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Protecting Australia & New Zealand and Saving Lives.

Pandemic preparedness for our citizens and our economy.

A White Paper by 3M Australia Pty Limited 2017.

#3MScienceOfSafety

The 3M National Pandemic Preparedness Team.

This White Paper has been developed by 3M Australia and 3M New Zealand's National Pandemic Preparedness Team.

Through this White Paper, 3M shares its knowledge of global best practices as well as Australia and New Zealand's approach to pandemic preparedness. In particular the provision of Personal Protective Equipment (PPE) to the National Medical Stockpile (NMS) in Australia and the National Reserve Supplies (NRS) in New Zealand.

3M has developed a statistical simulation engine for pandemic stockpile and logistical supply chain projections. Statistical simulations are employed to assist with understanding the process to calculate the quantity of product required within the Stockpile. The key factors are discussed through 3M's worldwide observations that comprise an effective stockpile. These key factors are presented on pages 15–17.

This White Paper highlights the importance of effective pandemic preparedness at the national level and warns of ambivalence. In times of fiscal restraint it can be alluring to postpone the allocation of resources to pandemic preparedness. Such ambivalence can be at the peril of our citizens and the nation's economy.

This White Paper is written to reach a broad audience base, including those who may or may not possess either medical knowledge or background.

Contents

Executive Summary

This White Paper has been developed by 3M Australia and New Zealand to highlight the importance of maintaining a current and adequate national stockpile of Personal Protective Equipment (PPE) and hand hygiene products. In the event of a national human influenza pandemic, the stockpile will be used by Health Care Workers (HCWs), emergency personnel and those in charge of operating essential national infrastructure.

The Australian Government is to be commended on its approach to pandemic preparedness, in particular its support of the National Medical Stockpile (NMS) which is a vital component in any effective pandemic preparedness plan.

Australia, like many countries, has a long history of exposure to epidemics and pandemics. Incursions of Spanish Flu, Polio and Bubonic Plague have caused 84% of the disaster-related deaths in our country over the past century. Pandemics are insidious and a threat which is easy to ignore, but to do so could be to the peril of our citizens and the nation's economy.

New Zealand has experienced four influenza pandemics in the last 100 years and one of them was the worst natural disaster in the country's history resulting in 8500 deaths, or 22% of the population. According to a 1947 United Nations report, it ranked as 'one of the most disastrous epidemics recorded anywhere in the world during the present century, so far as the proportion of deaths to the population is concerned'.

The influenza A (H1N1 – generally known as swine flu) pandemic in 2009 caused more than 3,000 cases and 20 deaths in New Zealand. These events in the nation's history is an indication that future pandemics are worth preparing for, considering the potential for high death rates and possible severities.

Neither Australia nor New Zealand can afford apathy, particularly from within the Government. Preparedness plans and Stockpiles require the investment of significant resources to build and maintain. The best outcome, one hopes, is that they will never be used. While costly, they provide an insurance that we can ill afford to neglect.

This White Paper concludes with a Call to Action:

01. The Australian and New Zealand Governments must continue to resource and manage the NMS and NRS of PPE and hand hygiene products, amongst other stockpiled products within its national borders.
02. The inventory therein must be fit for purpose, within shelf life and of a quantity sufficient to meet a readiness level to be determined by the Government.
03. The quantity to be stockpiled can be estimated using scientific modelling tools and taking into account different scenarios.
04. 3M is available to conduct separate workshops with Australian and New Zealand Government experts who can provide relevant data input variables and assumptions to run the statistical simulations to determine the readiness level for the stockpile of products.
05. The procurement of stockpile of products should favour manufacturers that understand pandemic preparedness and have global expertise in the field.
06. Procurement should favour manufacturers that have a global footprint and supply chain elasticity, combined with a local presence.
07. Supply will optimally be procured from manufacturers that have capacity to upsize output and that have production facilities in more than one country.
08. The Australian and New Zealand Government must continue to recognise that during an event no amount of excess capacity can compensate for the exponential rise in global demand, hence the wisdom of stockpiling.

Page 15 outlines the criteria that embrace an effective pandemic preparedness stockpile programme.

The Purpose of This White Paper

3M is a global expert in PPE in human influenza pandemic preparedness. We provide not only products, but also a high level of expertise and technical advice to over 40 Governments around the world. As the world's population becomes more transient, potential for pandemics escalates. Every Government has a duty to protect its citizens from disasters. Despite popular belief, pandemic diseases have claimed more lives in Australia over the past 100 years than any other disaster.

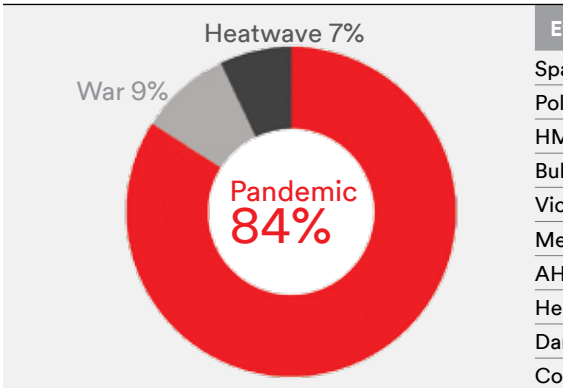
The purpose of this White Paper is to highlight the role of PPE and hand hygiene products for HCWs, emergency personnel and those in charge of operating essential national infrastructure in the event of a national human influenza pandemic.

For more information about 3M, refer to page 19.

A History of Global Pandemics and Their Effects

Ask a group of Australian or New Zealanders to guess which disasters have caused the most deaths in their country and it is likely that they will nominate either Cyclone Tracy, the Victorian bushfires, the Christchurch Earthquake or perhaps the Queensland floods. While these disasters are terrible in their own right, they do not even make it into the list of the top 10 disaster-related death tallies.

As illustrated by Chart 1, it is in fact pandemics which have been the cause of 84% of the disaster-related deaths in Australia since 1900. Similarly, table 1 below illustrates pandemic history in NZ.



