only the typhoid parathyphoid portfolio ranks in the

top five for ICERs per death averted and ICERs per DALY averted. S. pneumonia is in the top five of ICERs per death averted but not I ICERs per DALY averted, while tapeworm, cholera, and P. Vivax rankin the top five of ICERs per death averted or ICERs per DALY averted.

对社会 NMB 贡献最高的前五大 ND 诊断组合是多种腹泻病（24.296 万亿美元）、肺炎链球菌（17.075 万亿美元）、伤寒和副伤寒（3.748 万亿美元）、多种/其他疟疾菌株（1.655 万亿美元）和恶性疟原虫（1.194 万亿美元）。在这些组合中，只有伤寒副伤寒组合在每例避免死亡产生的 ICERs 和避免每 DALY 产生的 ICERs 中排名前五。肺炎链球菌在每例避免死亡产生的 ICERs 中排名前五，但不排在每例避免死亡产生的 ICERs 的前列，而绦虫、霍乱和间日疟原虫在每例避免死亡产生的 ICERs 或避免每 DALY 产生的 ICERs 中排名前五。

7.3 Top EID products for global prioritization 占有全球最高优先级的 EID 产品

Table 11 lists the top five product portfolios for each EID product archetype, ranked by highest contributors to NMB, and the best ICERs per death averted and ICERs per DALY averted. The top five EID vaccine

portfolios measured by NMBs are Zika, Lassa fever, chikungunya, Rift Valley Fever, and Nipah. Of these, only Zika ($0.25 B), Lassa fever ($.20 B) will yield positive NMB to society. Zika, Lassa fever and chikungunya, also rankin the top five of ICERs per death averted and ICER per DALY averted, with Zika being cost-saving for both indicators. Ebola and Crimean-Congo Hemorrhagic Fever rankin the top five from a health system

perspective, but they both have ICERs per DALY averted that exceed $10,000.

表 11 列出了每种 EID 产品原型的前五大产品组合，按 NMB 的最高贡献者，以及每例避免死亡产生的最佳 ICERs 和避免每 DALY 产生的最佳 ICERs 来排名。NMB 最高的前五大 EID 疫苗组合是寨卡病毒、拉沙热、基孔肯雅热、裂谷热和尼帕病毒。其中，只有寨卡病毒（2.5 亿美元）和拉沙热（2 亿美元）将对社会产生正值的 NMB。寨卡病毒、拉沙热和基孔肯雅热也位列每例避免死亡产生的 ICERs 和避免每 DALY 产生的 ICERs 的前五名，寨卡病毒在这两项指标上都节省了成本。从医疗健康体系的视角来看，埃博拉和克里米亚-刚果出血热排在前五名，二者避免每 DALY 产生的 ICERs 都超过了 1 万美元。

Table 11. Top five priority EID product portfolios for each product-archetype

表 11　每个产品原型的前五大 EID 产品组合

Incremental cost per death averted (in USD) 避免每例死亡的增量成本（以美元计）	Incremental cost per DALY averted (in USD) 避免每 DALY 的增量成本（以美元计）	Net monetary benefits (in billion USD) 净货币收益
Vaccines **疫苗**		
1. Zika （cost-saving） 2. Lassa fever （$132,773） 3. Chikungunya （$397,638） 4. Ebola （$440,302） 5. CCHF （Crimean-Congo Hemorrhagic Fever） （$1,253,038） 1. 寨卡病毒（节约成本） 2. 拉沙热（132,773 美元） 3. 基孔肯雅热（397,638 美元） 4. 埃博拉病毒（440,302 美元） 5. CCHF（克里米亚-刚果出血热）（1,253,038 美元）	1. Zika （cost-saving） 2. Lassa fever （$3,128） 3. Chikungunya （$6,290） 4. Ebola （$10,480） 5. CCHF （Crimean-Congo Hemorrhagic Fever） （$29,607） 1. 寨卡病毒（节约成本） 2. 拉沙热（3,128 美元） 3. 基孔肯雅热（6,290 美元） 4. 埃博拉病毒（10,480 美元） 5. CCHF（克里米亚-刚果出血热）（29,607 美元）	1. Zika （$.25 B） 2. Lassa fever （$.20 B） 3. Chikungunya （-$.20 B） 4. RVF （Rift Valley Fever） （-$.26 B） 5. Nipah （-$.27 B） 1. 寨卡病毒（2.5 亿） 2. 拉沙热（2 亿） 3. 基孔肯雅热（- 2 亿美元） 4. RVF（裂谷热）（- 2.6 亿美元） 5. 尼帕（- 2.7 亿美元）

Therapeutics 治疗		
1. Lassa fever ($204,511) 2. RVF (Rift Valley Fever) ($529,660) 3. Ebola ($1,071,550) 4. Chikungunya ($2,047,996) 5. CCHF (Crimean-Congo Hemorrhagic Fever) ($2,337,336) 1. 拉沙热（204,511 美元） 2. RVF（裂谷热）（529,660 美元） 3. 埃博拉病毒（1,071,550 美元） 4. 基孔肯雅热（2,047,996 美元） 5. CCHF（克里米亚-刚果出血热）（2,337,336 美元）	1. Lassa fever ($4,774) 2. RVF (Rift Valley Fever) ($12,599) 3. Chikungunya ($25,271) 4. Ebola ($25,484) 5. CCHF (Crimean-Congo Hemorrhagic Fever) ($54,843) 1. 拉沙热（4,774 美元） 2. RVF（裂谷热）（12,599 美元） 3. 基孔肯雅热（25,271 美元） 4. 埃博拉病毒（25,484 美元） 5. CCHF（克里米亚-刚果出血热）（54,843 美元）	1. Lassa fever (-$0.02 B) 2. RVF (Rift Valley Fever) (-$0.09 B) 3. Nipah (-$0.13 B) 4. Marburg (-$0.28 B) 5. MERS (-$0.32 B) 1. 拉沙热（- 2000 万美元） 2. RVF（裂谷热）（- 9000 万美元） 3. 尼帕（- 1.3 亿美元） 4. 马尔堡（- 2.8 亿美元） 5. Mers（- 3.2 亿美元）
Diagnostics **诊断**		
1. Lassa fever ($25,624) 2. Ebola ($36,869) 3. Marburg ($69,731) 4. CCHF (Crimean-Congo Hemorrhagic Fever) ($298,977) 5. RVF (Rift Valley Fever) ($410,459) 1. 拉沙热（25,624 美元） 2. 埃博拉病毒（36,869 美元） 3. 马尔堡（69,731 美元） 4. CCHF（克里米亚-刚果出血热）（298,977 美元） 5. RVF（裂谷热）（410,459 美元）	1. Lassa fever ($598) 2. Ebola ($877) 3. Marburg ($1,660) 4. CCHF (Crimean-Congo Hemorrhagic Fever) ($7,015) 5. RVF (Rift Valley Fever) ($9,763) 1. 拉沙热（598 美元） 2. 埃博拉病毒（877 美元） 3. 马尔堡（1,660 美元） 4. CCHF（克里米亚-刚果出血热）（7,015 美元） 5. RVF（裂谷热）（9,763 美元）	1. Lassa fever ($0.58 B) 2. Ebola ($0.41 B) 3. Marburg ($0.02 B) 4. RVF (Rift Valley Fever) (-$0.03 B) 5. CCHF (Crimean-Congo Hemorrhagic Fever) (-$0.07 B) 1. 拉沙热（5.8 亿美元） 2. 埃博拉病毒（4.1 亿美元） 3. 马尔堡（2000 万美元） 4. RVF（裂谷热）（- 3000 万美元） 5. CCHF（克里米亚-刚果出血热）（- 7000 万美元）

* Red indicate negative net monetary benefits to society.

