公共卫生应急防护装备储备的经验分享和政策建议

3M 公司

目录

摘要

生命至上。新冠肺炎疫情期间，各国政府都在竭力保护本国民众和奋战在抗疫一线的医务工作者、应急响应人员和关键岗位工作人员。新冠肺炎疫情对世界各国 的疫情应对能力都是一次严峻的考验。疫情的全球性传播引发世界各国竞相获取 抗疫资源。这种争夺也造成了需求的大幅增长。在市场供不应求时，供应链只有很小的回旋余地。

需求的大幅增长带来了严峻挑战，特别是包括个体防护装备在内的关键防疫物资。此次新冠疫情导致人们对个体防护装备的需求达到了平时的 20 至 40 倍。整个行业的生产能力都无法满足这样的需求。拥有健全的公共卫生政策，并实施个体防护装备和其他关键物资国家储备项目的政府能够更好地应对疫情。

3M 在 70 多个国家设有业务运营机构，在此次疫情期间与各国政府和私营部门密切合作。近二十来，3M 与许多国家的政府开展了国家储备项目合作。本报告的目的在于分享我们的经验，报告我们观察到的各国政府在实施稳健、高效、可持续的个体防护装备储备的经验。

我们期待着与政府加强合作，以满足广大人民群众、一线医务工作者、应急响应人员、关键岗位工作人员的防护需求，共同应对此次新冠疫情和未来大规模疫情带来的挑战。

除了完备的应急物资储备体系，以下因素对于政府的疫情应对大有帮助：

- 保持预算的灵活性，可在需要时采购所需物资，而不受预算周期的限制。
- 把个体防护装备的紧急调用纳入到公共卫生政策法规体系，以确保依法

依规迅速跨境获取所需物资。

- 具有快速反应能力以应对个体安全防护装备需求的激增以及储备物资随时可用，特别是确保一线人员的使用。
- 在政策法规中把应急物资储备和有力的供应保障列入硬性规定，并确保充足的资金支持。
- 拥有打击欺诈行为和假冒产品的法律制度和海关体系。
- 拥有与其他国家一致的个体防护装备性能的标准。这确保了全球供应链的共享。独特、标准不一致的法规使采购变得更加困难。
- 允许货物跨境流动。短期而言，实行出口限制的国家虽然能迅速获得个体防护装备供应，但从长远来讲，这一策略往往会整体上减少获得必需品的机会。
- 与关键的优质供应商建立公私合作伙伴关系。事实证明，这种合作战略比简单的买卖关系更有效。

本报告从以下方面详细介绍了制定和实施稳健、高效的和可持续的储备计划的国际经验。

1. 储备库存必须始终在规定的存储期限内。
2. 精简储备产品的型号以简化储备管理。
3. 使用分析工具帮助政府建立与国家计划相匹配的最低储备水平。
4. 所储备个体防护装备满足不同的使用目的。
5. 个体防护装备储备应适合多种终端用户。
6. 储备供应商应能提供交错采购、紧急使用授权、产品使用寿命管理等方面的专业建议。

7. 制造商的全球化的业务网络、生产能力和原材料供应有助于减轻出口限制的影响。

8. 国家储备物资的制造商应能满足不定期的和一定幅度增长的需求。

9. 国家储备物资制造商应具备疫情防控的知识和经验。

10. 国家储备物资制造商应成为卫生部门的合作伙伴，而不仅仅是供应商。

11. 储备需求规划工具能够帮助卫生部门进行情景分析和规划。

我们将发挥我们的技术优势，为确保为广大人民群众、一线医务工作者、应急响应人员和关键岗位人员得到有效的防护贡献我们的力量。我们也衷心希望与政府进一步加强合作，协助政府部门借鉴国际上的成功经验，完善公共卫生应急管理体系，制定和实施稳健、高效和可持续的储备计划。

前言

生命至上。疫情期间，全球各国政府都在竭力保护本国公民及奋战在一线的医务工作者、应急响应人员和关键岗位工作人员。新冠肺炎对世界各国的疫情应对能力都是一次严峻的考验。疫情的全球性传播引发世界各国竞相获取抗疫资源。这种争夺也造成了需求的大幅增长。在需求大幅增长导致供不应求时，供应链几乎没有任何回旋余地。疫苗、医疗用品、个体防护装备等许多关键物资都是如此。此次新冠肺炎疫情引发了对个体防护装备需求的激增，达到了正常水平的 20 至 40 倍。整个行业的产能都不足以满足这种需求。拥有健全的公共卫生政策和个体防护装备及其他关键物资国家储备体系可以帮助政府更好地应对疫情。

由世界卫生组织和世界银行共同发起建立的全球应急准备监测委员会在其名为《一个混乱的世界》的 2020 年年度报告中写道：“产能、储备和脆弱

的供应链是疫情应对的主要瓶颈。大多数国家没有足够的储备或现存的能力和资源临时扩大生产规模并采取必要的疫情应对措施。其结果是全球对医疗资源的需求大幅上升，这暴露了全球医疗用品及其原材料供应链的脆弱。这种医疗资源的短缺已经威胁到各国抗击新冠肺炎疫情的能力。”报告还指出：“国家层面的疫情防范体系是基础，此外，还要建设、完善、维护和资助全球性和区域性的防范体系，涉及潜在病原体的追踪、早期预警、信息共享、研发、监管能力建设和提升、资源分配、储备和供应链”。

国家储备仍然是弥补供应链缺口的核心战略。有些政府拥有国家储备的经验，而很多政府缺乏这样的经验。本报告的目的就是以个体防护装备为重点，分享 3M 观察到的各国政府国家储备项目的成功经验。3M 是全球主要的个体防护装备生产商。我们本着分享知识的原则，在本报告中汇总了政策建议。多年来，我们在世界各地与许多政府合作，协助他们应对传染性疾病、自然和人为灾难。我们在全球各地的团队随时准备与政府进行深入沟通，协助他们总结抗击新冠肺炎疫情的经验和教训，并开展系统性改革。国家储备项目有助于确保为一线医务工作者、应急响应人员和关键行业工作人员配备足够的和适当的个体防护设备，以使他们能够正常履行其工作职责。

全球疫情防范计划概览

世界上每个国家都拥有一种或几种形式的应急准备和响应计划。这类计划重点在于应对国家所预期的最大威胁。

世界卫生组织对于应急响应计划是这样描述的：“应急响应计划（ERP）是关于一个机构或组织关于紧急情况应对管理的文件。应急响应计划描述了

应对措施的目标、政策和行动纲要，并使应对措施系统化、协调化和有效化的组织结构、权利机关和主要职责。"(《应急准备战略框架》，世界卫生组织，2017 年，ISBN978-92-4-151182-7）

应急响应计划可以包括各种紧急事件，例如传染性疾病爆发、自然灾害乃至各种人为事件。响应措施往往需要国家应急响应部门和其他有关政府机构的参与。非政府组织和产业界也可以参与支持。每个计划都描述了机构内部和机构之间的协调工作机制。通常，一个部委或政府机构发挥主导作用，其他部委或政府机构则根据其职责范围和专业知识提供支持。这种协调与合作是国家应急响应计划的一项重要职能。

我们注意到，许多应急响应计划往往缺少一个附录，阐述有效应对特定事件所需的物流和供应链措施，尤其是疫情应对计划更是如此。疫情应对计划通常聚焦于流感病毒。新冠肺炎疫情已证明，其他类型的病原体也可以在全球范围内传播，并构成疫情威胁。

国家疫情应对计划的物流、供应链和库存目录对各种疫情情景及其严重程度做出假设。对于每一种情景，都必须评估相应的物流、供应链和储备。行业的应对能力也必须在考虑范围内。每一种情景随着严重程度的增加，对于物流、供应链和储备量的要求也相应提高。在灾难性事件中，响应速度对有效应对和拯救生命至关重要。物资和供应链方面的不足会降低响应措施的有效性。新冠肺炎疫情是对国家疫情应急响应计划及其相关的物流、供应链和国家储备准备情况的一次考验。