Event	Disaster Type	Death Toll
Spanish Flu (1918-1919)	Pandemic	12,000
Polio (1946-1955)	Pandemic	1,013
HMAS Sydney (1941)	War	727
Bubonic Plague (1900/10)	Pandemic	550
Victoria Heatwave (1939)	Heatwave	438
Melbourne Heatwave (2009)	Heatwave	374
AHS Centaur (1943)	War	268
Heatwave (1907/8)	Heatwave	246
Darwin bombing (1942)	War	243
Cowra breakout (1944)	War	235

Chart 1 - Top 10 disaster-related deaths in Australia since 1900[1]

Event	Disaster Type	Outcome
Meningococcal (1991–2007)	Epidemic	5,244 cases, 252 deaths
Rubella (1995)	Epidemic	1,600 confirmed cases
Influenza (1996)	Prevalent	90 deaths
Measles (1997)	Epidemic	2,000 cases notified, 200 hospitalised
Campylobacteriosis (1997–2008)	Epidemic	
Influenza (1999)	Prevalent	Over 500 hospitalisations
Pertussis (1999–2001)	Epidemic	6,523 cases notified
Peak of meningococcal group B (2001)	Epidemic	648 confirmed cases
Influenza (2003)	Prevalent	600 hospitalisations
Pertussis (2004–2005)	Epidemic	3,489 cases notified, 159 hospitalised
H1N1 'swine flu' (2009)	Pandemic	3,150 confirmed cases, 20 deaths

Table 1 - A time line of epidemics in New Zealand, 1991–2009

A "pandemic" is defined by the Dictionary of Epidemiology[2] as 'an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people'.

1. various, including http://www.emknowledge.gov.au/
2. http://global.oup.com/academic/category/medicine-and-health/public-health-and-epidemiology/epidemiology

In 1918/19 the Spanish Flu (a H1N1 influenza virus pandemic) killed over 12,000 people in Australia. The virus infected around 500 million people worldwide. Up to 100 million people died - a figure which represents around 5% of the world's population at the time. These deaths, by contrast, are three times the number of military deaths that occurred worldwide in World War I and II combined.

Spanish Flu has been just one of the pandemics to infect Australia. Between 1946 and 1955 there were 1,013 deaths attributed to Polio, while Bubonic Plague killed 550 people from 1900 until its eradication in 1910. These figures relegate Cyclone Tracy to a "minor disaster" with 71 deaths. The 2009 Victorian bushfires claimed 173 lives.

In the same way, during the early 21st century anxieties concerning the dangers of Influenza A virus subtypes H5N1 (avian flu) and more recently H1N1 (swine flu) has revived memories of New Zealand's worst disease outbreak, the lethal influenza pandemic that struck between October and December 1918. In two months New Zealand lost about half as many people to influenza as it had in the whole of the First World War. No other event has killed so many New Zealanders in such a short time[3].

Studies in NZ have found that hospital admissions and discharge rates for infectious diseases have increased since the 1980s. This confirms that these diseases have not become any less of a burden. Air travel is one of the reasons that New Zealand is not isolated anymore and because of it, the country has been affected by more diseases as they spread through the world; most notably seasonal acute respiratory syndrome (SARS) and influenza. Notwithstanding the increased uptake of the annual influenza vaccination, seasonal influenza epidemics continue to have an impact, especially on adults. On average, approximately 40 deaths are linked to influenza in New Zealand each year[4].

Considering the number of lives lost during pandemic it is surprising that the event has not had greater prominence in national histories and public monuments.

It has been suggested that its mark on the collective memory may have been more distinct had it emerged during peacetime.

Humans and farm animals can play host to pandemic virus. It is in these hosts that the virus can mutate. Over the last century the human population has dramatically increased, as has the population of farm animals that sustain them. As a consequence, opportunities for mutation of the virus have also exponentially risen.

Since 1919, the human population has increased by a factor of four. While a bushfire, flood and cyclone affect small regions of a country, a pandemic is a global event that can affect the entire country and the world. To make matters worse, the threat is increasing as our planet embraces globalisation, our population grows, international travel increases and as national economies grow.

Despite their relative remoteness, small populations and historical youth, Australia and New Zealand are clearly not immune to the devastation of human disease.

Pandemics are an ever-present threat to our population. The potential consequences are so terrible and frightening that many people would rather not contemplate it.

Inevitably, we must face pandemic threats, as evidenced most recently by the H1N1 influenza virus outbreak in 2009.

Pandemics are a threat that is easy to ignore, but to do so may be at our peril. In every country there is an unspoken social contract between the Government and its citizens. Part of that social contract is that the Government is prepared to protect its citizens when disaster strikes.

Pandemics, such as influenza, are rare yet can be catastrophic.

It is to Australia and New Zealand's great credit that their Governments have created and maintained a National Medical Stockpile (NMS) and National Reserve Supplies (NRS) comprised of vaccines, supplies, hand hygiene and Personal Protective Equipment (PPE).

The Stockpile gives our health care system the ability to have surge capacity during an intense wave of pandemic influenza.

In preparing for a pandemic, it is important to recognise that ultimately Health Care Workers (HCWs), first responders and providers of essential services across Australia and New Zealand are not immune to disease. They will need to be given the confidence that they are protected when they are at work to care for the wave of ill patients needing their attention. They will need to be confident that they will not carry a virus home from work and infect their own family.

3. URL: https://nzhistory.govt.nz/culture/influenza-pandemic-1918.
4. http://www.TeAra.govt.nz/mi/epidemics/print.

Australia and New Zealand's Pandemic Plan

An influenza pandemic occurs when:

- **a new subtype of influenza virus emerges in humans which most people have not been previously exposed to and are, therefore, highly susceptible;**
- **the virus has potential to cause disease in humans; and**
- **the virus is easily and rapidly spread between humans, infecting large numbers of people worldwide with the potential to cause many deaths.**

Australia and New Zealand's approach to managing human influenza pandemic are outlined in the *National Action Plan (NAP)*[5] issued in 2014 and the *National Health Emergency Plan (NHEP)*[6] respectively.