* 红色表示对社会的净货币收益为负。

None of the top five EID therapeutics portfolios will yield positive NMB to society. However, from a health systems perspective, the top five product portfolios in this category are Lassa fever, Rift Valley Fever,

Chikungunya, Ebola, and Crimean-Congo Hemorrhagic Fever.

前五大 EID 治疗组合中没有一个将对社会能产生正值的 NMB。然而，从医疗健康系统的视角来看，该类别中排名前五的产品组合是拉沙热、裂谷热、基孔肯雅热、埃博拉和克里米亚-刚果出血热。

The top five EID diagnostics portfolios measured as NMBs to society are Lassa fever, Ebola, Marburg, Rift Valley Fever, and Crimean-Congo Hemorrhagic Fever. Of these, only Lassa fever, Ebola, and Marburg have positive NMBs. All three of them also rankin the top five when assessed from a health systems perspective, using ICER per death averted and ICER per DALY averted.

对社会 NMB 贡献最高的前五大 EID 诊断组合是拉沙热、埃博拉、马尔堡病毒、裂谷热和克里米亚-刚果出血热。其中，只有拉沙热、埃博拉和马尔堡病毒拥有正值的 NMBs。从医疗健康体系的视角评估时，拉沙热、埃博拉和马尔堡病毒使用每例避免死亡产生的 ICERs 和避免每 DALY 产生的 ICERs 来衡量时，也都排在前五名。

7.4 Ranking of the top maternal health products for global prioritization 占有全球最高优先级的孕产妇保健产品

Table 12 lists the top five product portfolios for each maternal health product archetype, ranked by highest contributors to NMB, and the best ICERs per death averted and ICERs per DALY averted. The top five maternal health therapeutics portfolios with the potential for the highest NMBs to society are preeclampsia/eclampsia, preterm labor/birth, maternal enteric microbiome, maternal iron deficiency anemia, and intrauterine growth restriction. All five will have positive NMB that range from $132 billion to $550 billion.

表 12 列出了每种孕产妇保健产品原型的前五大产品组合，按 NMB 的最高贡献者，以及每例避免死亡产生的最佳 ICERs 和避免每 DALY 产生的最佳 ICERs 来排名。对社会具有最高 NMB 贡献潜力的前五大孕产妇保健治疗组合是子痫前期/子痫、早产/分娩、孕产妇肠道微生物群、孕产妇缺铁性贫血和宫内生长限制。这五个组合将贡献 1320 亿美元至 5500 亿美元不等的正值 NMB。

The top five maternal health diagnostics portfolios with the potential for the highest NMBs to society are maternal iron deficiency anemia, preeclampsia/eclampsia, preterm labor/birth, maternal enteric microbiome, and fetal distress. All five will have positive NMB that range from $66 billion to $481 billion.

对社会 NMB 贡献最高的前五大孕产妇保健诊断组合是：孕产妇缺铁性贫血、先兆子痫/子痫、早产/分娩、孕产妇肠道微生物群和胎儿窘迫。这五个组合将贡献 660 亿至 4810 亿美元不等的正值 NMB。

Table 12. Top five priority maternal health product portfolios for each product-archetype

表 12　每个产品原型的前五大孕产妇保健产品组合

Incremental cost per death averted (in USD) 避免每例死亡的增量成本（以美元计）	Incremental cost per DALY averted (in USD) 避免每 DALY 的增量成本（以美元计）	Net monetary benefits (in billion USD) 净货币收益
Vaccines **疫苗**		
1. Preeclampsia/eclampsia（PE/E）（$1,079） 2. Maternal iron deficiency anemia（$2,132） 3. Preterm labor/birth（PTL/PTB）（$5,466） 4. Intrauterine growth restriction（IUGR）（$5,708） 5. Maternal enteric microbiome（MEM）（$6,503） 1. 子痫前期/子痫（PE/E）（1,079 美元）	1. Preeclampsia/eclampsia（PE/E）（$23） 2. Maternal iron deficiency anemia（$44） 3. Preterm labor/birth（PTL/PTB）（$70） 4. Intrauterine growth restriction（IUGR）（$85） 5. Fetal distress（$99） 1. 子痫前期/子痫（PE/E）（23 美元） 2. 产妇缺铁性贫血（44 美元）	1. Preeclampsia/eclampsia（PE/E）（$550） 2. Preterm labor/birth（PTL/PTB）（$454） 3. Maternal enteric microbiome（MEM）（$216） 4. Maternal iron deficiency anemia（$180） 5. Intrauterine growth restriction（IUGR）（$132） 1. 子痫前期/子痫（PE/E）（550 美元） 2. 早产（PTL/PTB）（454 美元）

2. 产妇缺铁性贫血（2,132 美元） 3. 早产（PTL/PTB）（5,466 美元） 4. 宫内生长限制（IUGR）（5,708 美元） 5. 孕妇肠道微生物群（MEM）（6,503 美元）	3. 早产（PTL/PTB）（70 美元） 4. 宫内生长限制（IUGR）（85 美元） 5. 胎儿窘迫（99 美元）	3. 孕妇肠道微生物群（MEM）（216 美元） 4. 孕妇缺铁性贫血（180 美元） 5. 宫内生长限制（IUGR）（132 美元）
Therapeutics **治疗**		
1. 1. Preeclampsia/eclampsia（PE/E）（$1,191） 2. Maternal iron deficiency anemia（$2,544） 3. Preterm labor/birth（PTL/PTB）（$6,217 4. Intrauterine growth restriction（IUGR）（$7,017） 5. Fetal distress（$7,050） 1. 子痫前期/子痫（PE/E）（1,191 美元） 2. 母亲缺铁性贫血（2,544 美元） 3. 早产（PTL/PTB）（6,217 美元） 4. 宫内生长限制（IUGR）（7,017 美元） 5. 胎儿窘迫（7,050 美元）	1. Preeclampsia/eclampsia（PE/E）（$25） 2. Maternal iron deficiency anemia（$53） 3. Preterm labor/birth（PTL/PTB）（$79） 4. Intrauterine growth restriction（IUGR）（$104） 5. Fetal distress（$105） 1. 子痫前期/子痫（PE/E）（25 美元） 2. 产妇缺铁性贫血（53 美元） 3. 早产（PTL/PTB）（79 美元） 4. 宫内生长限制（IUGR）（104 美元） 5. 胎儿窘迫（105 美元）	1. Maternal iron deficiency anemia（$481） 2. Preeclampsia/eclampsia（PE/E）（$216） 3. Preterm labor/birth（PTL/PTB）（$178） 4. Maternal enteric microbiome（MEM）（$83） 5. Fetal distress（$66） 1. 产妇缺铁性贫血（481 美元） 2. 子痫前期/子痫（PE/E）（216 美元） 3. 早产（PTL/PTB）（178 美元） 4. 孕妇肠道微生物群（MEM）（83 美元） 5. 胎儿窘迫（66 美元）

SECTION 8

Summary 总结

SUMMARY AND CONCLUSIONS 总结

We estimated the costs, health benefits, and economic benefits of investing in global health R&D for NDs, EIDs, and MH product portfolios. We found that over the next ten years, an additional $1.4 billion to $7 billion will needed annually for product development, depending on the complexity of the product candidates. We also estimated potential gains from adopting game-changing efficiency improvement innovations to the R&D ecosystem.

