Manufacturing Africa
Global PPE Demand/Supply

Overview of the impact of COVID-19 on global PPE demand and supply

Final report – December 2020

This programme is funded by UK aid from the UK Government; however, the views expressed do not necessarily reflect the UK government's official policies

COVID-19 is, first and foremost, a humanitarian challenge. Thousands of healthcare professionals are heroically battling the virus, putting their own lives at risk. Governments and industry are working together to understand and address the challenge, support victims, their families and communities, and search for effective treatments and vaccines.

Solving the humanitarian challenge is the top priority. Much remains to be done globally to prepare, respond, and recover, from protecting populations at risk to supporting affected patients and their families and communities. To address this crisis, responses must be evidence-informed, and based on partnerships across multiple stakeholders and sectors. This includes but is not limited to the medical/pharmaceutical industry and regulatory/compliance agencies.

The content in this document is preliminary and non-exhaustive. It is being made available solely for information purposes in response to the urgent need for measures to address the COVID-19 crisis. It reflects general insights and may present potential options for consideration based on currently available information, which is inherently uncertain and subject to change. It does not contain all of the information needed to determine a future course of action. The insights and concepts included herein have not been validated nor independently verified. References to specific products or organizations are solely for illustration and do not constitute any endorsement or recommendation.

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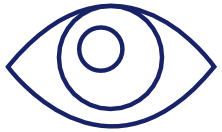
Contents

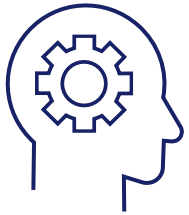
This project has 3 main objectives

Key objectives



Provide clarity about current market dynamics in global PPE supply and demand

Estimate global demand for PPE during 2021 to 2025 by geography and specific situation



Build an understanding of the main global dynamics and constraints of supply

Identify and describe the main global manufacturers

Disseminate this knowledge among other key stakeholders (e.g. health-related organizations, manufacturers) and specific fora

Sources of insights comprise 30+ global experts and 50+ international reports, databases & articles

SEE NEXT PAGES FOR DETAILS OF THE INTERVIEWEES

32 interviews with international experts

8 international experts interviewed (employees of PPE and input manufacturers)

~10 members of international organizations involved in supporting countries in the COVID-19 pandemic

~15 McKinsey experts in global public health and the PPE industry

50+ international reports, databases and articles

International institutional reports on the PPE supply chain and the impact of COVID-19

International databases of PPE use and prices

Official communications by governments & manufacturers

Proprietary models

McKinsey epidemiological model used to design potential scenarios for COVID-19 case estimates in the short and medium term

THE WORLD BANK · 3M · Honeywell · World Health Organization · IFC · Foreign, Commonwealth & Development Office

International Trade Centre · YouGov · OECD · ADB Asian Development Bank · World Health Organization · Mordor Intelligence

List of interviewees (1/2)

Type	Organization	Name	Position
International experts	3M (formerly)	Anonymous	Executive Director of Business Development
	3M (formerly)	Anonymous	General Manager (Life Safety Product)
	Kimberly Clark (formerly)	Anonymous	National Account Manager Healthcare GPO
	Waterloo Filtration Institute	Anonymous	Director of Sales
	Ansell	Anonymous	Senior Director Marketing
	Grain Processing Corporation	Anonymous	VP - Alcohol Products
	Hayat Kimya	Anonymous	Production Chief
	MSA – The Safety Company	Anonymous	Former Regional Channels leader, ME/Africa/India
International organizations[1]	Field Ready	Andrew Lamb	Innovation lead
	Field Ready	Cecilia Ho	Innovation manager
	World Bank	John Williams	Senior Procurement Specialist
	CHAI	Michael Curran	Program Manager
	UNICEF	Hani El-Jadaa	Contracts Manager
	UNICEF	Ehab Atia	Technical Officer