The NAP outlines the roles and responsibilities of the Commonwealth, States and Territories as well as the Local Governments for coordination arrangements and management of a human influenza pandemic and its consequences in Australia. The execution of these responsibilities will be guided by the nature and severity of the pandemic and by the relevant influenza health, emergency management and business continuity plans of each government.

The *NAP* was first published in July 2006, revised in 2009 and 2010 before the next version was published in September 2011. This plan was developed with the knowledge available from Australian public health and infectious diseases advisory groups, the World Health Organisation (WHO) and other clinical advice agencies. The *NAP* was updated in 2014 as further information became available and as national policy directions were refined. The *NAP* demonstrates the level of planning undertaken to best prepare Australia to prevent the occurrence of a human influenza pandemic. It is designed to ensure that Australia is prepared to respond to and recover effectively from any emerging pandemic outbreaks.

Correspondingly in NZ, The Ministry of Health is working with the health sector and other government agencies to ensure New Zealand is as prepared as possible for a potential pandemic. New Zealand's pandemic planning includes the Epidemic Preparedness Act 2006 and the Health Act 1956 - Part 3 (amended 2006) amongst others. The aim is to ensure that if any nuisance, or any condition that is likely to be injurious to health exists, all proper steps are to be taken to secure the abatement of the nuisance.

The New Zealand Influenza Pandemic Action Plan has been in existence since 2002, but has undergone substantial revision since then due to the evolving threat from H5N1 influenza, the influenza A (H1N1) 2009 pandemic and the subsequent all-of-government programme of pandemic planning and exercises that have been implemented. The most recent edition was published in 2017[7].

The framework acknowledges the high importance of planning for, responding to and recovering from a pandemic event. Aspects of the plan encompass direct entities across the government and heath sectors to enter arrangements, develop plans and build capabilities to strengthen the resilience of New Zealand.

The third edition of the National Health Emergency Plan - National Reserve Supplies explains the purpose of national reserve supplies and outlines the responsibilities of the Ministry in managing the national reserve supply. The composition of which includes a mix of 17 million units of disposable respirators (80% general purpose and 20% P2 masks) purchased between 2006-2008.

5. http://www.dpmc.gov.au/publications/pandemic/
6. National Health Emergency Plan: National Reserve Supplies Management and Usage Policies, 3rd edition.
7. New Zealand Influenza Pandemic Plan: A framework for action (2nd edition) Wellington: Ministry of Health.

Lessons Identified From (H1N1) 2009

In late April 2009, WHO announced the emergence of a novel influenza A virus. This particular H1N1 strain had not circulated previously in humans. The virus was contagious, spreading easily from person to person and from one country to another. Based on available evidence and expert assessment, on 11 June 2009 the WHO's Director-General declared that the world was at the start of the pandemic (H1N1) influenza 2009. A total of 74 countries and territories, including Australia and New Zealand, had reported laboratory-confirmed infections of the new virus. The virus had appeared suddenly and spread rapidly (it spread more in just six weeks than other pandemic viruses did in six months) which demanded an immediate and coordinated international as well as national health response.

The pandemic (H1N1) influenza 2009 virus is not the same as seasonal influenza. The virus is mild in most people. However, in a small proportion of people the virus causes death due to viral pneumonia and lung failure. High risk groups have been identified where the illness is more likely to cause complications, including patients with chronic respiratory conditions, pregnant women, patients who are obese (BMI >30), indigenous people and patients with chronic cardiac, neurological and immune conditions. Children and younger people have also been shown to be at increased risk of serious complications as well as rapid spreaders of the virus.

In Australia, there were 37,636 cases of pandemic (H1N1) influenza reported in 2009, including 191 associated deaths. The median age of 2009 H1N1 influenza related deaths was 53 years, compared to 83 years for seasonal influenza.

Australia responded to the threat and reflected on its performance in the *Review of Australia's Health Sector Response to Pandemic (H1N1) 2009: Lessons Identified*[8], which states that "one of the most important lessons learned was that Australia's planning must be flexible to accommodate the biological variations in the clinical picture and the potential uniqueness of each pandemic scenario, to enable resources to be effectively directed to achieve optimal outcomes". This document also includes "one of the biggest challenges to decision making and coordination is the variation in timing of stages of the outbreaks across the country, highlighting that pandemic plans and governance arrangements need to incorporate responses adaptable to the severity of the disease, disease patterns and geographical differences".

Australia was in a good position to respond rapidly to the emerging threat from pandemic (H1N1) influenza 2009 virus and moved quickly to implement an appropriate health response.

The Australian government had spent considerable time developing and regularly updating a series of connected pandemic action plans – health and whole of government; national and jurisdictional – to guide a coordinated response to an influenza pandemic. These plans had been exercised. While the lessons from the 2009 pandemic are critical to further informing health and whole-of-government responses into the future, it is important that future planning not be based solely on the last pandemic.

Pandemics are unpredictable and therefore there is a need to remain flexible and adaptable to respond to all levels of threat to the health of the Australian and New Zealand population.

It is not possible to predict when the next pandemic will occur, how severe it will be, nor how long it may last. Equally, it is difficult to predict how quickly a pandemic will progress. Based on experience from pandemic (H1N1) influenza 2009, together with data and assumptions drawn from previous pandemics and seasonal influenza and their treatments, it is anticipated that a pandemic could last from seven to ten months. However, the impacts on the social, economic and health systems could last longer depending on the severity of the virus.

Australia and New Zealand understand that being well prepared is important. The report also reflected that "success depends on a multi-stakeholder cooperative approach, with key elements being effective communications, robust science-based decision making and a flexible public health response system that is able to respond rapidly to a crisis".

8. http://www.flupandemic.gov.au/internet/panflu/publishing.nsf/Content/review-2011

Protecting the Front Line

Any pandemic response will be reliant on there being a ready force of HCWs. These include General Practitioners (GPs), nurses, ambulance officers and other emergency personnel who are trained, ready and willing to be mobilised. 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 in Australia and New Zealand. 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. Australia and New Zealand need to be in a position to ensure that our HCWs have access to appropriate PPE.

What levels of PPE do the Australian and New Zealand Governments have in the Stockpile and what level of readiness do they afford the HCWs?