我们估计了投资于 NDs、EID 和 MH 产品组合的全球医疗健康研发的成本、健康获益和经济效益。我们发现，根据候选产品的复杂程度，未来十年，每年将需要额外 14 亿至 70 亿美元用于产品研发。通过革命性的创新大幅改善研发生态系统的效率将带来巨大的获益。

Our results show that efficiency gains from coordinated investments to guarantee product launches in each portfolio, adoption of artificial intelligence, faster market entry, and lower manufacturing costs will yield positive benefits from 2023 to 2040. Coordinated investments will lead to product launches in 94 product portfolios that would not be possible otherwise. Using AI and smarter clinical approaches will save over $9 billion and reduce the average cost per launch by up to $100 million.

我们的研究结果表明，从 2023 年到 2040 年，通过协调投资来保证每个产品组合都有产品发布、采用人工智能、更快的市场准入和更低的制造成本，将产生积极的效益。协调投资将带来 94 个产品组合的产品发布，否则这些发布是不可能实现的。使用人工智能和更智慧的临床方法将节省超过 90 亿美元，并将每次发布的平均成本降低高达 1 亿美元。

Furthermore, all these efficiency innovations will increase the number of product portfolios that yield positive NMB to society, strengthening the economic case for future product development. The reductions in average CPL from the efficiency innovations could potentially reduce the current annual funding gap, as it will be possible to conduct more trials with current funding levels.

此外，所有这些效率创新将增加对社会产生正值的 NMB 的产品组合的数量，加强未来产品开发的经济可行性。效率创新带来的平均 CPL 的降低可能会减少目前的年度资金缺口，因为在目前的资金水平下，有可能进行更多试验。

Our prioritization of candidate product portfolios by three value-for-money indices showed that 15 ND vaccine portfolios and one EID vaccine portfolio would be cost-saving from a health system perspective and yield positive NMBs to society that range from $0.25 billion to $48,679 billion.

我们根据三个物有所值指数对候选产品组合优先排序，结果显示，从医疗健康体系的视角来看，15 种 ND 疫苗组合和 1 种 EID 疫苗组合将节省成本，并为社会带来 2.5 亿至 486.79 亿美元的正值 NMBs。

This analysis yielded some additional important findings.

本分析还带来了一些额外的重要发现。

- All the MH diagnostics and therapeutics portfolios included in our analysis had favorable ICERs from a health system perspective and very high positive NMBs, implying significant benefits from a societal perspective.
从医疗健康体系的角度来看，我们分析中包括的所有 MH 诊断和治疗组合都具有良好的 ICERs 和非常高的正值 NMB，从社会视角来看，这意味着显著的获益。

- Most EID product portfolios tended to have negative NMBs, suggesting that the investments needed to develop these products will surpass the economic value of any health gains anticipated for society. This phenomenon is partly driven by the low prevalence of the EIDs, which makes it difficult to offset the massive costs of product development.

  大多数 EID 产品组合往往 NMB 值为负，这表明开发这些产品所需的投资将超过社会预期的任何健康获益所带来的经济价值。造成这种现象的部分原因是 EID 的流行率低，难以抵消产品开发的巨大成本。

- The effect of prevalence extends beyond EIDs. High-prevalence conditions are more likely to yield positive NMBs, while low-prevalence, low-mortality conditions are more likely to yield negative NMBs. For example, mycetoma is a low-prevalence low-mortality condition with less than 200 expected annual cases and less than 1% mortality.[5,6] At an expected CPL of $336 million for a mycetoma vaccine launch, the ICER per death averted will exceed $336 million for any vaccine with less than 50% efficacy and less than 100% coverage.
流行的影响超出了 EID 的范围。高患病率条件下更有可能产生正值的 NMB，而低患病率、低死亡率条件下更有可能产生负值的 NMB。例如，足菌肿是一种低患病率、低死亡率的疾病，预计每年病例少于 200 例，死亡率低于 1%。[5,6]按一种足菌肿疫苗的预期 CPL 为 3.36 亿美元计算，对于任何效力低于 50%、覆盖率低于 100%的疫苗，每例避免死亡产生的 ICERs 将超过 3.36 亿美元。

The position of the different candidates in the product development pipeline and the subsequent effect on the product launch year influenced the NMBs. It seems counter-intuitive that a diagnostics portfolio will yield more NMBs than a vaccines or therapeutics portfolio. However, this can be explained by the length of time each launched product spent on the market and the assumed product uptake during the time horizon of our study (2023 to 2044). For example, the expected launch of a new dengue vaccine ($39 billion NMB) is in 2036, allowing it to spend five years on the market following a three-year regulatory delay. By contrast, the expected launch of a new dengue diagnostic ($225 billion NMB) is 2025, which will allow it to spend 16 years on the market following a three-year regulatory delay. This additional time over which a diagnostic can be used to drive uptake of existing dengue case management approaches.

不同候选产品在研发管线中的位置及其对产品上市年份的作用影响了 NMB 的计算。诊断产品组合比疫苗或治疗产品组合能产生更多的 NMB，似乎超出了人们的意料。然而，这可以通过每个已经发布的产品在市场上流通的时间，以及我们研究期间（2023 年至 2044 年）假设的产品采用率来解释。例如，一种新的登革热疫苗（390 亿美元）预计将于 2036 年上市，在因监管批准而延误三年之后，可以在市场上流通五年的时间。相比之下，一种新的登革热诊断产品（2250 亿美元）预计将于 2025 年上市，在因监管批准而延误三年之后，可以在市场上流通十六年的时间。这给了诊断产品更多时间，来推动目前登革热病例管理的普及度。

Our results should be interpreted in light of the study's limitations. We modeled the independent effect of each portfolio and the health and economic effects of the first product launch for each portfolio. We did not model the joint effects of a vaccine and a therapeutic launch for the same disease. We also did not account for the substitution effects that might occur when more than one product is launched in a single product portfolio.

我们的结果应根据研究的局限性来解释。我们对每个产品组合的独立影响以及每个产品组合首次推出产品的医疗健康和经济影响建模。我们没有建立针对同一疾病的疫苗和治疗的联合影响建模。我们也没有考虑到在单一产品组合中推出多个产品时可能发生的替代效应。

Our model closely linked the health and economic benefits of each product launch to assumed health system effectiveness. We assumed that product uptake would be five percentage points per year up to a maximum of 95% coverage. This is achievable for some health systems but might be out of reach for others. While this might affect the precision of our estimates, it does not affect the conclusions reached from our comparison of different scenarios and product portfolios. Further research will be needed to address scale-up and other health system efficiency issues.

我们的模型将每个产品发布的医疗健康和经济获益与假定的医疗健康体系的有效性紧密联系在一起。我们假设产品的采用率将以每年 5 个百分点的速度增长，直至 95%的覆盖率。这对一些医疗健康体系来说是可以实现的，但对其他医疗健康体系来说可能遥不可及。虽然这可能会影响我们估计的准确性，但它不会影响我们从不同情景和产品组合的比较中得出的结论。将需要进一步研究以解决商业化规模扩大和其他医疗健康体系的效率问题。

The lack of reliable disease burden data, especially for EIDs, should be addressed. Incidence and prevalence estimates of EIDs are difficult to find at the global and country levels. This influenced the results for EIDs with rapidly changing transmission dynamics. For example, the Global Burden of Disease estimates for the incidence of Zika was 3.44 per 100,000 in 2019.[7] However, recent country-level estimates suggest a significant reduction in incidence since 2019.[8] Using the latest (2019) global estimates, we found that investments in developing the Zika vaccines portfolio will yield a positive NMB, but at lower incidence rates, these investments would yield negative NMBs.