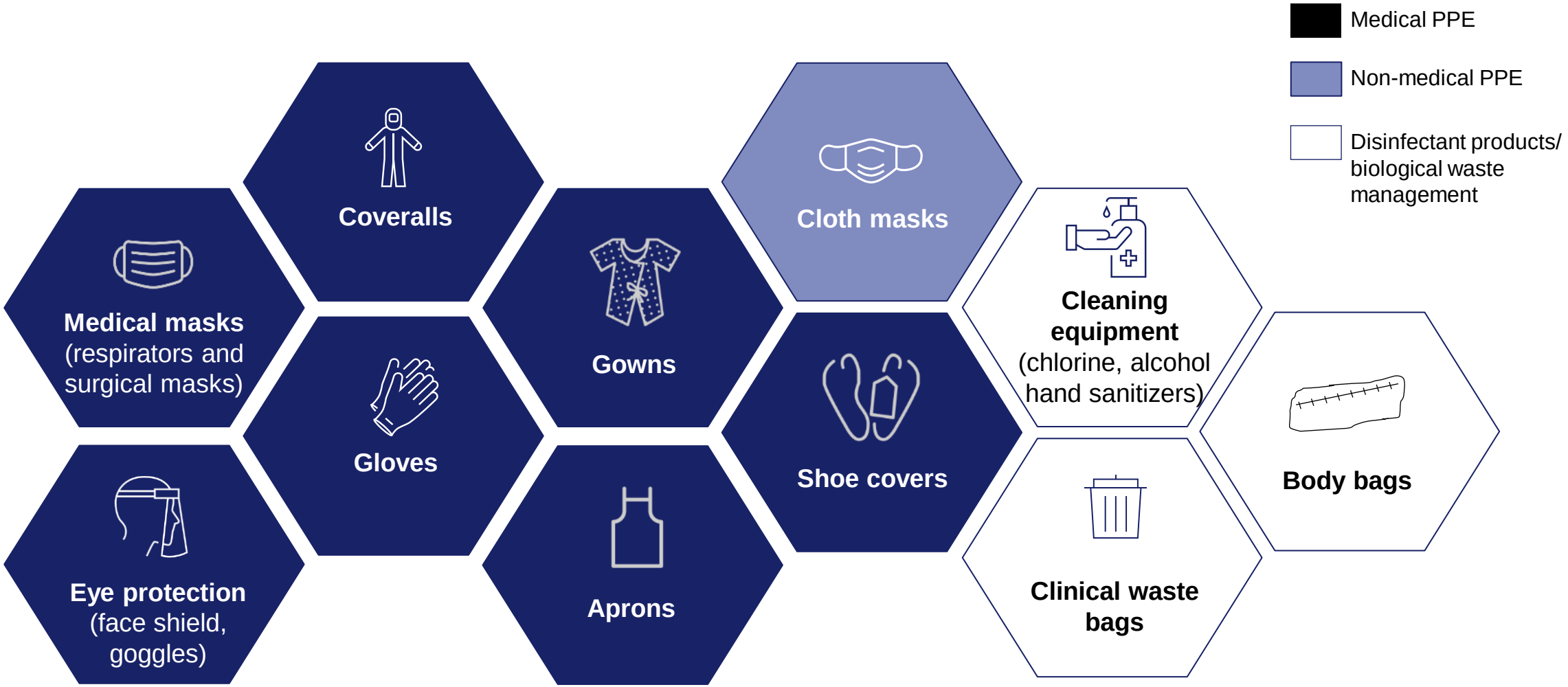
1. In addition to FCDO & the IFC

List of interviewees (2/2)

Type	Name	Position – Expertise
McKinsey global experts	Mark Baptista	Partner – Manufacturing, PPE
	Mike Gordon	Senior Expert – Manufacturing, PPE
	Josh Rothenberg	Associate Partner – Manufacturing, PPE
	Adolf Makgatho	Associate Partner – Global Public Health, Africa
	Tania Holt[1]	Partner – Global Public Health, Africa
	Sunny Sun[1]	Partner – Global Public Health, Africa
	Bart Van de Vyver[1]	Partner – Global Public Health, Global
	Matt Craven[1]	Partner, MD – Global Public Health, Global
	Mengwei Xin[1]	Associate Partner – Global Public Health, China
	Marie-Renée B-Lajoie[1]	Engagement Manager, MD – Global Public Health, North and Latin America
	Chirag Adatia[1]	Partner, MD – Global Public Health, India
	Neeraja Nagarajan[1]	Associate, MD – Global Public Health, India and North America
	Sanjiv Baxi[1]	Associate Partner – Global Public Health, North America
	Jorge Torres[1]	Director of Client Development – Global Public Health, Latin America