由世界卫生组织和世界银行共同发起建立的全球应急准备监测委员会在其 2020 年年度报告中指出，储备是应急准备和响应的一个组成部分。应急储备的难点之一是确定基本药物、医疗器械及其他装备的清单。个体防护装备

是清单中关键的和必不可少的。这些装备的规格，例如类型和功能，也要详细地说明。在疫情期间，它们可以帮助采购方在全球性物资短缺的情况下，能够大范围的采购到高质量、规格齐全的产品。可见，政府公共卫生部门、个体防护装备监管机构、采购部门和制造商之间的合作协同机制非常重要。

有效的疫情防范计划应该包含以下重要因素:

- 保持预算的灵活性，可在需要时采购所需物资，而不受预算周期的限制。
- 把个体防护装备的紧急调用纳入到公共卫生政策法规体系，以确保依法依规迅速跨境获取所需物资。
- 具有快速反应能力以应对个体安全防护装备需求的激增以及储备物资随时可用，特别是确保一线人员的使用。
- 在政策法规中把应急物资储备和有力的供应保障列入硬性规定，并确保充足的资金支持。
- 拥有打击欺诈行为和假冒产品的法律制度和海关体系。
- 拥有与其他国家一致的个体防护装备性能的标准。这确保了全球供应链的共享。独特、标准不一致的法规使采购变得更加困难。
- 允许货物跨境流动。短期而言，实行出口限制的国家能迅速获得个体防护装备供应，但长远看，这一策略往往总体上会减少获得必需品的机会。
- 与关键的优质供应商建立公私合作伙伴关系。事实证明，这种合作战略比简单的买卖关系更有效。

本报告从以下方面详细介绍了制定稳健、高效的和可持续的储备计划的国际经验。

1. 储备库存必须始终在规定的存储期限内。

2. 精简储备产品的型号以简化储备管理。

3. 使用分析工具帮助政府建立与国家计划相匹配的最低储备水平。

4. 所储备个体防护装备满足不同的使用目的。

5. 个体防护装备储备应适合多种终端用户。

6. 储备供应商应能提供交错采购、紧急使用授权、产品使用寿命管理等方面的专业建议。

7. 制造商的全球化的业务网络、生产能力和原材料供应有助于减轻出口限制的影响。

8. 国家储备物资的制造商应能满足不定期的和一定幅度增长的需求。

9. 国家储备物资制造商应具备疫情防控的知识和经验。

10. 国家储备物资制造商应成为卫生部门的合作伙伴，而不仅仅是供应商。

11. 储备需求规划工具能够帮助卫生部门进行情景分析和规划。

个体防护装备储备政策建议

1. 储备库存必须始终在规定的存储期限内。

稳健的国家储备方案的核心是全生命周期管理。为了优化储备物资的使用寿命管理，政府合理地使用公共资金购买新产品替换过期储备。国家储备相当于购买了国家保险。当灾难发生时，政府可以动员起来，为民众服务。长久存放的个体防护装备会过期，因为每个产品都有固定的存储期限。在各国的国家储备的实践中，有很多成功经验值得借鉴，比如适当的长期储备、物资轮换和库存管理。

健全的储备管理体系包含很多重要因素，例如：储存条件的管控、储备

的集中管理、库存轮换及相应的交错采购。政府要与具备个体防护装备储备管理知识、经验和能力的制造商和物流服务商合作。

自 2003 年“非典”以来，3M 配合很多国家的政府部门开展国家储备项目。在设计稳健、高效和可持续的国家储备项目以及为政府提供符合其需求的选择方面，我们有很多经验可以与政府储备管理部门进行分享。

3M 希望协助政府部门制定最佳的个体防护装备储备管理方案，以优化物资使用寿命管理，尽量减少公共资金的占用，确保突发重大事件造成物资需求激增时防护产品的供应。

2. 精简储备产品型号以简化储备管理。

国家储备项目中可能需要包含不同型号的呼吸防护用品。产品类型越多，产品有效期的管理就越复杂。个体防护装备的型号种类直接关系到储备管理效率。选择适用于广泛人群的呼吸器可以减少型号的数量，简化储备物资的维护工作。

选择的呼吸器要适应目标人群的。任何一款型号的呼吸器都不可能 100%适合所有目标人群。因此，个体的适合性测试是确保所选择的呼吸器能有效适合使用者的唯一方法。呼吸器的适合性测试是一项重要工作，在一些国家是法规的要求。适合性测试有助于呼吸器佩戴者实现适当的密封，从而在正确选择和正确佩戴的情况下达到预期的隔离效果。此外，接受培训、遵循佩戴说明，并根据每款呼吸器的使用说明进行密合性测试，对佩戴时实现适当的密合也至关重要。制造商可能会提供有数据支持的适合性能说明，帮助判定某种型号呼吸器的适用群体。

根据呼吸器的适合性描述文件选择几个不同的型号，将使储备项目管理人员有足够的选择，满足大多终端用户。储备项目管理部门可以与呼吸器制

造商合作，尽可能减少国家储备中个体防护装备的型号数量，同时不降低针对佩戴者的适合性。

我们可以与政府主管部门和储备企业就精简产品型号数量的最优策略和不同的产品组合、协助制定量身定制的储备方案。

3. 使用分析工具帮助政府建立与国家储备计划相匹配的最低储备水平。

疫情的应对依靠一支随时做好准备的医务工作者队伍和支撑国家关键基础设施的队伍，以确保在保护人民生命和维持经济运转的同时，社会能够保持正常运转。国家的医疗服务体系以及国家关键基础设施企业需要确保在岗人员都能得到适当的个体防护装备，以维持工作的正常进行。掌握个体防护装备的日常消耗水平以及突发事件的持续时间，对于把握适当的物资供应量、保障一线工作人员的正常工作至关重要。

预测疫情中个体防护装备的消耗水平是一个难题，难点在于要将一种新出现的疾病及其相关流行学的专业知识与个体防护装备物流和供应链管理知识相结合。国家储备的制定者须确定预计需要的个体防护装备的种类和数量。虽然许多政府部门、医疗机构和关键基础设施企业善于制定应急响应计划，但很多这类计划侧重于明确职责和分工，以便协调行动。确定国家储备计划所要求的最低储备水平，可以帮助主管部门储备适当数量的物资。将最低准备水平与国家储备计划中的情景预测和预期效果相结合，对于储备计划的制定和管理至关重要。

自 2003 年“非典”爆发以来，3M 开发了需求规划工具供许多国家政府使用。这些工具根据所在地的应急响应计划，对所需的个体防护装备的储备量进行估算。

3M 可以免费提供这些工具。这些需求规划工具的功能和特点在其他报告

中有详细介绍。

我们希望与有关主管部门就需求规划进行深入的探讨。

4. 所储备个体防护装备满足不 同的使用目的。

防颗粒呼吸器的设计目的是减少颗粒物的吸入。病毒可以伴随这些颗粒物被人体吸入，包括“非典””病毒和流感病毒的病原体。在大流行病疫情中，防颗粒呼吸器适用于高风险个人、医务工作者、应急响应人员以及国家关键基础设施(水、电、交通等行业)从业人员。过滤式防颗粒物呼吸器有三种类型：颗粒物防护口罩、可重复使用面罩和电动送风过滤式呼吸器。颗粒物防护口罩是最常见的储备品种。然而，在某些情况下，可重复使用面罩或电动送风过滤式呼吸器可能更经济实用。

3M 在个体防护装备国家储备方面有着丰富的专业经验。我们的个体防护装备包括呼吸器（颗粒物防护口罩、可重复使用的呼吸器以及电动送风过滤式及长管供气式呼吸器)、护目镜、防护服和听力防护产品。我们在业界领先的个体防护装备长期以来提供高标准的健康和安全解决方案。

3M 拥有疫情应对的国际经验。我们在全球 70 多个国家设有业务运营机构，为许多政府提供高水平的专业知识、建模工具和技术咨询服务。我们提供针对不同工作环境的产品和服务，帮助保护员工和资产，并在事件期间和之后提供恢复援助。