应当解决缺乏可靠的疾病负担数据的问题，特别是关于 EID 的数据。不论在全球还是国家层面都很难找到关于 EID 发病率和流行率的估计。鉴于 EID 的传播情况充满变化，这会影响 EID 的数据结果。例如，2019 年全球疾病负担（GBD）对寨卡病毒发病率的估计为每 10 万人 3.44 例。[7]然而，最近的国家一级估计表明，自 2019 年以来，发病率显著下降。[8]使用最新的（2019 年）全球估计，我们发现，投资开发寨卡疫苗组合将产生正值的 NMB，但在发病率较低的情况下，这些投资将产生负值的 NMB。

In sum, our results highlight the significant positive benefits that will accrue to society from investing in several ND, EID, and MH product portfolios. We also show that game-changing efficiency gains are possible with innovations from AI and smarter product development approaches. Although we did not estimate the actual costs of implementing these innovations, the estimated potential cost savings that will accrue from these investments provide a ballpark estimate of the amount society should be willing to invest in these innovations.

总而言之，我们的研究结果彰显了通过投资几种 ND, EID 和 MH 产品组合将为社会带来显著积极获益。我们的研究还表明，通过人工智能和更智慧的产品研发创新，实现变革性的效率提升是可能的。虽然我们没有估计实施这些创新的实际成本，这些投资产生的潜在成本节约，为社会应该在这些创新中的投资金额提供了大致估计。

Finally, the local context should always be considered as regional and country-level R&D priorities might differ from global R&D priorities. The prioritization differences might reflect variations in disease burden, costs, equity considerations, political feasibility, or other factors. Efforts to advance global health R&D must acknowledge and address these factors to be successful.

最后，应该始终考虑当地情况，因为区域和国家一级的研发重点可能与全球的研发重点不同。优先顺序的差异可能反映了疾病负担、成本、公平考虑、政治可行性或其他因素的差异。推动全球医疗健康研发，必须充分考虑这些因素才能取得成功。


R SINGLE USE

APPENDIX A1 附录 A1

Model structure, variables, and parameters

模型结构、变量和参数

APPENDIX A2 附录 A2

Analytic approach 分析方法

Table A2.1. Estimation of deaths, disability-adjusted life-years (DALYs), costs, and value for money ratios.

表 A2.1. 估计死亡、伤残调整生命年（DALYs）、成本和物有所值比率。

Measure 方法	Equation/Notes 公式/注解
Deaths averted The difference in the number of deaths at baseline (without investment) and the number of deaths with additional investment. 避免的死亡 基线时（无投资）死亡人数与有额外投资的死亡人数之差。	Deaths averted=No.of deaths at baseline-No.of deaths with investment,(Eq 1.) 避免的死亡= 基线死亡人数- 投资之后的死亡人数，（公式 1）
Number of deaths Total number of cause-specific deaths. 死亡数 特定原因死亡的总人数。	No.of deaths=f(Pop at risk,incidence rate,treatment coverage rate,treatment success),(Eq.2) 死亡人数=f（高危人口、发病率、治疗覆盖率、治疗成功率），（公式 2）
DALYs averted Disability-adjusted life years averted 避免的 DALYs 避免的伤残调整生命年	DALYs averted=DALYs at baseline-DALYs with investment,(Eq 3.) 避免的 DALYs =基线 DALYs -投资后的 DALYs，（公式 3)
DALYs	DALY=YLL+ YLD,(Eq.4) DALY=YLL+ YLD,（公式 4）
Years of life lost (YLL)	YLL=✣_(g=0)^(g=n) deaths averted*LE for age group,(Eq.5)

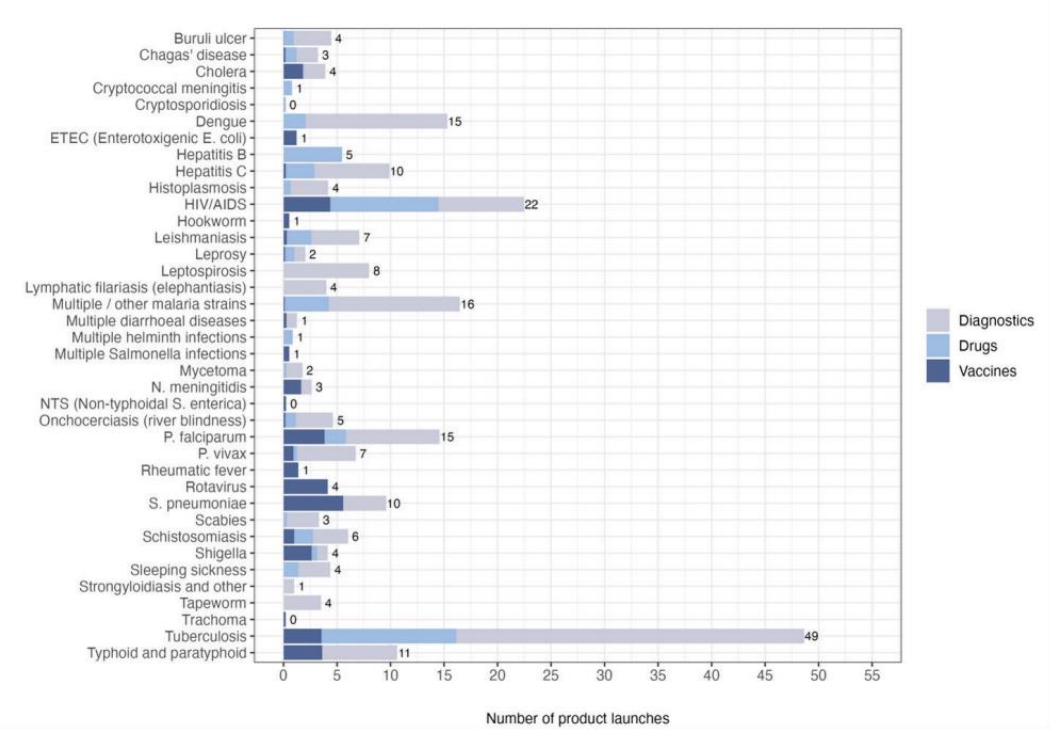
生命损失年数（YLL）	YLL= Σ_(g=0)^(g=n) 避免的死亡*年龄组特定 LE ,(公式 5)
Years lost to disability (YLD) 伤残损失年数（YLD）	YLD=Pop*Incidence rate*disability weights YLD=人口*发病率*残疾权重
Clinical trial costs 临床试验成本	Estimates from P2I model. 来自 P2I 模型的估计
Manufacturing costs 制造成本	Estimates from expert reviews. See working paper. 来自专家评审的估计。见工作文件。
Unit cost of treatment 单位治疗费用	Estimates from peer-reviewed articles. 来自同行评议文章的估计。
Treatment costs 治理成本	Treatment costs= f(Pop at risk,incidence rate,treatment coverage rate, unit cost of treatment),(Eq.6) 治疗费用= f（高危人群、发病率、治疗覆盖率、单位治疗费用），（公式 6）
Treatment costs averted The difference in total population costs of treating a disease condition at baseline and with investment. 避免的治疗成本 在基线和投资情况下治疗疾病的总人口成本的差异。	Treatment costs averted=Treatment costs at baseline-Treatment costs with investment,(Eq 7.) 避免的治疗成本=基线治疗成本-投资之后的治疗成本（公式 7）
Incremental Cost Effectiveness Ratios (ICERs) A ratio of the difference in costs and difference in health benefits. Where health benefits are measured as deaths averted or DALYs averted 增量成本效果比（ICER） 成本差异与健康获益差异的比率。健康获益是以避免的死亡或避免的 DALY 来衡量的	ICER= (Total Costs _investment- Total Costs _baseline)/(Health benefit _invesment-Health benefit _baseline),(Eq.8) ICER=（总成本_投资-总成本_基线）/（健康获益_投资-健康获益_基线），（公式 8）
Net Monetary Benefits 净货币收益	NMB=Economic value of health benefits-Total Soceital Costs ,(Eq.9) NMB=健康获益的经济价值-社会总成本，（公式 9）
Economic value of health benefits **健康获益的经济价值**	**f(DALYs,proportion of DALYs in working age population,employment rate,and national minimum wage),(Eq.10)** f（DALYs，DALYs 占工作年龄人口的比例，就业率，国家最低工资)，(公式 10)