1. Global public health experts contacted to validate the regional vaccine coverage and efficacy scenarios

This project looks at 3 types of products: medical PPE, non-medical PPE and disinfectant/waste management products



Contents

Executive summary (1/3)

I. Impact of COVID-19 on global PPE supply

Before the crisis, the medical PPE market, which represented ~$8bn in 2019, was relatively consolidated and led by the US and Asia

- China and the US accounted for ~60% of production across most types of PPE, except gloves, which are principally made in Malaysia and Thailand; nevertheless, despite this concentration in global production, there has historically been strong interdependence in the PPE trade. Every country has depended on at least one other for at least one type of PPE
- While global leaders account for ~40% of the entire market, distributing an exhaustive range of products and operating production units in multiple geographies, local/specialty players have emerged in both direct sales and contract manufacturing channels

During the course of the COVID-19 outbreak, industry experts suggest that global supply of medical PPE increased by at least 300% at the peak, driven mainly by masks, which increased by more than 1,200%[1]

- 50-60% of this supply increase was driven by existing global players who expanded their production capacities (e.g. DuPont doubled its gowns output; 3M increased its face shield output ten-fold)
- 40-50% came from (i) a partial shift in production by adjacent industry manufacturers (e.g. automotive, textile), and (ii) entirely new small-scale local players. Supply stress in the early months of the crisis drove up market prices throughout Q1-Q3 2020, enabling these new entrants to achieve good returns on their investment. Currently, however, prices are gradually returning to pre-crisis levels

This increase in output has placed significant pressure on the PPE manufacturing value chain: (i) limited availability of raw materials, (ii) limited manufacturing plant capacity, especially for regulated products and (iii) distribution constraints, including trade restrictions limiting exports. In particular, there is a shortage of melt-blown nonwoven fabric for surgical masks/respirators. Furthermore, limited manufacturing capacity for gloves (due to their relatively complex manufacturing processes) has become critical.

1. The peak will differ by geography: Asian countries have experienced bigger growth than other countries (e.g. the US).

Source: ITC Trade Map, OECD, Mordor Intelligence, Asian Development Bank, interviews with industry experts (November-December 2020), official government statements, press search.

Executive summary (2/3)

II. Forecast for global PPE demand for 2020-25

Global PPE demand for 2020-25 has been forecast across 5 main demand segments – non-COVID-19-related use, hospitals and clinics, immunization campaigns, workforce (non-healthcare) and general public use; each segment will use a differently weighted set of products

- Demand from hospitals/clinics and immunization campaigns is modelled through 2022 and aligned with regional vaccination scenarios (depending on vaccine coverage and efficacy rates in each region)
- Demand from the general public & non-healthcare workforce is estimated through 2025, and depends on regional assumptions about return to work rates as well as those relating to adoption and frequency of use rates

Global demand for PPE is estimated to have increased by 300-400% between 2019 and 2020[1]. This peak is expected to be sustained in 2021 driven by consumer demand and that of non-healthcare workers. Demand from both these groups should fall by 2022, and as a result overall demand, growth rates and product mix may return to historic levels.

- While surgical masks are expected to account for ~40% of global demand in 2021 (125-160bn units), it could drop by ~85% in 2025 (20-25bn units) due to expected herd immunity and the associated decline in the use of PPE among non-healthcare workers and the population at large
- The trajectory is somewhat different for gloves. While the spike in demand for gloves in 2021 may be lower than for other categories (a jump of 120-180% between 2019 and 2021), the category will remain a strong driver of overall PPE market growth through 2025 (115-165bn units, i.e. ~60% of total demand)

While North America was the primary consumer of PPE in 2017-19 (~30% of total demand in 2019), **Asia may take over this position by 2025. Indeed, Asian countries are estimated to account for ~40% of total 2025 demand due to continuing use of PPE by consumers and non-healthcare workers**

- By 2021, Asian countries could account for ~70% of global demand for surgical masks, driven by their large population and high (~60-80%) adoption rate
- By 2025, PPE demand is expected to be dominated by gloves in Western countries and Africa (~70%). In Asia, the higher demand for surgical masks (15-25% in Asia vs. 5% in Western countries and Africa) suggests gloves may account for only ~55-65% of total demand for PPE

1. In volume

Source: ITC Trade Map, OECD, Mordor Intelligence, Asian Development Bank, interviews with industry experts (November-December 2020), official government statements, press search.