To some, calculating the amount of PPE required may be akin to estimating the length of a piece of string. 3M has developed a tool called the *3M™ Emergency Preparedness & Response – PPE Surge Capacity Demand Planning Tool* which, based on assumptions that can be derived from the NAP, other scenarios, or user-defined parameters can be utilised for what-if 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.

The 3M Demand Planning Tool

The 3M demand planning tool was developed by working closely with 40 Ministries of Health worldwide. The demand planning tool takes various parameters such as:

01. Population and demographics
02. Intensity and virulence of the pandemic strain (captured via the attack rate)
03. Variability of spread across the population
04. Connecting the epidemiology of the disease to the logistics and supply chain

At 3M, we have studied Australian and New Zealand health statistics and arrived at a range of parameters used in our prototype simulations. To demonstrate its features and functions the tool needs to be populated with data. We have chosen to use some data from the national Australian sources as well as the *NAP*.

It is of note to mention that the quality of output is entirely dependent on the quality of input. We have chosen judiciously to arrive at a first generation model. However, we would like to invite the Australian and New Zealand experts to use this sophisticated calculator and populate it with their own data and assumptions to explore the outcomes.

The next few pages illustrates how such logistics and supply chain tools can be used together with the *NAP* and the epidemiology of the disease.

This statistical simulation can be run for a varied number of service delivery nodes, e.g. ambulance service, emergency room, intensive care unit and home-stay. The simulations are based on assumptions informed by 3M's experience. Service delivery nodes can be introduced as needed by the end-users.

Simulations of consumption of products at different service delivery nodes over each wave of the pandemic can be aggregated to estimate the national demand.

For illustration purposes, service delivery node for GPs has been utilised and is based on N95/P2 particulate respirators. The same demand modelling tool can be adapted to determine stockpile of other PPE like hand hygiene, goggles, gowns and so forth.

A Practical Example

This example is based on the service delivery node for the Australian GPs at national level, whereby statistical simulations were run using the *3M™ Emergency Preparedness & Response – PPE Surge Capacity Demand Planning Tool*. During the first wave of a pandemic in Australia of the intensity described in the *NAP*, how much PPE must be distributed to GPs across the country to provide protection while the pandemic is raging? For this example, the demand planning tool provides an estimated number of N95/P2 particulate respirators that may be stockpiled for GPs and their support staff based on data input variables and assumptions entered as shown in Table 2 below.

Variable	Assumption (Mean Values)	Notes
Event duration	60 days	Statistical simulation was run over a range of possible duration of the first wave of the pandemic with minimum duration at 30 days, likeliest at 60 days and maximum at 90 days
Attack rate	40%	This is the unmitigated clinical attack rate that was taken from the Australian Health Management Plan for Pandemic Influenza 2008[9]
Daily patient surge	1,000 per 1,000,000 population visiting the GPs	This is the number of patients seeking care from their GPs per one million population
Primary staff	GP x one	Primary staff refers to the GP on duty
Support staff	Two	We made an assumption of support staff on duty being: • Receptionist x one • Nurse x one
Staff productivity	Three patients per hour	The number of exposure by primary and support staff are three patients per hour
Shift duration	12 hours	Each shift being 12 hours in duration
Consumption of respirators/shift	Five	We assumed consumption of respirators being: • GP x two • Nurse x two • Receptionist x one

Table 2 - All of the above parameters can be adjusted in the demand planning tool and can be set to any value desired to create different scenarios to view possible outcomes.

9.. http://www.flupandemic.gov.au

Figure 1 provides a screenshot of the demand planning tool with the data input variables and assumptions shown in Table 2 employed.