Total societal costs **The total cost incurred by society from R&D till product is used by patient.** **Include costs of preclinical research, clinical trials, manufacturing, delivery and treatment.** 社会总成本 社会从研发到产品被患者使用的总成本。 包括临床前研究、临床试验、生产、交付和治疗的费用。	**=f(research costs,manufacturing and delivery costs,treatment costs),(Eq.11)** **=f（研究成本、制造和交付成本、治疗成本），（公式 11）**

APPENDIX A3 附录 A3

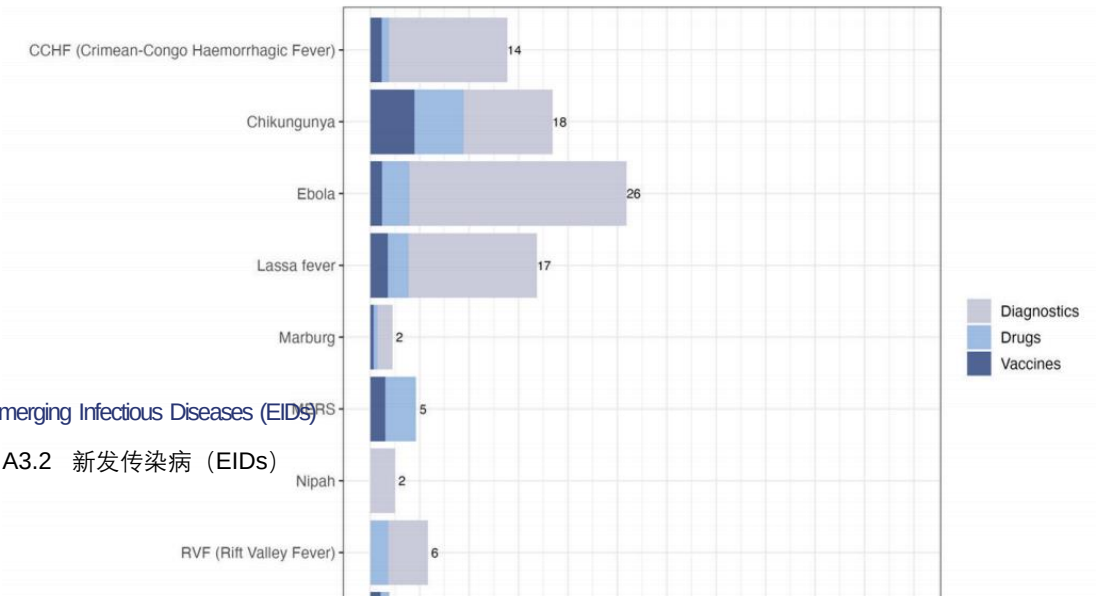
Details of reference case product launches 参考案例产品发布的详细信息

A3.1. Poverty-related neglected diseases (NDs)　　A3.1 与贫困相关的被忽视疾病（NDs）

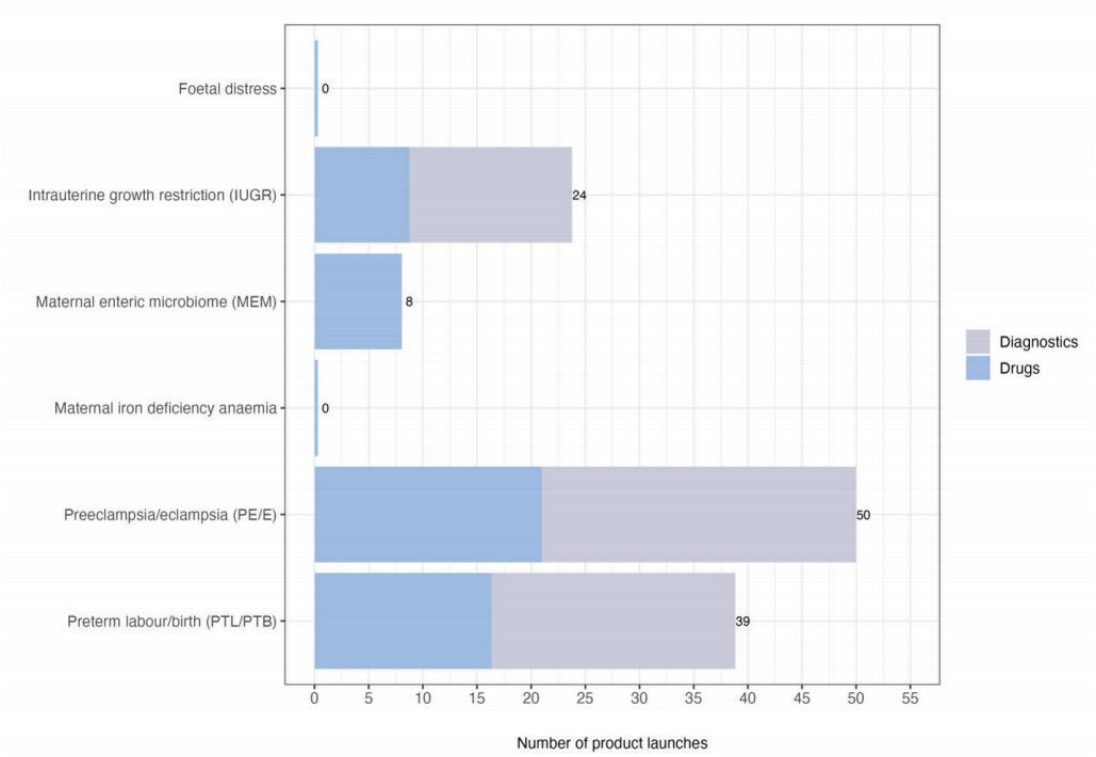


A3.2. Emerging Infectious Diseases (EIDs)

A3.2 新发传染病（EIDs）



A3.3. Maternal Health A3.3 孕产妇保健



Appendix Table A3.4. Disease categories that will not have successful product launches without replenishment of the current product pipeline

附录表 A3.4　　如果不补充现有产品线，将无法成功推出产品的疾病类别

	Diseases categories
NDs with no expected launches for all three product archetypes (vaccines, therapeutics, and diagnostics). 所有三种产品原型（疫苗、治疗和诊断）都无预期上市产品的 NDs。	Cryptococcal meningitis, cryptosporidiosis, ETEC, hookworm, multiple salmonella infections, multiple helminth infections, mycetoma, NTS, rheumatic fever, trachoma. (10 disease categories, 30 product portfolios) 隐球菌性脑膜炎、隐孢子虫病、ETEC、钩虫、多种沙门氏菌感染、多种蠕虫感染、足菌肿、NTS、风湿热、沙眼。（10 个疾病类别，30 个产品组合）