Executive summary (3/3)

III. Emerging perspectives on PPE market dynamics in the short to medium term

The expected 2021 peak due to the COVID-19 pandemic could result in 2 scenarios: (i) established players continue to capture the greatest share of peak demand; (ii) new entrants capture part of the market share through cost-competitiveness, meeting quality standards and government support

Interviews with industry experts suggest there could be oversupply in the coming months as additional capacity is now sufficient to meet most of the demand for PPE in almost all geographies[1]. Furthermore, growth in demand is expected to decelerate by 2022. Combined, these factors could limit the prospects for new entrants

- Some countries are already evidencing oversupply. Governments have built up PPE stocks, especially masks, and export restrictions are progressively being lifted, as global supply and demand return to some form of balance. As a result, a number of major players (especially in China) have started to scale back production
- As prices return to pre-crisis levels it will be harder for new small-scale players to be sufficiently cost-competitive and thus economically viable. This may be especially true for local players should market economics trump any desire for local PPE self-sufficiency in the medium term.

In light of this, PPE manufacturers (both incumbents and new players) should explore 3 strategic moves for the future: secure their short and medium term offtake in geographies where they are the most cost-competitive, diversify activities across the value chain (e.g. melt-blown nonwoven fabric, alcohol for hygiene purposes) and focus on innovation.

1. Our interviews suggest that some issues remain in gloves

Source: ITC Trade Map, OECD, Mordor Intelligence, Asian Development Bank, interviews with industry experts (November-December 2020), official government statements, press search

Contents

Important notes about the methodology used in this section

This section provides a high-level analysis of the current dynamics of global PPE supply, including a short overview of the market pre-COVID-19 and a review of the most significant trends arising as a consequence of COVID-19

Methodology

- The pre-COVID-19 market analysis is based on multiple sources, including Mordor Intelligence, private company reports and interviews with industry players
- COVID-19-related trends comprise both quantitative and qualitative analyses. The quantitative elements are based on a non-exhaustive assessment of major country/player reactions to the crisis (e.g. increased production capacity) and not on any exhaustive and comprehensive modelling. Thus it has not been validated. In general, the data obtained was very fragmented, with no solid consensus across the industry. This is a fast-evolving situation with rapid redistribution of capacities. Sources include several interviews with key stakeholders (including industry leaders, national procurement agencies, and international donors) as well as a review of official government statements and press reports

Impact of COVID-19 on global PPE supply

1. **Before the crisis, the medical PPE market, which represented ~$8bn in 2019, was relatively consolidated and led by the US and Asia**
   - China and the US have accounted for ~60% of production across most types of PPE, except gloves, which are principally made in Malaysia and Thailand; nevertheless, despite this concentration in global production, there has historicly been strong interdependence in the PPE trade. Every country has depended on at least one other for at least one type of PPE
   - While global leaders account for ~40% of the entire market, distributing an exhaustive range of products and operating production units in multiple geographies, local/specialty players have emerged in both direct sales and contract manufacturing channels

2. **During the course of the COVID-19 outbreak, industry experts suggest that global supply of medical PPE increased by at least 300% at the peak, driven mainly by masks, which increased by more than 1,200%[1]**
   - 50-60% of this supply increase was driven by existing global players who expanded their production capacities (e.g. DuPont doubled its gowns output; 3M increased its face shield output ten-fold)
   - 40-50% came from (i) a partial shift in production by adjacent industry manufacturers (e.g. automotive, textile), and (ii) entirely new small-scale local players. Supply stress in the early months of the crisis drove up market prices throughout Q1-Q3 2020, enabling these new entrants to achieve good returns on their investment. Currently, however, prices are gradually returning to pre-crisis levels

3. **This increase in output has placed significant pressure on the PPE manufacturing value chain:** (i) limited availability of raw materials, (ii) limited manufacturing plant capacity, especially for regulated products and (iii) distribution constraints, including trade restrictions limiting exports. In particular, there is a shortage of melt-blown nonwoven fabric for surgical masks/respirators. Furthermore, limited manufacturing capacity for gloves (due to their relatively complex manufacturing processes) has become critical