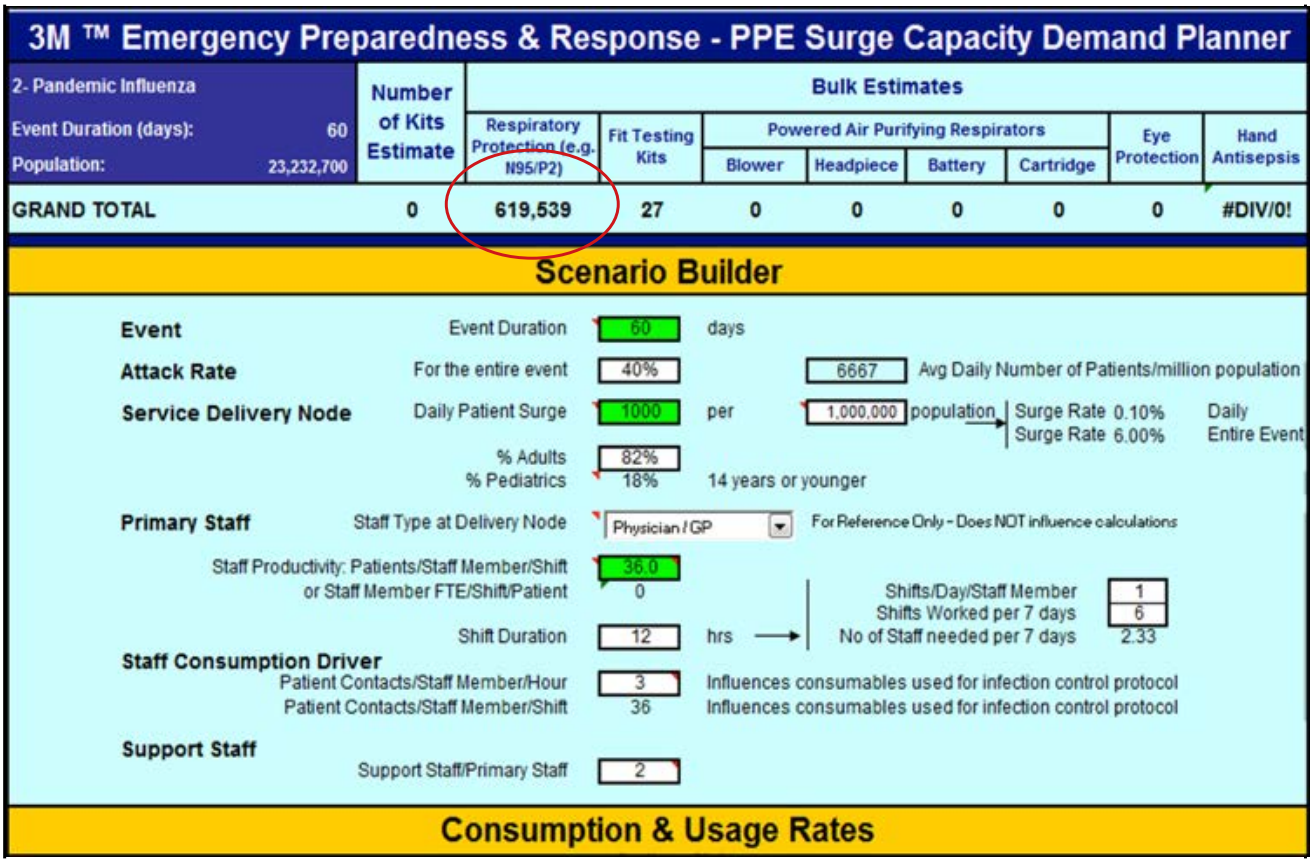


Figure 1 – Data input variables and assumptions were entered in the demand planning tool.

The resultant estimate is that the total demand for N95/P2 particulate respirators for GPs and their support staff will be 619,539 units over the 60 days duration.

The simulation engine behind the tool takes critical variables highlighted in green and varies them across a range of possible outcomes. For each combination of these variables, the simulation engine calculates the consumption of products. By doing enough scenarios, we are able to create a range of outcomes from weak pandemics to strong ones. We also develop the corresponding consumption intensities over the range of simulations performed. We will know what the consumptions will be for a weak pandemic and for a strong pandemic as well as for intensities in between. No one can predict in the absence of the virus for an emerging pandemic strain which intensity in the range is the right one to choose. However, the range allows decision makers and policy makers to establish baseline national readiness levels for their stockpiles.

For example, you can see a range of outcomes that is predicted by our tools in the following chart and table.

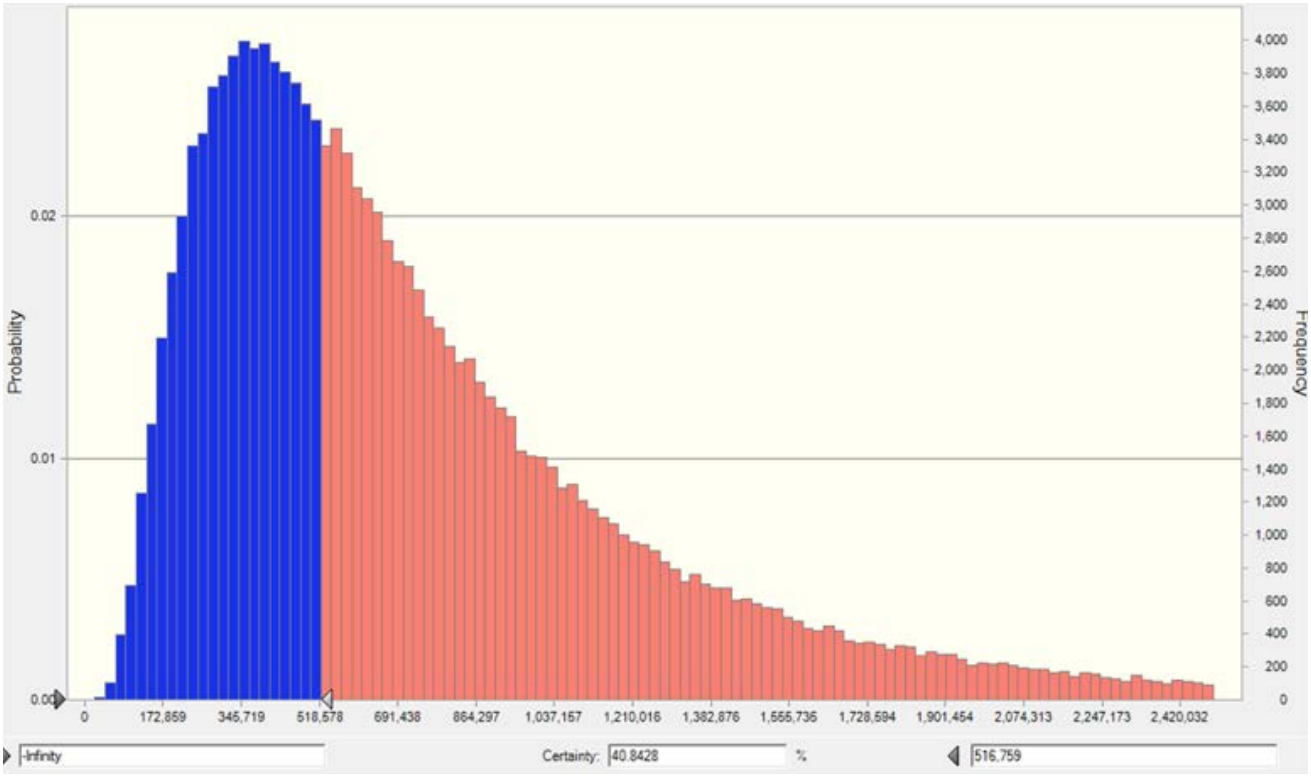


Chart 2 – Demand for N95/P2 particulate respirators for GPs and their support staff across a spectrum of pandemic intensities

Chart 2 can be interpreted as follows:

The further to the left of the graph (i.e. towards and into the blue shaded area) the relatively less virulent the scenario. This means that for these scenarios, less N95/P2 particulate respirators will be consumed by the GPs and their support staff when the pandemic outbreak is occurring. In other words, there is a relatively smaller surge in patients at the GP clinics resulting in lesser demand for N95/P2 particulate respirator consumption.

Moving to the right hand side of the graph, i.e. the pink shaded area, the stronger the scenario demands. This means that more N95/P2 particulate respirators will be consumed by the GPs and their support staff as the pandemic outbreak in the community spreads effectively across the population mass. This relates to a greater surge in patients at the GP clinics resulting in more demand for N95/P2 particulate respirator consumption.