NDs with no expected launches for two product archetypes (vaccines and therapeutics) but expected launches of diagnostics. 预计两种产品原型（疫苗和治疗）无预期上市的产品、但有诊断产品上市的 NDs。	Buruli ulcer, chagas disease, cholera, dengue, histoplasmosis, leishmaniasis, leprosy, leptospirosis, lymphatic filariasis, multiple diarrheal diseases, onchocerciasis, P. vivax, scabies, schistosomiasis, shigella, sleeping sickness, strongyloidiasis, tapeworm. (18 disease categories, 36 product portfolios) 布鲁里溃疡、恰加斯病、霍乱、登革热、组织浆体病、利什曼病、麻风病、钩端螺旋体病、淋巴丝虫病、多重腹泻病、盘尾丝虫病、间日疟原虫、疥疮、血吸虫病、志贺氏菌、昏睡病、圆线虫病、绦虫。（18 个疾病类别，36 个产品组合）
No expected launch of a ND vaccine. 无疫苗产品预期上市的 ND	Hepatitis B, hepatitis C, multiple/other malaria strains. (3 disease categories, 3 product portfolios) 乙型肝炎、丙型肝炎、多种/其他疟疾毒株。（3 个疾病类别，3 个产品组合）
No expected launch of a ND therapeutic. 无治疗产品预期上市的 ND	N. meningitidis, P. falciparum,S. pneumoniae, typhoid and paratyphoid, rotavirus. (5 disease categories, 5 product portfolios) 脑膜炎奈瑟菌，恶性疟原虫，肺炎奈瑟菌，伤寒和副伤寒，轮状病毒。（5 个疾病类别，5 个产品组合）
No expected ND diagnostic 无诊断产品预期上市的 ND	Rotavirus (1 disease category, 1 product portfolio) 轮状病毒（1 个疾病类别，1 个产品组合）
EIDs with no expected launches for all three product archetypes (vaccines, therapeutics, and diagnostics) 所有三种产品原型（疫苗、治疗和诊断）都无预期上市产品的 EID	Nipah, Zika. (2 disease categories, 6 product portfolios) 尼帕、寨卡病毒。（2 个疾病类别，6 个产品组合）
EIDs with no expected launches for two product archetypes (vaccines and therapeutics) but expected launch of diagnostics. 预计两种产品原型（疫苗和治疗）无预期上市的产品、但有诊断产品上市的 EIDs。	Crimean-Congo Hemorrhagic Fever, Ebola, Marburg. (3 disease categories, 6 product portfolios) 克里米亚-刚果出血热、埃博拉、马尔堡。（3 个疾病类别，6 个产品组合）
No expected launch of an EID vaccine 无疫苗产品预期上市的 EID	Rift Valley Fever (1 disease category, 1 product portfolio) 裂谷热（1 种疾病类别，1 个产品组合）
No expected launch of an EID diagnostic 无诊断产品预期上市的 EID	Middle East Respiratory Syndrome. (1 disease category, 1 product portfolio) 中东呼吸综合征。（1 个疾病类别，1 个产品组合）
No expected launch of an MH therapeutic 无治疗产品预期上市的 MH	Fetal distress, maternal iron deficiency anemia. (2 disease categories, 2 product portfolios) 胎儿窘迫，产妇缺铁性贫血贫血。（2 个疾病类别，2 个产品组合）
No expected launch of an MH diagnostic 无诊断产品预期上市的 MH	Fetal distress, maternal enteric microbiome, maternal iron deficiency anemia. (3 disease categories, 3 product portfolios) 胎儿窘迫，产妇肠道微生物群，产妇缺铁性贫血。（3 个疾病类别，3 个产品组合）

APPENDIX A4 附录 A4

Table A4.1. Annual funding gap by disease-product-archetype, over the next 10 years

表 A4.1　按疾病-产品-原型划分的未来 10 年年度资金缺口

Disease-product-archetype 疾病-产品-原型		Reference case 参考案例		Replenishment with simple products 以简单产品补充		Replenishment with complex products 以复杂产品补充	
	Available funding (in million USD) 可用资金（百万美元）	Needed funding (USD millions) 所需资金（百万美元）	Funding gap (USD millions) 资金缺口（百万美元）	Needed funding (USD millions) 所需资金（百万美元）	Funding gap (USD millions) 资金缺口（百万美元）	Needed funding (USD millions) 所需资金（百万美元）	Funding gap (USD millions) 资金缺口（百万美元）
PRND vaccines PRND 疫苗	$1,308	$1,260	-$48	$2,341	$1,033	$4,909	$3,601
PRND therapeutics PRND 治疗	$1,436	$613	-$823	$1,171	-$265	$3,688	$2,252
PRND diagnostics PRND 诊断	**$164**	**$228**	**$64**	**$508**	**$344**	**$244**	**$80**
All PRND products 所有 PRND 产品	**$2,908**	**$2,102**	**-$806**	**$4,020**	**$1,112**	**$8,841**	**$5,933**
EID vaccines EID 疫苗	**$274**	**$341**	**$67**	**$510**	**$236**	**$911**	**$637**
EID therapeutics EID 治疗	**$422**	**$228**	**-$194**	**$296**	**-$126**	**$604**	**$182**

EID diagnostics **EID 诊断**	**$46**	**$17**	**-$29**	**$79**	**$33**	**$20**	**-$26**
All EID products **所有 EID 产品**	**$742**	**$586**	**-$156**	**$885**	**$143**	**$1,536**	**$794**
MH vaccines* **MH 疫苗***	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
MH therapeutics **MH 治疗**	**$154**	**$240**	**$86**	**$267**	**$113**	**$390**	**$236**
MH diagnostics **MH 诊断**	**$43**	**$60**	**$17**	**$121**	**$78**	**$63**	**$20**
All MH products **所有 MH 产品**	**$197**	**$299**	**$102**	**$388**	**$191**	**$453**	**$256**

* There are no vaccines in the maternal health technologies category 孕产妇保健技术类别中没有疫苗

NOTES: 注:

• Needed funding is total R&D funding / 10 years. 所需资金为总研发资金/ 10 年。

• Available funding is from GFINDER data portal (latest year available) 可用资金来自 GFINDER 数据门户（可获得最近一年的数据）

• Negative values indicate that needed funding is met, thus no funding gap exists 负值表示所需资金得到满足，因此不存在资金缺口

APPENDIX A5 附录 A5

Table A5.1. Vaccines development 表 A5.1. 疫苗研发

Incremental cost-effectiveness ratios and net-monetary benefits for investing in vaccines development (Assumes replenishment of current pipeline to guarantee at least one launch in each disease-product-archetype category)

投资于疫苗开发的增量成本效果比和净货币收益（假设现有管线得到补充，以保证在每种疾病-产品-原型类别中至少推出一种疫苗）

排名	避免每DALY的增量成本（以美元计）*	净货币收益（十亿美元）
	NDs	
1	结核病（节省成本）	肺炎链球菌 ($48,679 B)
2	脑膜炎奈瑟菌（节省成本）	多种腹泻病 ($6,518 B)
3	多重沙门氏菌感染（节省成本）	伤寒和副伤寒 ($2,740 B)
4	登革热（节省成本）	恶性疟原虫 ($311 B)
5	HIV/AIDS（节省成本）	多种/其他疟疾菌株 ($126 B)
6	轮状病毒（节省成本）	肺结核 ($118 B)
7	隐球菌性脑膜炎（节省成本）	轮状病毒 ($96 B)
8	类圆线虫病和其他（节省成本）	多发性蠕虫感染 ($74 B)
9	恶性疟原虫（节省成本）	脑膜炎奈瑟菌 ($63 B)
10	风湿热（节省成本）	艾滋病毒/艾滋病 ($53 B)
11	多种/其他疟疾菌株（节省成本）	绦虫 ($49 B)
12	乙型肝炎（节省成本）	登革热 ($39 B)
13	伤寒和副伤寒（节省成本）	血吸虫病 ($30 B)
14	多种腹泻病（节省成本）	乙型肝炎 ($28 B)
15	肺炎链球菌（节省成本）	多重沙门氏菌感染 ($17 B)
16	志贺氏菌（$128）	志贺氏菌 ($16 B)
17	绦虫（$131）	类圆线虫病和其他 ($15 B)
18	NTS（非伤寒肠炎）（$179）	间日疟原虫 ($12 B)