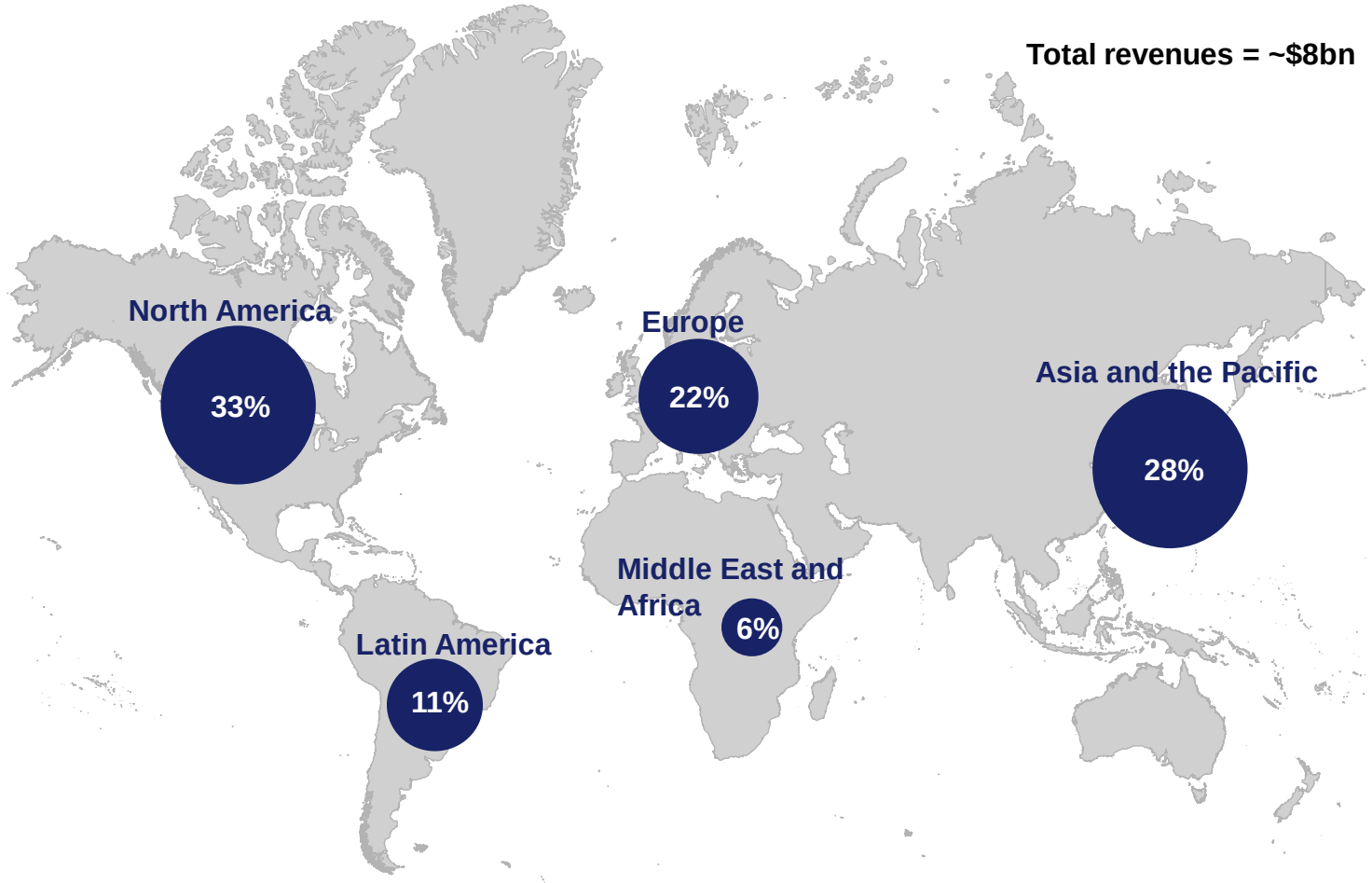
1. The peak will differ by geography: Asian countries have experienced bigger growth than other countries (e.g. the US)