Minimum Readiness Levels

The demand planning tool simulates thousands of scenarios per minute allowing planners to observe a variety of scenarios from weak pandemics to strong ones and their corresponding consumption levels.

Table 3 in the following page demonstrates these scenarios in 10% increments. For instance, for the 10% weakest pandemic, the consumption of respirators by the GPs and support staff will be 245,295. This means to be ready for the 10% of weakest pandemics that number of respirators must be in the national stockpile. If the Government is interested in being ready for the 20% of the weakest scenarios the stockpile level must be at 335,289. Furthermore, if the Government is interested in being ready at the 50% level then the stockpile level must be at 608,248.

A key question that often is raised - what is the right stockpile level? That question must be answered by the national public health officials knowledgeable about both global influenza surveillance and the availability as well as the elasticity of products and supply chains.

The tool provides planners, decision makers as well as policy makers with target levels that they can use in developing detailed plans, budgets and outcomes.

Note, estimated demand changes significantly from 90% to 100%. The last 10% takes more resources, i.e. consumption of N95/P2 particulate respirators is at the highest level when the event duration, patient surge rate and usage rate are all maximised in these "worse case" simulations with a huge surge in patients over a long period (~90 days) attended by the GPs and their support staff.

The desired level of readiness required is a decision to be made by the relevant Australian and New Zealand Government authorities.

Minimum Readiness Levels	Forecast Units
0%	22,499
10%	245,295
20%	335,289
30%	419,334
40%	508,844
50%	608,248
60%	725,836
70%	878,182
80%	1,095,312
90%	1,486,244
100%	13,902,017

Table 3 – Readiness level at 10% increments for the estimated demand of N95/ P2 particulate respirators

The simulation above is an example of the demand planning tool in use. It has been presented here to demonstrate how the tool may be utilised. This tool can also be run for other stockpile items, such as hand hygiene products and protective coveralls.

The Stockpile Is a Vital National Asset

As a population we are attuned to the notion of risk management. We invest our private resources in insurance policies aimed at providing us and our families with a safety net in the event of an accident or misfortune. We accept the fact that insurance companies establish the level of their policy premiums according to an assessment of the level of risk versus consequence. We in turn make our own judgments regarding our preparedness to forgo funds now as a contingency to mitigate the effect of an incident we hope and pray will never happen.

In making that judgment we mentally consider a risk matrix (refer to Figure 2 on the following page). If an incident falls within the "high probability/high consequence" quadrant then we will probably not hesitate to take some action. Conversely, an incident with "low probability/low consequence" will likely be ignored.

The most difficult decision relates to those risks that are considered unlikely to occur – but devastating if they do. Here we must base the decision on our own attitude and tolerance towards risk.

Figure 2 – Probability : Consequence Risk Matrix

When an event happens infrequently yet when it occurs the results are catastrophic at national level what should our readiness level be, how much as a nation should we invest? Given demand for many other needs that Australia and New Zealand have in infrastructure, healthcare and security, how much of our national resources can we dedicate to these types of risks and scenarios?

For a government, it is a hard gamble to not be ready. Can we afford not to invest? How does a nation prepare for a "low probability" yet a very "high consequence" event like pandemic influenza?

Over the past 300 years, 11 pandemics have been recorded globally. The shortest time period between pandemics has been 11 years and the longest 49 years. Emergence of pandemics is highly variable. Being well prepared when a pandemic may hit Australia and New Zealand could mean the difference between a minor disruption and the total cessation of business activities. It is for this reason that the New Zealand Government has developed the NHEP and the Australian Government its NAP, a dedicated management team and the NMS.

Developing a stockpile is like buying an insurance policy to help protect the country in case a pandemic outbreak occurs. **This insurance is the unspoken social contract that the Government has with its citizens to protect their lives and the nation.** Should a catastrophic event like pandemic hit, then the HCWs and other workers in the essential emergency services must be protected so that they can continue to turn up for work to look after the sick. For this reason, Australia and New Zealand have to protect their economies for the crippling effects of a pandemic. The probability of a pandemic outbreak is low, however the consequence of not being prepared is highly catastrophic.

What Factors Comprise an Effective Pandemic Preparedness Stockpile?

Stockpiles are a key component of any pandemic preparedness plan. To be effective a number of criteria should be met.

01. The Stockpile must contain the right equipment in numbers proportional to the anticipated minimum readiness levels.

The challenge here is one of mixing the medical science and epidemiology with logistics and supply chain management.

The developers of the Stockpile must establish the type of equipment required and how many units are to be stockpiled.

With regard to the equipment needs, a pandemic preparedness stockpile must as a minimum comprise:

Personal Protective Equipment for:

- First responders
- Health care workers
- Essential services
- Workforce

Medical supplies

- Vaccines for the patients

Disinfection

- Hand hygiene products
- Health care personal and environmental products

Once the equipment needs are established, the next question is "how many?". This figure is derived through considering different scenarios and utilising sophisticated modelling as per the **3M Emergency Preparedness & Response – PPE Surge Capacity Demand Planning Tool.**

02. The equipment must be fit-for-purpose.

Particulate respirators are designed to help reduce exposure to influenza viruses. The function of particulate respirators in a pandemic situation is twofold, occupational use and non-occupational use. Occupational use of particulate respirators will be by high risk individuals, health care workers, first responders, employees providing business to business related activities and essential services. Non-occupational use could be by infected patients and members of their household, international travellers, Foreign Service employees and their families as well as the greater public.

What are the differences between particulate respirators and surgical masks?

The key difference between a particulate respirator and a surgical mask is its intended use.

Particulate respirators that meet performance requirements of AS/NZS 1716:2012 are designed to help reduce the wearer's respiratory exposure to airborne contaminants, such as particles that are small enough to be inhaled - particles less than 100 microns in size down to nanometre size. This includes airborne particles that may contain biological material, e.g. viruses and influenza. Respirators are designed to seal to the face of the wearer. Therefore most of the inhaled air is drawn through the filter media and does not leak through gaps between the respirator and the wearer's face. The filtration efficiency and face fitting capability of a respirator is tested as part of AS/NZS 1716:2012 to demonstrate a minimum performance requirement using standardised testing protocols.