我们愿与有关政府部门进行沟通，就打造与政府工作重点相对应的储备体系进行探讨。我们愿意与政府分享我们的全球经验、提供关于产品选择和使用的务实建议，最大程度地确保防护效果和适用范围的情况下，尽量减少储备中的单个产品的型号数量。

5. 个体防护装备储备应适合多种终端用户。

密合型呼吸器，如过滤式呼吸面罩（有时亦称为防护面罩）和弹性橡胶呼吸面罩(有时亦称为可重复使用呼吸面罩),其设计紧密贴合佩戴者的面部。密封性越好，吸入的空气越能经过呼吸器的过滤原件。密封性差会导致空气和颗粒绕过过滤原件，直接进入呼吸道。由于每个人的面部特征不同，人们使用某一特定型号的呼吸器所能减少暴露程度也不同。使用呼吸器是为了减少佩戴者暴露在有害空气环境中，适合性测试可以确认佩戴者使用特定型号的呼吸器是否可以达到规定的密封保护水平。适合性测试有助于确保佩戴者的脸部与呼吸器之间良好的密合性，呼吸器与任何其他需要佩戴的个体防护装备兼容性，以及呼吸器在佩戴者面部的稳固性。

对呼吸器进行适合性测试是公认的值得推荐的做法。美国、加拿大、英国和澳大利亚等一些国家要求佩戴者使用每种不同型号的呼吸器前都进行单独的适合性测试。中国的国家标准也有同样的要求。一些国家要求在首次使用一种新型号的呼吸器时进行适合性测试，并在此后定期进行培训和适合性测试。为了确定列入国家储备计划的呼吸器清单，主管部门可以与制造商讨论不同型号呼吸器的适合性情况。这有助于确定呼吸器在某一特定人群中的预期适用比例。这可能也有助于评估应该在储备中准备多少型号，从而在进行适合性测试时，有较高比例的人通过测试。

作为呼吸防护领域的先行者，3M 不仅发明了首款美国国家职业卫生研究所(NIOSH)批准的一次性过滤式呼吸器,还参与制定了目前仍在使用的适合性测试协议。3M 拥有经验丰富的科研和工程师团队致力于传播有关呼吸防护的关键专业知识和提高公众的呼吸防护意识。

6. 储备供应商应能提供交错采购、紧急使用授权、产品使用寿命管理等方面的专业建议。

全球应对新冠肺炎疫情的经验表明，一个运行良好的国家储备管理方案需要以保障有力的供应链为支撑。灵活的供应链以国内储备为缓冲，在进行长期采购的同时，也能够应对短期的需求激增。没有开展储备项目或不更新储备产品的国家可能不了解，一个稳健的储备项目可以最大程度地发挥个体防护装备的作用和实现公共价值。我们将在本节中阐述国家储备项目的主要特点。

所有的产品都会随着储存时间而老化和降低品质。没有存储期限信息的产品会带来一种风险，即产品可能已经过了使用期限，性能达不到预期，使储备管理人员不知应何时补充和更换储备物资。没有人希望提供给一线医务工作者无法发挥作用甚至可能已经失效的产品。储备管理者应向制造商了解产品存储期限及对应性能的相关信息。

举个例子，呼吸器等个体防护装备可能有五年的存储期，许多国家倾向于根据产品的生命周期采购储备物资。在这种方案中，他们将在五年内每年采购五分之一的储备。在第六年时，只需要更换 20%、而不是 100%的储备。此外，每年等量采购也有利于储备预算的规划。另一种方案是第一年采购全部储备，每年调取 20%供政府日常使用（医院、培训等），再以新产品补足这 20%的缺口。这种方案确保从第一天开始就保持全额配置的储备。许多国家发现，在政策法规中授权紧急使用功能基本相同的产品，可以帮助扩大物资的来源和选择范围。这种紧急使用授权是一种有效的缓解物资短缺的公共卫生政策措施。

最后，对储备产品再利用，可以减少储备物资中过期产品的浪费。各国

采取了不同方法将过期产品从国家储备中移除，并寻找合适的用途。有些国家将呼吸器降级为普通面部遮挡物使用，有些国家把呼吸器用于培训，还有一些国家则用于人道主义项目。3M 希望与政府开展合作，分享国际经验，协助有关卫生和储备管理部门完善个体防护装备的储备。

我们将借助我们的专业知识、在 70 多个国家的全球业务网络，以及我们参与国家储备项目和应急计划方面的经验，在个体防护物资储备方面贡献我们的力量。

7. 制造商的全球化业务网络、生产能力和原材料供应有助于减轻出口限制带来的影响。

具备全球业务网络和生产能力的制造商可以为政府提供更好的服务。在新冠肺炎疫情爆发之初，一些国家就迅速采取了个体防护装备的出口限制措施。出口限制使世界各地货物和服务流通减缓，并对许多国家的公共卫生应急工作产生了负面影响。生产基地广泛分布的厂商可以从不同地域的工厂提供产品。虽然不能完全摆脱出口限制，但它们有更加灵活的应对办法。世界卫生组织总干事谭德塞在 2020 年 3 月强调：“如果不保护医务工作者，我们就无法阻止新冠肺炎疫情”。这些人员需要手套、防护口罩、防护面屏、防护服等必要的防护装备。新冠肺炎病毒的传播导致了物资紧缺。2020 年 1 月 1 日至 3 月 21 日，54 个国家的政府出台了 46 项医疗物资出口的限制措施。其中 33 项出口限制措施是在 2020 年 3 月 1 日至 3 月 21 日期间宣布的，这表明了新的贸易限制措施在全球范围内蔓延的速度之快。出口限制措施的增长势头到 2020 年中期才有所放缓。

全球化生产能力是政府选择制造商的重要指标。全球布局业务越广，制造商应对各国海关对个体防护装备出口限制的能力就越强。在危急时刻，政

府获得个体防护装备最可靠的途径就是确保国内有足够的储备可供随时调用。

3M 的业务网络遍及 70 多个国家。在这些国家都有具备个体防护装备专业知识的科研人员和工程师。3M 个体防护装备的生产基地分布于 14 个家。2020 年，3M 大幅提高了呼吸防护装备的产量，在全球范围内交付了 20 亿件呼吸防护装备，是 2019 年产量的三倍多。3M 产能的提高缓解了一些物资的短缺。然而，迅速获得个体防护装备最可行的途径仍然是国家储备项目或按计划交付的采购项目。

3M 借助科技力量保护劳动者的安全、健康并帮助他们提高生产效率。今天，新冠肺炎疫情赋予了我们新的使命，就是保护一线医务工作者、应急响应人员、关键岗位工作人员，以及其他需要防护的人员。

我们将发挥技术优势以及在培训和教育方面的专长，分享我们的国际经验，协助政府完善个体防护装备储备体系。

8. 国家储备物资的制造商应能满足不定期的和一定幅度的增长需求。

新冠肺炎疫情是对公共卫生系统的巨大考验。政府和供应商都不得不迅速进行调整以应对新情况。在各国寻求额外的呼吸器库存或扩大现有物资的使用范围时，一些国家成功地采取了若干措施，增加新产品供应以及优化现有产品的使用。储备能力的建设、物资消耗的计算以及通过实行绿色监管通道和灵活的采购标准来扩大供应规模，这些都是 3M 可以协助政府实施的重要策略，以解决突然增长的需求。

3M 充分发挥技术优势和制造能力扩大生产。我们的团队与各国政府保持着密切的沟通，帮助他们做出快速反应。最重要的是，我们在全球各地奉行统一的宗旨：与政府携手并肩，服务于国家需求，以争取最好的结果。我们的服务宗旨及“科技改善生活”的企业愿景在这次疫情中得到了充分体现。