19	钩端螺旋体病（$200）	钩虫（$10 B）
20	ETEC（产肠毒素大肠杆菌）（$238）	隐球菌性脑膜炎（$9 B）
21	间日假单胞菌（$252）	NTS（非伤寒肠炎）（$9 B）
22	血吸虫病（$310）	淋巴丝虫病（象皮病）（$8 B）
23	沙眼（$479）	风湿热（$7 B）
24	丙型肝炎（$514）	钩端螺旋体病（$5 B）
25	淋巴丝虫病（象皮病）（$529）	霍乱（$5 B）
26	霍乱（$628）	丙型肝炎（$4 B）
27	钩虫（$847）	沙眼（$4 B）
28	多种蠕虫感染（$949）	ETEC（产肠毒素大肠杆菌）（$4 B）
29	盘尾丝虫病（河盲症）（$1,033）	盘尾丝虫病（河盲症）（$1 B）
30	隐孢子虫病（$2,019）	隐孢子虫病（$1 B）
31	组织胞浆菌病（$7,855）	组织胞浆菌病（-$.13 B）
32	利什曼病（$7,918）	利什曼病（-$.18 B）
33	疥疮（$8,230）	昏睡病（-$.28 B）

续： 表A5.1.疫苗研发：

34	恰加斯病（$16 999）	足菌肿 （-$.35 B）
35	昏睡病（$23,121）	麻风病 （-$.37 B）
36	麻风病（$151,279）	布鲁里溃疡 （-$.38 B）
37	布鲁里溃疡（$777, 160）	恰加斯病 （-$.40 B）
38	足菌肿（$472,737,652）	疥疮 （-$3 B）
	EIDs	
1	寨卡病毒（节省成本）	寨卡病毒 （$.25 B）
2	拉沙热（$3,128）	拉沙热 （$.20 B）
3	基孔肯雅热（$6,290）	基孔肯雅热 （-$.20 B）
4	埃博拉病毒（$10,480）	裂谷热 （-$.26 B）
5	CCHF（克里米亚-刚果出血热）（$29 607）	尼帕 （-$.27 B）
6	裂谷热（裂谷热）（$57,729）	MERS （-$.41 亿）
7	马尔堡（$99,837）	马尔堡 （-$.46 B）
8	尼帕（$126,530）	CCHF（克里米亚-刚果出血热） （-$.50 B）
9	MERS （$245 251）	埃博拉 （-$.50 B）

* Negative ICERs imply that a successful launch will lead to cost savings. Negative net monetary benefits imply that in economic terms, the costs of investing in product devel- opment are higher than the economic value of expected health benefits.

* ICER为负意味着成功发布将带来成本节约。负值的净货币收益简单地说，从经济角度来看，投资于产品研发的成本高于预期健康获益的经济价值。

表 A5.2. 治疗药物开发

Incremental cost-effectiveness ratios and net-monetary benefits for investing in therapeutics development (Assumes replenishment of current pipeline to guarantee at least one launch in each disease-product-archetype category)

投资于治疗药物研发的增量成本效果比和净货币收益（假设补充当前管线，以保证在每个疾病-产品-原型类别中至少有一个产品推出）

排名	避免每DALY的增量成本（以美元计）*	净货币收益（十亿美元）
	ND	
1	绦虫（$6）	多种腹泻病 （$6,002 B）
2	多发性蠕虫感染（$8）	肺炎链球菌 （$3,354 B）
3	血吸虫病 （$19）	多种/其他疟疾菌株 （$840 B）
4	钩虫（$22）	伤寒和副伤寒 （$761 B）
5	伤寒和副伤寒（$24）	艾滋病毒/艾滋病 （$460 B）

6	肺炎链球菌 ($38)	多发性蠕虫感染 ($251 B)
7	淋巴丝虫病（象皮病）（$56）	恶性疟原虫 ($131 B)
8	间日假单胞菌（$104）	绦虫 ($126 B)
9	多种/其他疟疾菌株（$108）	血吸虫病 ($99 B)
10	霍乱（$137）	乙型肝炎 ($77 B)
11	NTS（非伤寒肠炎） ($193)	登革热 ($50 B)
12	恶性疟原虫（$198）	类圆线虫病和其他 ($44 B)
13	类圆线虫病和其他（$204）	钩虫 ($37 B)
14	多种腹泻病（$265）	间日疟原虫（$29 B）
15	沙眼（$269）	风湿热 ($19 B)
16	隐球菌性脑膜炎（$606）	淋巴丝虫病（象皮病） ($16 B)
17	艾滋病毒/艾滋病（$633）	隐球菌性脑膜炎 ($12 B)
18	风湿热（$645）	霍乱 ($10 B)
19	盘尾丝虫病（河盲症）（$669）	NTS（非伤寒肠炎） ($8 B)
20	钩端螺旋体病（$704）	多重沙门氏菌感染 ($4 B)

续： 表 A5.2.治疗药物开发：

21	登革热（$740）	盘尾丝虫病（河盲症） ($4 B)
22	乙型肝炎 ($1,962)	沙眼 ($3 B)
23	恰加斯病 ($2,036)	脑膜炎奈瑟菌 ($2 B)
24	隐孢子虫病（$2,557）	恰加斯病 ($2 B)
25	多重沙门氏菌感染 ($2,932)	钩端螺旋体病 ($2 B)
26	脑膜炎奈瑟菌 ($3,090)	隐孢子虫病 ($1 B)
27	组织胞浆菌病（$3,501）	志贺氏菌 ($.99 B)
28	志贺氏菌（$4,202）	组织胞浆菌病 ($.07 B)
29	利什曼病 ($4,332)	利什曼病 ($.02 B)
30	丙型肝炎 ($4,755)	昏睡病 (-$.09 B)
31	轮状病毒（$6,405）	足菌肿 (-$.19 B)
32	昏睡病 ($7,143)	布鲁里溃疡 (-$.22 B)
33	ETEC（产肠毒素大肠杆菌）（$7,776）	麻风病 (-$.23 B)
34	肺结核（$8 333）	丙型肝炎 (-$3 B)
35	疥疮（$16,002）	轮状病毒 (-$5 B)
36	布鲁里溃疡（$430,461）	ETEC（产肠毒素大肠杆菌） (-$6 B)
37	足菌肿（$412,936,555）	疥疮 (-$11 B)
38	麻风病 （无法获得）**	肺结核 (-$43 B)
	NDs	
1	拉沙热（$4,774）	拉沙热 (-$.02 B)
2	裂谷热（$12,599）	裂谷热 (-$.09 B)
3	基孔肯雅热（$25,271）	尼帕 (-$.13 B)
4	埃博拉病毒 ($25,484)	马尔堡 (-$.28 B)
5	CCHF（克里米亚-刚果出血热）（$54 843）	中东呼吸综合征 (-$.32 B)
6	MERS ($117,493)	CCHF（克里米亚-刚果出血热） (-$.33 B)
7	马尔堡（$180,470）	埃博拉 (-$.58 B)
8	尼帕 ($187,198)	基孔肯雅热 (-$.87 B)
9	寨卡病毒 ($5,065,397)	寨卡病毒 (-$2.35 B)
	MH	

1	先兆子痫/子痫（PE/E）（$23）	先兆子痫/子痫（PE/E）（$550 B）
2	孕产妇缺铁性贫血（$44）	早产（PTL/PTB）（$454 B）
3	早产（PTL/PTB）（$70）	孕产妇肠道微生物群（MEM）（$216 B）
4	宫内生长受限（IUGR）（$85）	孕产妇缺铁性贫血（$180 B）
5	胎儿窘迫（$99）	宫内生长受限（IUGR）（$132 B）
6	孕产妇肠道微生物群（MEM）（$117）	胎儿窘迫（$24 B）