Surgical masks, even those that meet AS4381, do not have adequate filtering and/or fitting attributes to provide effective respiratory protection for the wearer against particles less than 100 microns in size. They are designed to help prevent contamination of work environment (or sterile area) from particles generated by the wearer, e.g. spit or mucous being expelled into the environment. Most surgical masks are open on the side and they do not provide a good seal to the face. Therefore, air leakage around the edges exists, leading to the wearer being exposed to airborne hazards and potential infection. Particularly concerning in pandemic situations.

Products that are not compliant to AS/NZS 1716:2012 should not be worn in occupational and non-occupational environments where there is a risk of infectious airborne particulates, such as during pandemic situations.

03. The stockpile of N95/P2 particulate respirators must be sourced in configurations that fit a large variety of facial features.

Today's workforce and community come from a wide ethnic and cultural background. Whilst this adds to our sense of cultural diversity, it also means that across our community there are a wide variety of facial shapes and sizes. This means that the PPE stockpile must accommodate different facial shapes and sizes in order to provide the assigned level of protection.

An extensive range of class P2/N95 rated filtration particulate respirators are available locally and globally for pandemic use. The particulate respirators are available in both cupped and folded platforms that suit most facial sizes. They come either with or without an exhalation valve for added breathing comfort especially when working in hot and humid environments or doing activities for prolonged periods.

04. The Stockpile inventory must always be within its anticipated shelf life.

The shelf life of particulate respirators is normally three (3) years from date of manufacture. Through extensive research, test and analysis, some manufacturers have extended the shelf life of the particulate respirators from three (3) to five (5) years. As a result, some manufacturers have five (5) years as the standard shelf life of the particulate respirators from date of manufacture. **The shelf life can be maximised to its full capability when the stockpile of particulate respirators is properly warehoused in storage conditions specified by the manufacturer.**

Engaging with sources that can provide advice on how best to maximise the shelf life of the PPE will be fundamental in the procurement process.

05. Stockpile Life Cycle Management.

It is an incongruent reality that the Stockpile is designed and filled in the hope that the inventory will never be used. Design then must take into account inventory degradation and the continual need to replenish and maintain a current, effective stockpile.

It will be essential to engage with a manufacturer and a logistics provider who have the knowledge, experience and capability to offer advice on the life cycle management of stockpile of personal protective equipment.

06. The inventory should be sourced from a manufacturer with a global production capacity, footprint and sources of raw material.

The Stockpile must have the ability to meet the sporadic and modest rise in demand. During a pandemic, the manufacturer should be able to activate their internal processes to respond to such demands. This will be possible where the manufacturer has a global production capacity and a wide footprint along with a large network of sources for procurement of raw material to satisfy such demands.

Every country will be vying to procure the equipment necessary to protect its citizens during a pandemic outbreak. A sudden surge in demand will result in shortage of the necessary equipment. By replenishing the NMS, the stockpiled items will be available for use in an outbreak. Note that the readiness level is yet to be determined by the Government.

In the event of a vigorous outbreak, nations may choose to close borders or prohibit the export of material that could service their own needs.

For these reasons it is wise to source inventory from manufacturer(s) with production facilities located in more than one country.

07. Inventory (particularly PPE) must be sourced from a manufacturer that has the capability to meet sporadic and modest rises in demand.

Calls for efficiency decree that we now live in a world of just-in-time production and just-in-time consumption. Our global production of goods and services for emergencies are also based on the concept of “just-in-time”. Some manufacturers have the inbuilt capacity and elasticity to respond to sporadic and modest rise in demand. Most manufacturers do not have the inbuilt capacity and elasticity to respond to dramatic rises in demand. If they did, they would have large factories that would remain idle for years before they are activated during pandemic episodes. This is not practical and simply does not exist. The entire reason behind stockpiling within sovereign borders of a country is to ensure availability of products in this just-in-time production and consumption system. We recommend the Government to continue with stockpile to ensure availability.

08. Suppliers should be experienced and knowledgeable in pandemic preparedness.

Stockpile inventory should be sourced from manufacturers that not only have world class supply chain management, but also possess vast experience in providing pandemic preparedness services to many national health systems globally. In addition to global support, a company with its own local team can provide customised support for their product and customers at national level. This local expertise will have a deep understanding of cultural and social needs of the country and will be able to deploy this at national level.

It will be important to select a manufacturer who offers products and services for different sets of working environments that can help protect employees and assets, and provide recovery assistance during and after the incident.

09. Training and monitoring services.

As part of its product offering, the manufacturer should have the capability to offer customised training and support from its team of qualified Occupational Hygienists and support staff. The team must have extensive knowledge of the issues and complications that can be associated with the use of PPE. This team should be able to provide guidance in the selection, use and maintenance of its PPE. They can also provide a range of support services to help with the implementation and management of a safe and compliant system of protection to the Australian and New Zealand health care workers and the wider infrastructure staff.

10. Engagement with a manufacturer that is prepared to be a partner rather than just a supplier.

True benefits will be achieved where manufacturers and suppliers to the Stockpile are prepared to collaborate and share their experience and expertise. The Government could, for example, gain access to analytical tools enabling the anticipation of outcomes based on pandemic scenarios that assists in building national surge capacity and resilience. Amongst others, focus is given to patient surge capacity, additional personnel requirement, stockpile cache and their management, demand for PPE as well as education and training in the use of the products.

Ideally, such a supplier will have experience working with Governments globally for disasters scenarios such as tsunami, bushfires, earthquakes, floods and even major outbreaks of food borne illnesses.

Conclusion

Australia and New Zealand's capacity to protect their people in the event of a pandemic will only ever be as strong as the will of Government to support and maintain the components of the *NAP and NHEP* respectively.

The National Medical Stockpile (NMS) in Australia and the National Reserve Supplies (NRS) in New Zealand are vital components in any effective pandemic preparedness plans. The Stockpile is a form of insurance – the unspoken social contract that the Government has with its people to help protect the nation and their lives.