当新冠肺炎疫情来袭时，3M 在几周内将口罩的产量扩大了一倍，以及时为一线医务工作者、应急响应人员和关键岗位人员提供防护。3M 在整个 2020 年持续扩大产能，最终在年底前全球共生产了 20 亿件呼吸器。这使我们长期拥有了应对需求突然增长的生产能力。值得一提的是，这个需求量是平时的 20 至 40 倍。这意味着，要确保政府快速获得个体防护装备，最可靠的手段就是国家储备项目。

3M 希望与政府加强沟通与合作，共同打造作为国家疫情防控战略重要组成部分的应急物资储备体系。我们将努力配合政府的工作，以更好地满足一线的医务工作者、应急响应人员和其他人员的防护需求。

9. 国家储备物资制造商应具备疫情 防控的知识和经验。

各国政府会根据本国面对的各种风险因素，针对不同的紧急情况做好准备。有的国家容易发生地震、火灾、海啸等自然灾害。它们需要为工业事故、人为事件、突发或大流行的传染性疾病做好准备。新冠疫情给许多国家政府带来了深刻的教训，其中一个就是，许多政府的疫情防控体系缺乏物流和供应链的内容，或至少缺乏执行计划的能力。这些重要内容的缺失会造成全国性的关键物资的匮乏。各国政府还意识到，具有应对各类紧急事件(包括传染性疾病)经验的供应商是首选的合作伙伴。这样的供应商经过在突发事件中进行全球供货的历练，因而能够利用过去的经验迅速和高效地调动资源。

生产商和供应商所提供的应对大型灾害和传染性疾病爆发的经验对政府很有帮助。制造商提出的实际工作中遇到的瓶颈和障碍可以为政府解决这类问题提供参考。例如，当某个国家遇到产品需求上升时，参与过其他国家储备项目的制造商可以分享宝贵的国际经验以供借鉴，这对这个国家开展储备

项目大有裨益。

本报告中的许多建议都是基于 3M 与世界各国政府在国家和地方层面开展储备合作的长期经验积累。二十年来，我们不断努力，开发相应工具和技术，提高生产能力，以满足政府的需求。

我们希望与各国政府进行务实的沟通，介绍我们在各种此类项目中积累的知识和经验，以及我们为成为政府在疫情防范和应对方面可靠合作伙伴而建立的内部工作机制。

时间	流行病	灾害
2003	非典	法国森林火灾
2004		印度洋大地震和海啸
2005		巴基斯坦地震，飓风卡特里娜
2006		厄瓜多尔火山爆发，印度尼西亚地震/海啸
2008		飓风艾克，加州野火
2010	H1N1 流感	海地地震
2011	H1N1 流感	日本地震和海啸，新西兰地震
2012		飓风桑迪
2013	中东呼吸综合征	菲律宾超强台风，东南亚雾霾，俄克拉荷马州龙卷风
2014	埃博拉（线状病毒）	
2015	中东呼吸综合征	

2016		飓风马修，巴吞鲁日水灾
2017		飓风艾玛，飓风哈维和飓风玛利亚
2019	新冠肺炎	美国加州野火，澳大利亚丛林大火
2020	新冠肺炎	全球多地森林火灾

表一，3M 与世界各国政府开展危机应对合作项目一览表

10. 国家储备物资生产商应成为卫生部门的合作伙伴，而不仅仅是供应商。

新冠肺炎疫情中个体防护装备的采购热潮表明，虽然普通供应商也可以向政府批量供货，但政府与供应商关系中一个关键环节是分享对国家公共卫生管理产生积极影响的知识。政府与供应商的关系不再是单纯的买卖关系，供应商通过介绍其他国家的经验和教训对政府建言献策。对许多国家政府的卫生主管部门而言，国家储备是一个新概念。因此，这类知识的分享对于政府打造国家利益最大化的储备体系具有重要意义。

自 2003 年“非典”爆发后，3M 就开始着手政府储备方面的工作。我们开发了一些工具，供各国政府在发生此类灾害时用来预测物资需求。我们还开发了其他储备管理工具，并一直致力于培训和能力建设。3M 成功的本土化经营策略和长久的运营历史帮助我们与所在国政府部门建立了良好的沟通与合作。我们了解政府在全球危机中所面临的巨大挑战，并开发了一些工具供政府选择。因此，除了所生产的产品外，我们掌握的丰富知识也能为政府所用。

我们通常以签订合作性协议的形式开始与政府的合作，确定政府需求的范围和感兴趣的话题。通过建立这样的合作框架，我们与政府开展紧密合作，并在政府的指导下，为实现公共利益最大化、增进人民福祉做出积极的贡献。

我们欢迎政府部门与我们本地团队就如何更好地服务国家需求进行探讨。

11. 储备需求规划工具能够帮助卫生部门进行情景分析和规划。

任何公共卫生事件的应对措施都依靠一支随时可以救治患者的医务工作者队伍。这些人员包括医生、护士、急救相应人员和其他临时征召的相关人员等。在许多国家，医务工作者对自己在疫情期间个体防护措施的信心不足导致了很高的缺勤率。我们必须给医护工作者以足够的信心。如果我们做到这点，医护人员就会安心工作，知道在工作过程中不太可能会被传染或将疾病传染给家人和朋友。各国政府须确保医务工作者能够获得足够数量的、适当的个体防护装备。

大多数疫情应急响应计划都包含灾难发生或疫情爆发时职责分工等重要细节。这些计划确保政府在危急时刻的坚强领导、果断决策和全局统筹。然而，大多数计划都缺乏关于物流和供应链的方面所需资源的具体说明。

3M 开发了一款针对应急准备和响应的个体防护装备突发需求规划工具。该工具根据国家疫情防控计划或新冠疫情响应计划和其他参数进行储备需求模拟分析。

3M 为全球各国政府免费提供这一需求规划工具。3M 还可以与政府专家一起举办研讨会，由专家提供数据变量和假设，对不同提供服务的节点进行模拟测试。通过这种研讨会，我们可以用政府提供的数据来模拟相关情境，并提供关于储备量的预测。

结束语

我们希望，本报告所分享的个体防护装备储备的国际经验对于健全国家公共卫生应急管理体系和应急物资保障体系有所启示。作为国家公共卫生应急物资保障体系的重要组成部分，完善的应急防护装备储备对于疫情期间保护一线医务工作者、应急响应人员、关键岗位从业人员和广大人民群众的生命安全和健康具有重要意义。与国家整体医疗预算相比，防疫物资储备投资规模不算大，但它可以确保在重大疫情期间，有关工作人员和广大人民群众得到更好的防护。

在与世界各国政府部门合作的多年实践中，我们发挥自身技术和全球业务网络的优势，与政府部门携手并肩，积极投身于应对自然灾害和重大疫情的工作之中，为保护人民的生命安全和健康，特别是保护一线医务工作者、应急响应人员、关键岗位人员，确保重大危机事件中社会的正常运转进行着不懈的努力。

我们愿与公共卫生、物资储备和其他有关主管部门和学术机构就个体防护装备储备进行深入探讨，分享我们的知识和经验，为健全和完善公共卫生应急管理体系及应急物资保障体系，制定和实施高效、安全、可靠的个体安全防护装备储备计划，贡献我们的力量。

Preparing Nations and Protecting Lives:
Pandemic Preparedness for Citizens and Economies

3M

Table of contents

Executive summary

Every life is precious. Governments worldwide are working hard to protect their citizens and their heroic health care workers, first responders, and essential workforce against the COVID-19 Global Pandemic. The COVID-19 pandemic has been a harsh test of the world's preparedness. Due to the global nature of the pandemic, the world has rushed to secure resources to fight COVID-19. This rush has created a massive spike in demand. In a world of just-in-time production and just-in-time consumption, little supply chain elasticity exists.

This poses a challenge when there are such dramatic spikes in demand. This is true in many critical categories including personal protective equipment (PPE). With COVID-19, the spikes in demand for PPE have been as high as 20x to 40x normal consumption levels. The entire industry capacity has not been enough to respond. Governments that were able to respond well had robust public policy frameworks and had implemented a national stockpile programme for PPE and other essential supplies.