*ICER 为负意味着成功的发布将节省成本。净货币收益为负，简单地说，从经济角度来看，投资于产品研发的成本高于预期的健康获益的经济价值。

**基准年的麻风病治疗率已超过95%，因此没有对药物上市后麻风病治疗的扩大进行分析。

表 A5.3.诊断开发

投资于诊断产品研发的增量成本效果比和净货币收益（假设补充当前管线，以保证在每个疾病-产品-原型类别中至少有一个产品推出）

排名	避免每DALY的增量成本（以美元计）*	净货币收益（十亿美元）
NDs		
1	伤寒和副伤寒（$24）	多种腹泻病（$24,296 B）
2	绦虫（$27）	肺炎链球菌 （$17,075 B）
3	霍乱（$48）	伤寒和副伤寒 （$3,748 B）
4	血吸虫病（$68）	多种/其他疟疾菌株（$1,655 B）
5	间日疟原虫（$73）	恶性疟原虫 （$1,194 B）
6	恶性疟原虫（$81）	多发性蠕虫感染 （$780 B）
7	肺炎链球菌（$83）	绦虫 （$651 B）
8	类圆线虫病和其他（$94）	艾滋病毒/艾滋病 （$467 B）
9	多种/其他疟疾菌株（$94）	血吸虫病 （$451 B）
10	昏睡病（$117）	间日疟原虫（$242 B）
11	淋巴丝虫病（象皮病）（$138）	登革热 （$227 B）
12	NTS（非伤寒肠炎） （$153）	类圆线虫病和其他 （$180 B）
13	钩虫（$181）	钩虫 （$122 B）
14	风湿热（$186）	淋巴丝虫病（象皮病）（$103 B）
15	盘尾丝虫病（河盲症）（$211）	风湿热 （$62 B）
16	沙眼（$225）	霍乱 （$42 B）
17	多种蠕虫感染（$267）	盘尾丝虫病 （河盲症） （$38 B）
18	多种腹泻病（$285）	隐球菌性脑膜炎 （$31 B）
19	钩端螺旋体病（$309）	脑膜炎奈瑟菌 （$23 B）
20	利什曼病（$331）	NTS（非伤寒肠炎） （$21 B）
21	隐球菌性脑膜炎（$492）	乙型肝炎 （$18 B）
22	恰加斯病（$501）	多重沙门氏菌感染 （$11 B）
23	艾滋病毒/艾滋病（$666）	钩端螺旋体病 （$9 B）
24	登革热（$726）	沙眼 （$7 B）
25	组织胞浆菌病（$943）	利什曼病 （$3 B）

26	脑膜炎奈瑟菌 ($962)	隐孢子虫病 ($2 B)
27	乙型肝炎 ($1,998)	组织胞浆菌病 ($1 B)
28	多重沙门氏菌感染 ($2,943)	昏睡病 ($.59 B)
29	隐孢子虫病 ($3,449)	恰加斯病 ($.46 B)
30	志贺氏菌 ($4,449)	志贺氏菌 ($.22 B)
31	丙型肝炎 ($4,975)	布鲁里溃疡 (-$.01 B)
32	轮状病毒 ($6,819)	麻风病 (-$.03 B)
33	肺结核 ($8 137)	丙型肝炎 (-$.06 B)
34	布鲁里溃疡 ($8,193)	足菌肿 (-$.25 B)
35	ETEC（产肠毒素大肠杆菌） ($8,239)	轮状病毒 (-$15 B)
36	疥疮 ($49,576)	ETEC（产肠毒素大肠杆菌） (-$17 B)
37	足菌肿 ($73,391,445)	肺结核 (-$33 B)
38	麻风病 （无法获得） **	疥疮 (-$177 B)

EIDs		
1	拉沙热（$598）	拉沙热 （$.58 B）
2	埃博拉病毒（$877）	埃博拉 （$.41 B）
3	马尔堡（$1,660）	马尔堡 （$.02 B）
4	CCHF（克里米亚-刚果出血热）（$7,015）	裂谷热 （-$.03 B）
5	裂谷热（$9,763）	CCHF（克里米亚-刚果出血热） （-$.07 B）
6	基孔肯雅热（$20,262）	尼帕 （-$.21 B）
7	尼帕 （$72,828）	中东呼吸综合征 （-$.22 B）
8	MERS （$199 736）	基孔肯雅热 （-$.39 B）
9	寨卡病毒 （$4,177,530）	寨卡病毒 （-$5 B）
MH		
1	先兆子痫/子痫 （PE/E） （$25）	孕产妇缺铁性贫血 （$481 B）
2	孕产妇缺铁性贫血（$53）	先兆子痫/子痫 （PE/E） （$216 B）
3	早产（PTL/PTB） （$79）	早产（PTL/PTB） （$178 B）
4	宫内生长受限 （IUGR） （$104）	孕产妇肠道微生物群（MEM） （$83 B）
5	胎儿窘迫（$105）	胎儿窘迫 （$66 B）
6	孕产妇肠道微生物群（MEM） （$148）	宫内生长受限 （IUGR） （$52 B）

* Negative ICERsimply that a successful launch will lead to cost savings. Negative net monetary benefitsimply that in economic terms, the costs of investing in product development are higher than the economic value of expected health benefits.

*ICER 为负意味着成功的发布将节省成本。净货币收益为负，简单地说，从经济角度来看，投资于产品研发的成本高于预期的健康获益的经济价值。

** Treatment for Leprosy in the base year already exceeds 95% so no analysis was conducted for scale-up of Leprosy treatment from a diagnostic launch.

**麻风病在基准年的治疗覆盖率已经超过 95%，因此没有对从诊断发布开始扩大麻风病治疗进行分析。

APPENDIX A6 附录 A6

REFERENCES 参考文献

1. Policy Cures Research, G-FINDER data portal, https://gfinderdata.policycuresresearch.org
2. Schäferhoff, M, Yamey, G, Ogbuoji,O, et al 2024. Reforming the research and development ecosystem for neglected diseases, emerging infectious diseases, and maternal health.
3. Zimmerman, A., Diab, M. M., Schäferhoff, M., McDade, K. K., Yamey, G., & Ogbuoji,O. (2023). Investing in a global pooled-funding mechanism for late-stage clinical trials of poverty-related and neglected diseases: an economic evaluation. BMJ Global Health, 8(5), e011842.
4. Schäferhoff, M., Zimmerman, A., Diab, M. M., Mao, W., Chowdhary, V., Gill, D., ... & Yamey, G. (2022). Investing in late-stage clinical trials and manufacturing of product candidates for five major infectious diseases: a modelling study of the benefits and costs of investment in three middle-income countries. The Lancet Global Health, 10(7), e1045-e1052.
5. van de Sande WW. Global burden of human mycetoma: a systematic review and meta-analysis. PLoS Negl TropDis. 2013 Nov 7;7(11):e2550. doi: 10.1371/journal.pntd.0002550. PMID: 24244780; PMCID: PMC3820768.
6. World Health Organization (WHO). 2022. Myecetoma. https://www.who.int/news-room/fact-sheets/detail/mycetoma
7. Guo Z, Jing W, Liu J, Liu M. The global trends and regional differences in incidence of Zika virus infection and implications for Zika virus infection prevention. PLoS Negl TropDis. 2022 Oct 21;16(10):e0010812. doi: 10.1371/journal.pntd.0010812. PMID: 36269778; PMCID: PMC9586358.
8. US Centers for Disease Control and Prevention. 2024. Countries and Territories at Risk for Zika. https://www.cdc.gov/zika/geo/index.html

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