Preparedness suffers from the fact that pandemics, while ultimately inevitable, are insidious and their occurrence so cataclysmic to our daily way of life that most people prefer to keep them out of mind.

Australia and New Zealand cannot afford such apathy, particularly from within the Government. In times of fiscal restraint there can be a real threat that preparedness for low probability : high consequence events may be neglected as scarce resources are directed to issues considered more pressing in the current context.

Stockpiles are incongruous as they require the investment of significant resources to build and maintain, in the hope that they will never be used. While costly, they provide an insurance that we can ill afford to neglect.

Call to Action

01. The Australian and New Zealand Governments must continue to resource and manage the NMS and NRS of PPE and hand hygiene products, amongst other stockpiled products within its national borders.
02. The inventory therein must be fit for purpose, within date and of a quantity sufficient to meet a readiness level that is yet to be determined by the Government.
03. The quantity to be stockpiled can be estimated using scientific modelling tools and taking into account different scenarios.
04. 3M is available to conduct a workshop with the Australian and New Zealand Government experts who can provide relevant data input variables and assumptions to run the statistical simulations in order to determine the readiness level for the stockpile of products.
05. The procurement of stockpile of products should favour manufacturers who understand pandemic preparedness and have global expertise in the field.
06. Procurement should favour manufacturers that have a global footprint and supply chain elasticity, combined with a local presence.
07. Supply will optimally be procured from manufacturers that have capacity to upsize output and that have production facilities in more than one country.
08. The Australian and New Zealand Government must continue to recognise that during an event no amount of excess capacity can compensate for the exponential rise in global demand, hence the wisdom of stockpiling.

3M – Who We Are

3M is fundamentally a science-based company. For more than a century, innovation has been our hallmark, reflecting a culture of shared ideas and technology.

We produce thousands of imaginative products, and we are a leader in scores of markets – from personal safety, security and protective products and services to highway safety, health care, office products, abrasives and adhesives. Our success begins with our ability to apply our technologies - often in combination - to an endless array of real-world customer needs. This is one of our greatest strengths. All of these are made possible by the people of 3M and their commitment to make life easier and better for the global community.

We provide solutions for work situations requiring basic PPE through to environments that call for the most sophisticated and comprehensive protection. Our industry leading PPE has long offered safety solutions designed to meet the highest industry standards of excellence.

As a global leader in Respiratory Protection Equipment, we possess significant global production capacity for N95/P2 particulate respirators. 3M's world class electrostatic filtration technology has enabled the design of respirators that meet industry and military performance standards around the world.

3M's technical staff have performed extensive research on the performance of respirators for over thirty years - work which has confirmed that the products meet and in some cases exceed their assigned protection level.

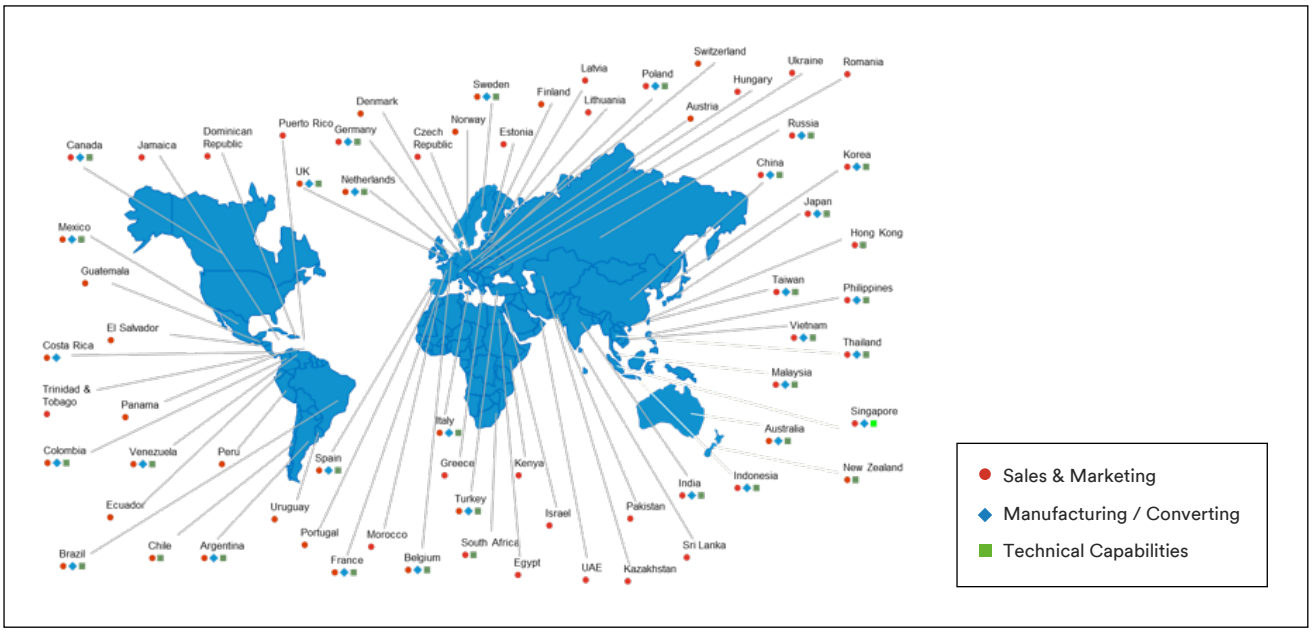
3M is an expert in providing products for the stockpile of PPE and hand hygiene. Our PPE includes respirators (particulate disposable and reusable respirators as well as powered and supplied air respirators), goggles, hearing protection products, surgical masks and protective coveralls to gowns and 3M™ Avagard™ hand hygiene products.

Whilst being a supplier, 3M is also a global expert in human pandemic preparedness. The company provides a high level of expertise, modelling tools and technical advice to over 40 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 is a current supplier of PPE to Australia's NMS, in particular the 3M 1860 N95/P2 respirators and Avagard™ hygiene hand rub.

Our global and Australian and New Zealand businesses welcome the opportunity to continue assisting the Australian and New Zealand Governments in positioning the nation to be optimally prepared for a pandemic incident.

3M Driving Progress Around the World



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