3M operates in over 70 countries working closely with governments and the private sector during the pandemic. 3M has worked with governments on stockpiling programmes in many of these countries for nearly two decades. The purpose of this white paper is to share our experience and discuss global government best practices that we have observed for developing a robust, resilient, and sustainable national PPE stockpile.

We are eager to work with governments in the spirit of public-private partnership to serve the health needs of the public and that of other essential workers of the nation and to help protect heroic frontline health care workers and emergency responders in the fit against this COVID-19 pandemic and other future events.

In addition to stockpiling best practices, governments are well served when they:

+ Have the budgetary flexibility to procure what they need when they need it. These governments are not restricted to budget cycles for acquiring needed supplies.

+ Have the ability to authorise emergency use of appropriate PPE as part of their public health laws and regulations. This can facilitate rapid regulatory access to needed supplies beyond their borders.

+ Are resilient and can respond to a sudden spike in demand for PPE. They have access to a national stockpile of needed supplies. They can then assure frontline workers are equipped and protected.

+ Have "Emergency Supplies Stockpiling & Supply Chain Resilience" specified in their laws as a non-negotiable national requirement, which is supported with adequate funding.

+ Have legal and customs systems designed to fight product fraud and counterfeit.

+ Have PPE performance standards that are thoughtfully harmonised with other countries. This allows access to global supply chains. Unique and non-standard regulations make procurement even more difficult.

+ Allow for flow of goods through their borders.

Countries that erect export restrictions may be able to secure short term PPE supplies quickly. However, this strategy often results in an overall reduction in longer term access to necessary supplies.

+ Enter into Public-Private Partnerships (PPP) with critical best-in-class suppliers. This PPP strategy has proven more effective than simple procurement agreements.

In our white paper we describe in detail 11 global best practices to develop a robust, resilient, and sustainable stockpile programme.

1. The stockpile inventory must always be within its stated shelf life.

2. Streamlined stockpile product models simplify stockpile management.

3. Analytics to assist governments in developing a stockpile proportional in size to the minimum readiness levels expected in National Plans.

4. Stockpiles built using a range of high quality Personal Protective Equipment (PPE) that matches the intended purpose for use.

5. Personal protective equipment (PPE) stockpiles that fit a wide range of end-users.

6. Stockpiles sourced from a manufacturer(s) that can offer staggered procurement options, emergency use authorization experience, strategies to help manage product useful- life considerations, and other relevant advice.

7. Stockpiles sourced from a manufacturer(s) with a global footprint, production capacity, and sources of raw material, which can help mitigate

potential export restrictions imposed by other nations.

8. Stockpiles sourced from a manufacturer(s) that has the capability to meet sporadic and modest spikes in demand.

9. Stockpiles sourced from a manufacturer(s) experienced and knowledgeable about pandemic preparedness.

10. Stockpiles sourced from a manufacturer prepared to be a partner with government health authorities rather than merely a supplier.

11. Stockpile demand planning tools allow for scenario planning and analytics by health authorities.

3M is eager to work with national and international governments and health authorities to help assure a long term robust, resilient, and sustainable stockpile programme is developed based on sound public health policy foundations and global government best practices. We are ready to apply our science to helping protect lives in public-private partnership with governments and specially to support heroic health care workers and other essential frontline workers that continue to help our sick and keep our society functioning.

Introduction

Every life is precious. Governments worldwide are working diligently to protect their citizens and their heroic health care workers, first responders, and essential workforce against the COVID-19 Global Pandemic. The COVID-19 pandemic has been a harsh test of the world's preparedness. Due to the global nature of the pandemic, the world has rushed to secure resources to fit COVID-19. This rush has created a massive spike in demand. In a world of just-in-time production and just-in-time consumption, little supply chain elasticity exists when there are such dramatic spikes in demand. This is true in many critical categories from vaccines and medical supplies to personal protective equipment (PPE). With COVID-19, the spikes in demand for PPE for instance have been as high as 20x to 40x normal consumption levels. The entire industry capacity has not been sufficient to meet demand. Governments that were able to respond well had robust public policy frameworks and had implemented a national stockpile programme for PPE and other essential supplies.

The Global Preparedness Monitoring Board, co-convened by the World Health Organization and the World Bank, in its 2020 report wrote: *"Surge manufacturing capacity, stockpiling and fragile supply chains have proven to be major barriers to pandemic response. The majority of countries did not have sufficient stockpiles or the pre-existing capacity and resources to suddenly scale up manufacturing for all the necessary countermeasures to respond to a pandemic. The consequence of this has been a significant upsurge in the global demand for medical countermeasures, which has exposed the fragility of global supply chains for medical goods and the*

materials needed to develop them. This shortage of medical countermeasures has threatened countries' capacities to fit COVID-19." They further emphasised: *"National preparedness is key, but global and regional mechanisms for tracking potential pathogens, early alert, information sharing, research and development, regulatory capacity-building and harmonization, allocation of countermeasures, stockpiles and supply chains must also be strengthened and developed, sustained and financed."* (A World in Disorder. Global Preparedness Monitoring Board Annual Report 2020, World Health Organization)

Stockpiling remains a core strategy to bridge gaps in supply chains. Some governments have experience with stockpiling. Many do not possess such experience. The purpose of this white paper is to share observations of global government stockpiling best practices focused on personal protective equipment. 3M is a major global producer of personal protective equipment. In light of varying levels of domestic stockpiling expertise, we have gathered these observations in this report in the spirit of knowledge-sharing and to contribute towards capacity-building. Over the years we have worked with many governments around the world assisting in their response to infectious disease, natural and man-made disasters. Our teams on the ground in countries and regions around the world are ready to follow up with in-person conversation and support national and local efforts. This is especially important as governments collect lessons learned from the COVID-19 experience and introduce systemic reforms. Stockpiling is one contributing action to assure heroic frontline health workers, first responders and essential personnel

are protected. They deserve to have access to appropriate personal protective equipment in quantities needed to fulfil their duties.

Global pandemic preparedness plans

Every country in the world possesses one or more forms of emergency preparedness and response plans. Such plans focus on the biggest threats a nation anticipates.

According to the World Health Organization, *"an emergency response plan (ERP) is a document describing how an agency or organisation will manage its response to emergencies. An ERP describes the objectives, policies and concept of operations (CONOPS) for the response, as well as the structure, authorities and responsibilities to make that response systematic, coordinated and effective."* (A strategic framework for emergency preparedness ISBN 978-92-4-151182-7 World Health Organization 2017).

Emergency response plans can cover a range of emergencies from infectious disease outbreaks to natural disasters to various man-made events. Response often requires the involvement of the national emergency response agency as well as relevant ministries and other key government agencies. Nongovernmental organisations as well as industry may also be involved for support. Each plan describes the anticipated inter-ministerial and inter-agency command and control response. One ministry or government agency often takes the lead and plays the coordinating role

while others support based on their areas of national responsibility and expertise. Such coordination and cooperation is an important function of a national emergency response plan.

It has been our observation that many plans often lack an appendix describing the logistics and supply chain required to respond effectively to events of specific profit. This is especially true of pandemic plans. Pandemic plans are often focused on the influenza virus. COVID-19 demonstrated that other pathogens can emerge on a global basis and pose a pandemic threat. A logistics, supply chain and stockpile appendix to the national pandemic plan will make assumptions about various pandemic scenarios and their intensities. For each scenario a proportional logistics, supply chain and stockpile estimate must be developed. Consideration must include industry's capacity to respond during such an event. For each scenario of increasing severity, logistics needs, supply chain requirements and stockpiles also increase. In catastrophic events, speed of response is essential to effectiveness of response and saving lives. Lack of access to needed supplies and supply chains reduces effectiveness of response. COVID-19 was a pressure test of national pandemic emergency response plans and their associated logistics, supply chain and stockpile readiness.

Stockpiling is cited by the Global Preparedness Monitoring Board, co-convened by the World Health Organization and the World Bank, in its 2020 report as a component of emergency preparedness and response. One of the major challenges

of stockpiling is to define an essential medicine and medical device and other equipment list. In this list for pandemics personal protective equipment is often a key and essential focus. Once defined then the types of personal protective equipment and the level of required performance must be specified. While on the surface such specifications may seem simple, in a global climate of product scarcity during a pandemic, high quality products and broad range of specifications are essential to enable procurement officers to procure from a larger array of producers. This requires a collaborative working relationship among public health leaders, PPE regulators, procurement officers and industry.

Governments are well served when they:

+ Have the budgetary flexibility to procure what they need when they need it. These governments are not restricted to budget cycles for acquiring needed supplies.

+ Have the ability to authorise emergency use of appropriate PPE as part of their public health laws and regulations. This can facilitate rapid regulatory access to needed supplies beyond their borders.

+ Are resilient and can respond to a sudden spike in demand for PPE. They have access to a national stockpile of needed supplies. They can then assure frontline workers are equipped and protected.

+ Have “Emergency Supplies Stockpiling & Supply Chain Resilience” specified in their laws as a non-negotiable national requirement, which is supported with adequate funding.

+ Have legal and customs systems designed to fight product fraud and counterfeit.

+ Have PPE performance standards that are thoughtfully harmonized with other countries. This allows access to global supply chains. Unique and non-standard regulations make procurement even more difficult.

+ Allow for flow of goods through their borders. Countries that erect export restrictions may be able to secure short term PPE supplies quickly. However, this strategy often results in an overall reduction in longer term access to necessary supplies.

+ Enter into Public-Private Partnerships (PPP) with critical best-in-class suppliers. This PPP strategy has proven more effective than simple procurement agreements.

In the following sections we describe in detail 11 global best practices to develop a robust, resilient, and sustainable stockpile programme.

1. The stockpile inventory must always be within its stated shelf life.

2. Streamlined stockpile product models simplify stockpile management.

3. Analytics to assist governments in developing a stockpile proportional in size to the minimum readiness levels expected in National Plans.

4. Stockpiles built using a range of high quality Personal Protective Equipment (PPE) that matches the intended purpose for use.

5. Personal protective equipment (PPE) stockpiles that fit a wide range of end-users.

6. Stockpiles sourced from a manufacturer(s) that can offer staggered procurement options, emergency use authorization experience, strategies to help manage product useful- life considerations, and other relevant advice.

7. Stockpiles sourced from a manufacturer(s) with a global footprint, production capacity, and sources of raw material, which can help mitigate potential export restrictions imposed by other nations.

8. Stockpiles sourced from a manufacturer(s) that has the capability to meet

sporadic and modest spikes in demand.

9. Stockpiles sourced from a manufacturer(s) experienced and knowledgeable about pandemic preparedness.

10. Stockpiles sourced from a manufacturer prepared to be a partner with government health authorities rather than merely a supplier.

11. Stockpile demand planning tools allow for scenario planning and analytics by health authorities.

PPE stockpile policy recommendations

1. The Stockpile inventory must always be within its stated shelf life.

At the core of a robust national stockpile programme lays the central concept of life cycle management. Governments are well served by maximizing the life expectancy of the stock, so they use public funds prudently to replenish outdated stock with newly produced products. Stockpiling is equivalent to buying national insurance so that when disaster strikes governments can mobilise and serve their citizens. The fact that personal protective equipment (PPE) become obsolete after years of storage is simply a natural consequence of the fi ed life expectancy each

product possesses. There are many stockpiling best practices, such as appropriate long-term storage, rotation of stock and inventory management.

Effective national Stockpile management can be achieved through various strategies such as assuring controlled stockpile storage conditions, centralized stockpiles, and staggered procurement of stockpile supplies for effective stockpile rotation. It is essential that governments engage with manufacturers and logistics providers who have the knowledge, experience, and capability to offer advice on the management of the stockpile of personal protective equipment.

Since the emergence of Severe Acute Respiratory Syndrome (SARS) in 2003, 3M has worked with governments on various stockpiling programmes. Our experience in designing a robust, resilient, and sustainable stockpile programme and providing governments with options that match their needs enable us to share our subject matter expertise with national stockpile authorities.

3M invites the government to work with 3M on defining options for the management of the stockpiled PPE to maximise the life expectancy and minimise the use of public funds in assuring the nation remains protected in the occasion of a significant event and subsequent massive demand spikes.

2. Streamlined stockpile product models simplify stockpile management.

Stockpiling programmes, at the national level, may contain a variety of different respiratory protection models. The larger the number of different products, the more complex the task of assuring those products are within their intended shelf life. The number of models of personal protective equipment (PPE) included in the stockpile simplifies the management of the PPE stockpile. Therefore, it is essential to seek respirators that have a design that can achieve a good fit on a large cross-section of the population. By doing so fewer PPE models may be needed thereby simplifying the maintenance of the stockpile.

Respirators should be selected to fit the intended population. No single respirator model is likely to fit 100% of any intended population. Therefore, individual fit testing is the only way to be sure the selected respirator fit each user effectively. Respirator fit testing is an important best practice and, in several countries, a legal requirement. Fit testing helps confirm a respirator wearer can achieve an adequate fit and therefore, can achieve the intended level of exposure reduction when properly selected and worn. In addition, being trained, following donning instructions, and performing user seal cheque procedures according to each respirator model's User Instructions is vital to a wearer to achieve an adequate fit. The manufacturer may be able to provide a fit profit which is data-based information that can help predict which respirator models will fit a population.

Selecting several different models of respirators, based on their fit profit will allow stockpile managers to provide an adequate selection to fit most end users. Stockpile

managers can work with the respirator manufacturer to help minimise the number of individual PPE models in the stockpile while not compromising the level of fit across the intended user population.

To discuss respirator model mix for stockpiling, please contact your 3M representatives. They can bring to your attention the product mix, strategies for stockpiling with as few individual product models as possible and discuss other stockpiling best practices. They will do so with inputs provided by the stockpile team based on your emergency preparedness plans.

3. Analytics to assist governments in developing a stockpile proportional in size to the minimum readiness levels in National Plans.

Any pandemic response will be reliant on a ready force of Health Care Workers (HCWs) and workers supporting the National Critical Infrastructure to assure society is functioning while the system responds to protecting lives and sustaining the economy. As a nation, a system of health care delivery networks and key National Critical Infrastructure companies, need to be able to ensure that all workers have access to appropriate personal protective equipment (PPE) to assure continuity of operations. Knowing what the day-to-day PPE consumption levels would be, and the duration of the event will be is essential in assuring the right amounts of products are available to assure frontline workers can do their jobs.

The challenge of predicting PPE consumption levels in a pandemic example is one of combining the medical science of an emerging disease and its associated epidemiology with PPE logistics and supply chain management. The developers of the stockpile must establish the type of PPE required and how many units are to be stockpiled. While many countries and health systems and national infrastructure companies are good at developing emergency response plans, many such plans focus on clarifying roles and responsibilities to assure a coordinated action. Establishing what the Minimum Readiness Level (MRL) for the stockpile is essential to guide managers to stockpile the right amount of product to match the National Plans. The concept of MRL tied to scenarios and expectations of response in the national plans is essential to stockpile development and management.

3M has developed demand planning tools that have been used by many governments since the SARS outbreak in 2003. 3M's demand planning tools draw from the local emergency plans and make projections of the amount of PPE needed for stockpiling based on the details in each of those plans.

The tools are available at no cost from 3M. A separate white paper is available detailing the functions and features of these demand planning tools.

To setup a demand planning session simply contact your 3M representative.

4. Stockpiles built using a range of Personal Protective Equipment (PPE) that

matches the intended purpose for use.

Particulate respirators are designed to help reduce exposure to particles, including those containing viruses spread through the inhalation transmission route. This includes such pathogens as SARS-CoV-2 and the influenza virus. Occupational use of particulate respirators in a pandemic will be by high- risk individuals, health care workers, first responders, and employees whose activities are especially required in the Critical National Infrastructure (water, electricity, transportation etc.). Particulate air purifying respirators are available in three types: disposable, reusable, and powered air purifying units. Disposable respirators are stockpiled most frequently. However, there may be occasions where a reusable or powered purifying air respirators may prove to be more economical and practical.

3M has deep subject matter expertise in providing products for the stockpile of PPE. Our PPE includes respirators (particulate disposable, reusable respirators and powered and supplied air respirators), goggles, coveralls, and hearing protection products. Our industry leading PPE has long offered health and safety solutions designed to meet the highest industry standards of excellence.

3M also has global expertise in pandemic preparedness. 3M operates in over 70 countries. The company has provided a high level of expertise, modelling tools and technical advice to many governments globally. We offer product and services for varied working environments that can help protect employees and assets as well as

provide recovery assistance during and after the incident.

3M invites your government to engage in the spirit of public and private partnership with 3M to evaluate how to design a robust national stockpile matching the national priorities established by your government. We can share global best practices, outcome-based information on selection and use, and the minimization of individual product models in a stockpile while maximizing protection and fit for workers.

5. Personal protective equipment (PPE) stockpiles that fit a wide range of end-users.

Tight-fitting respirators, such as filtering facepiece respirators (sometimes called disposable respirators) and elastomeric (sometimes called reusable) respirators, are designed to seal tightly to a wearer's face. The better the seal, the more inhaled air will travel through the respirator's filter. A poor seal results in air and particles bypassing the filter and entering the breathing zone. Because each person has different facial features, each person may receive a different amount of exposure reduction with a particular respirator model. In situations where a respirator is used with the intention to reduce a wearer's exposure, a fit test can confirm that the stated level of protection can be achieved for an individual with a specific model of respirator. Fit testing helps assure the worker has a good face to facepiece seal, the respirator is compatible with any other PPE required to be worn and that it is stable

on the wearer's face.

It is always considered a best practice to fit test workers with the respirator they will use. Some countries including the United States, Canada, the United Kingdom and Australia require that an individual fit test be performed for each respirator model that the wearer will use. Some countries require fit testing the first time a new respirator model is used and refresher training and fit testing regularly thereafter. In order to determine the mix of respirators to include in a stockpile, administrators can discuss the fit profile of the respirator models with the manufacturer. This will help indicate what percentage of a given population the respirator is expected to generally fit. This may help assess how many models should be placed in stockpile to increase the likelihood that, when fi tested, a relatively high proportion of people will pass the fit-test.

As pioneers in the field of respiratory protection, 3M not only invented the first single use NIOSH approved filtering facepiece disposable respirator, we helped develop the qualitative fit testing protocol used today. We have a deep bench of experienced and passionate scientists and engineers eager to spread knowledge about and increase understanding of this crucial part of respiratory protection.

6. Stockpiles sourced from a manufacturer(s) that can offer staggered procurement options, emergency use authorisation experience, strategies to help manage product useful-life considerations, and other relevant advice.

The global COVID-19 experience demonstrated the need for key attributes of a well-run stockpile management programme based on a resilient supply chain as its backbone. A flexible supply chain relies on buffers within the country so it can respond to spikes in demand in the short-term while long- term procurement takes place. Countries that have not had previous stockpile programmes or that have allowed stockpiled product to expire may not have the institutional memory of the key attributes of a robust programme which maximise the usefulness of the PPE as well as public value. We will recount key features of such a programme in this section.

All products age and slowly degrade as a function of storage time. Products without shelf-life information can create a risk of having products that may be past their useful life and do not perform to expectations and leaving the stockpile manager with no idea of when to replenish and replace that stock. No one wants to send product to frontline health care workers that does not work or may fail in the field. Stockpile managers should enquire about shelf-life information on respirators and that the manufacturer stands behind its performance. For example, a stockpile of PPE such as respirators may have a 5-year shelf life and many countries tend to procure the stock over the life of the product. In this case they would procure one-fifth of the stock every year for 5 years. That way on the 6th year only 20% of the stock needs to be replaced versus 100% of the stock if the entire stockpile was procured in one year. Also, equal annual procurement gives budget planners more predictability in government financing of the stockpile. Another option is to

purchase the full stock on year one and withdraw 20% each year for regular government use (hospitals, training etc.) and replace the used stock with 20% new stock. This option ensures full allotment of necessary stock from day one. Options were further detailed in Attribute 1 in this white paper. Many countries have found developing provisions in their laws for authorizing emergency use of substantially equivalent products to be a very practical way of enabling access to more products in their markets. These national Emergency Use Authorisations are an effective public health mechanism for mitigating scarcity of products in the country.

Finally, a robust cycling of stocked product will minimise the amount of product that reaches the end of their life cycle. For product that does pass its expiry date countries have taken various approaches to their removal from the national stockpiles while still finding suitable uses. Some countries have downgraded respirators for use as face coverings. Some have used respirators for training purposes, some have donated to select humanitarian causes and events. 3M can work with governments on their PPE stockpile so these elements of a robust, resilient, and sustainable stockpile programme can be implemented. 3M can share country best practices and broker connections to other countries' health authorities and those responsible for stockpiling for a substantive and meaningful dialogue.

We invite you to discuss your needs in this area with your local 3M team. With subject matter expertise and global exposure to over 70+ countries and engagement as a supplier and advisor to national preparedness and response strategies we can

share our collective knowledge with you to help enable better outcomes for the country.

7. Stockpiles sourced from a manufacturer(s) with a global footprint, production capacity, and sources of raw material, which can help mitigate potential export restrictions imposed by other nations.

Governments are well served by working with manufacturers that have a global footprint and production capabilities. As COVID-19 demonstrated, several countries were quick to erect personal protective equipment (PPE) export restrictions when the outbreak happened. Export restrictions slow the flow of goods and services around the world and have a negative impact on public health readiness of many countries. Producers with broad production footprints can provide products from their many manufacturing sites located in different geographies. While not completely immune from export restrictions, they have better flexibility to navigate. To appreciate its significance, the Director-General of the World Health Organization has argued that "*we can't stop COVID-19 without protecting health workers"* (WHO 2020). Those workers require gloves, medical masks, respirators, face shields, gowns, and other essential equipment. As the Coronavirus has spread, shortages have arisen. Between 1 Jan 2020 and 21 March 2020, 46 export curbs on medical supplies were introduced by 54 governments. Thirty-three of those export curbs were announced between 1 March 2020 and 21 March 2020, an indication of just how quickly new trade limits spread across the globe. Starting in April the

export restrictions grew, only slowing down in the middle of 2020.

Governments should ask manufacturers to demonstrate their production capacity around the world. The larger the global footprint the greater the manufacturer's ability to respond to restrictions imposed on the movement of PPE by customs authorities of various countries. The only sure way to minimise risk of access to PPE in times of crisis is to assure enough stocks are in the country, accessible to the government, at any time.

3M has operations in 70+ countries. There are scientists and engineers with subject matter expertise on PPE available in these countries. 3M produces PPE in 14 countries spread around the world. In 2020 3M significantly increased our respirator production, delivering 2 billion respirators around the world – or more than three times that of our 2019 production. 3M's increased capabilities have alleviated some shortages. Yet stockpiling or planned delivery remains the most viable national option for readily accessible PPE.

3M is focused on applying 3M science to improve the health, safety, and productivity of workers all over the world. Today we have a special focus on COVID-19 and helping protect the heroic frontline health care workers, first responders and essential workers.

Through our strong technical leadership and training and education efforts, we

strive to inspire action and assist governments and industry around the world to continue operating safely. We can discuss best practice stockpiling strategies with governments. This public-private partnership can play a pivotal role in capacity building and ultimately supplying the PPE for national stockpiles.

8. Stockpiles sourced from a manufacturer(s) that has the capability to meet sporadic and modest spikes in demand.

COVID-19 has created a pressure test of the public health system. Both governments and suppliers have had to make rapid adjustments to respond. As countries look to secure additional inventory of respirators or extend the use of existing supplies, some countries have successfully adopted several strategies to increase the availability of new supplies and/or optimise the use of existing supplies within their system. Building capacity, metering consumption, and maximizing access to supplies by fast-track regulatory green channels and flexible procurement criteria are all instrumental strategies that 3M can assist governments in implementing to help address spikes in demand.

At 3M we used our technology and manufacturing capabilities to ramp up production. Our teams were in close contact with governments allowing them to respond with agility – and perhaps most importantly, they are aligned around a singular vision: Serve the national need shoulder to shoulder with government for the best possible outcomes. Our spirit of service and servant leadership and our

corporate vision of “Science. Applied to Life.” was brought forth in our response in this pandemic by applying our science to improve every life. When COVID-19 hit, 3M doubled its production of respirators in weeks to help quickly protect nurses, doctors, first responders and essential workforce. 3M continued to expand our capacity throughout 2020, and ultimately produced 2 billion respirators globally by year end. This has given us the longer-term capability to respond to spikes in demand with more production capacity. However, it is noteworthy to mention, demand was 20 to 40 times higher than normal. This means stockpiling remains the only viable long-term method of assuring government access to PPE at a moment’s notice.

We invite the government to engage with 3M and work together to develop a logistics stockpile plan that is based on the national pandemic or COVID-19 response plan. By synchronizing our offering with the government’s needs we can arrive at a desired position to meet these needs as heroic health care practitioners, and first responders work hard to provide care to citizens across the nation.

9. Stockpiles sourced from a manufacturer(s) experienced and knowledgeable about pandemic preparedness.

Governments prepare for a variety of emergencies based on various risk factors their countries face. Some are prone to earthquakes, fires, tsunamis, and other natural disasters. They prepare for industrial accidents and man-made events. They

also must prepare for infectious disease outbreaks whether they are outbreaks or pandemics. COVID-19 taught many governments several important lessons. A key lesson was that many government pandemic plans lacked a logistics and supply chain plan or at least the ability to realistically implement the plan. Lack of such an important component creates national scarcity for critical products. Governments also learned that engaging with a supplier with prior experience across many different types of emergencies, including infectious disease outbreaks, is preferred. Such manufacturers have lived the challenge of providing products faced against global demand. They can rapidly mobilise their resources and have the institutional memory to work effectively.

Governments are well served to ask manufacturers and suppliers for their experience in large disaster response and infectious disease outbreaks. Practical examples of bottlenecks and barriers that the manufacturers share will inform the government about what they can do to alleviate these issues. For instance, in many cases developing a national stockpile will benefit the country when the need for product arises and manufacturers that have worked on similar stockpiles in other countries can help by sharing winning strategies including logistics.

Many of the recommendations of this white paper are based on the long history 3M has had in working with governments around the world on national and subnational stockpiles. Over the course of two decades, we have intensified our efforts, developed tools and techniques, and increased production capacity to be responsive

to government needs.

We welcome entering a substantive dialogue with the government sharing our knowledge and credentials in having worked on a variety of such events and sharing what internal mechanisms we have put in place to be a reliable partner to governments in pandemic preparedness and response..

	Health Epidemics	Disasters
2003	SARs (CoV)	France Forest Fire
2004		Indian Ocean Earthquake and Tsunami
2005		Pakistan Earthquake, Hurricane Katrina
2006		Ecuador Volcano, Indonesia Earthquake/Tsunami
2007		
2008		Hurricane Ike and California Wildfires
2009		
2010	Pandemic H1N1/09 Virus	Haiti Earthquake
2011	Pandemic H1N1/09 Virus	Japan Earthquake and Tsunami, New Zealand Earthquake
2012		Hurricane Sandy
2013	MERS	Philippines Super Typhoon, Southeast Asia Haze, Oklahoma Tornado
2014	Ebola (filovirus)	
2015	MERS	Yellow Dust (South Korea, China)
2016		Hurricane Matthew, Baton Rouge Flooding
2017		Hurricanes Irma, Harvey and Maria
2018		
2019	Covid-19	California Wildfires, Australia Brushfires
2020	Pandemic COVID-19	Global Wildfires

10. Stockpiles sourced from a manufacturer prepared to be a partner with government health authorities rather than a supplier.

The COVID-19 rush to procure personal protective equipment (PPE) showed that while volumes of product can be sold from a supplier to a government, a key aspect of the Government-Supplier relationship is the sharing of knowledge that will have

a positive impact on national public health outcomes. The range of relationships go from simply a procurement role between government and supplier to one where the supplier has a seat at the table and shares with government the global best practices various governments have accomplished, and the errors or challenges that did not work out so well. Because the concept of stockpiling is so new to many government health authorities, this type of knowledge sharing is critical in government's decision-making process to create the best national value in a stockpile.

3M has been working on government stockpiles since 2003 with the emergence of Severe Acute Respiratory Syndrome (SARS). We have developed tools for governments to use to predict their needs during such disasters. Other tools have been developed for stockpile management. Training and capacity building have been a key contribution from 3M. And because 3M Operations have been in the country for decades, the strong local presence assures that 3M is only a call away from engaging and working with government closely. We understand the daunting challenges countries face in these global crises and we have developed tools to share and give governments options. So, beyond manufacturing lines producing products, the vast knowledge we hold is also at the disposal of governments.

Often this begins by developing a Memorandum of Understanding (MOU) with the government to provide scope for needed areas and topics of interest by government. This creates a framework so 3M can contribute to maximizing public value and positive impact on people's lives through close partnership and with the leadership

of government.

We invite governments to reach out to our country leadership team so we can discuss how best we can serve such national needs.

11. Stockpile demand planning tools allow for scenario planning and analytics by health authorities.

Any public health pandemic response will be reliant on there being a ready force of health care workers (HCWs) to care for the sick. These include General Practitioners (GPs), nurses, ambulance officers and other emergency personnel who are trained, ready and willing to be mobilized. In many countries, lack of confidence by their HCWs about their own protection during outbreaks have created high levels of absenteeism. We must give confidence to our HCWs. If we do, then our HCWs will come to work, knowing that they may not infect themselves in the process, or transmit disease to their own families and friends. Governments need to be able to ensure that our HCWs have access to appropriate personal protective equipment (PPE) in the numbers necessary.

Most pandemic plans contain important details about roles and responsibilities when disasters strike, and national outbreaks happen. These plans assure government leadership can act decisively in time of crisis with a clear command and control structure. What most plans lack, however, is a logistics and supply chain

appendix to describe inventory of resources required to accomplish the mission.

3M has developed an analytical tool called the 3M™ Emergency Preparedness & Response – PPE Surge Capacity Demand Planning Tool which, based on assumptions that can be derived from the National Pandemic Plan or National COVID-19 Response Plan, other scenarios, or user-defi parameters can be utilized for what-if stockpile analysis.

3M assists governments globally to have access to this demand planning tool free of charge. 3M is also available to conduct workshops with government experts who can provide data input variables and assumptions to run the statistical simulations for different service delivery nodes. We invite governments to request such a workshop so we can simulate scenarios of interest using governments own input and data and provide projections of the range of stockpile levels.

Conclusion and call to action

When compared to the national health care budget, an effective stockpiling programme is a modest national investment in assuring healthcare workers, emergency responders and essential personnel are protected during a global infectious disease outbreak that will inevitably reach all countries.

Reforms to public health policy frameworks, trade policy frameworks and global best practices for stockpiles of personal protective equipment are essential to

protecting those heroic workers that risk their lives to save the nations' citizens and ensure societal operation. We have detailed these best practices in this white paper and are eager to engage in conversation to share more information. Knowledge sharing and capacity building are key 3M values we bring to governments around the world.

3M is eager to work with national and international governments and health authorities to help assure a long term robust, resilient, and sustainable stockpile programme is developed based on sound public health policy foundations and global government best practices. We are ready to apply our science to helping protect lives in public-private partnership with governments and specially to support heroic health care workers and other essential frontline workers that continue to help our sick and keep our society functioning.