Source: ITC Trade Map, OECD, Mordor Intelligence, Asian Development Bank, interviews with industry experts (November-December 2020), official government statements, press search

1| Before the crisis, the global PPE market accounted for ~$8bn and was led by North America and Asia

MARKET ESTIMATES – ONLY MEDICAL PPE CONSIDERED

Medical PPE market share by region, 2019, %



Key messages

The **medical PPE market** was estimated to represent ~$**8bn in 2019,** in turn accounting for **15% of total PPE[1] market size**

In 2019, the countries with the highest production were **China, US, and Germany, each with different export dynamics:** while China was the biggest exporter worldwide, the US exported mainly across North and Latin America and Germany served almost exclusively European countries

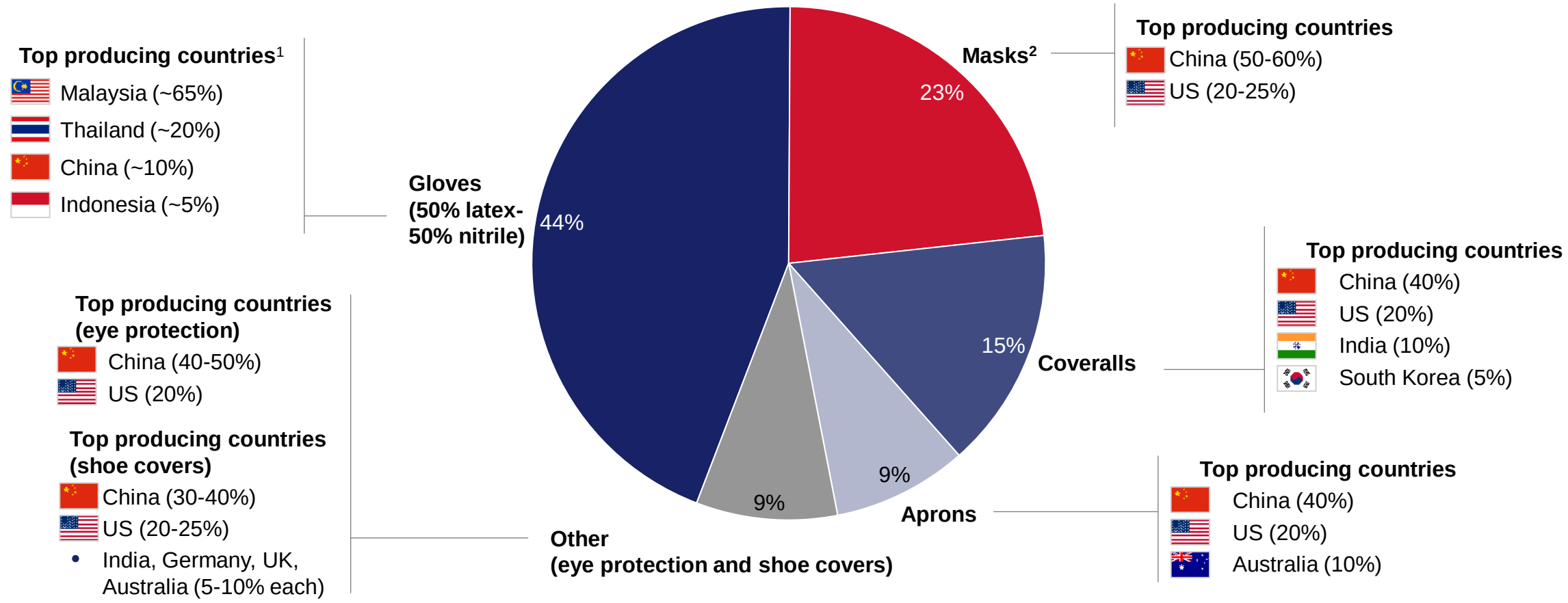
1. The PPE market has several sub-industries, including healthcare, construction, chemicals, and industry

Source: Mordor Intelligence (updated in November 2020), Asian Development Bank

1| China and the US lead in most categories, except for gloves, which are principally made in Malaysia and Thailand

MARKET ESTIMATES – ONLY MEDICAL PPE CONSIDERED

Medical PPE market share by type of PPE, 2019, % of total market

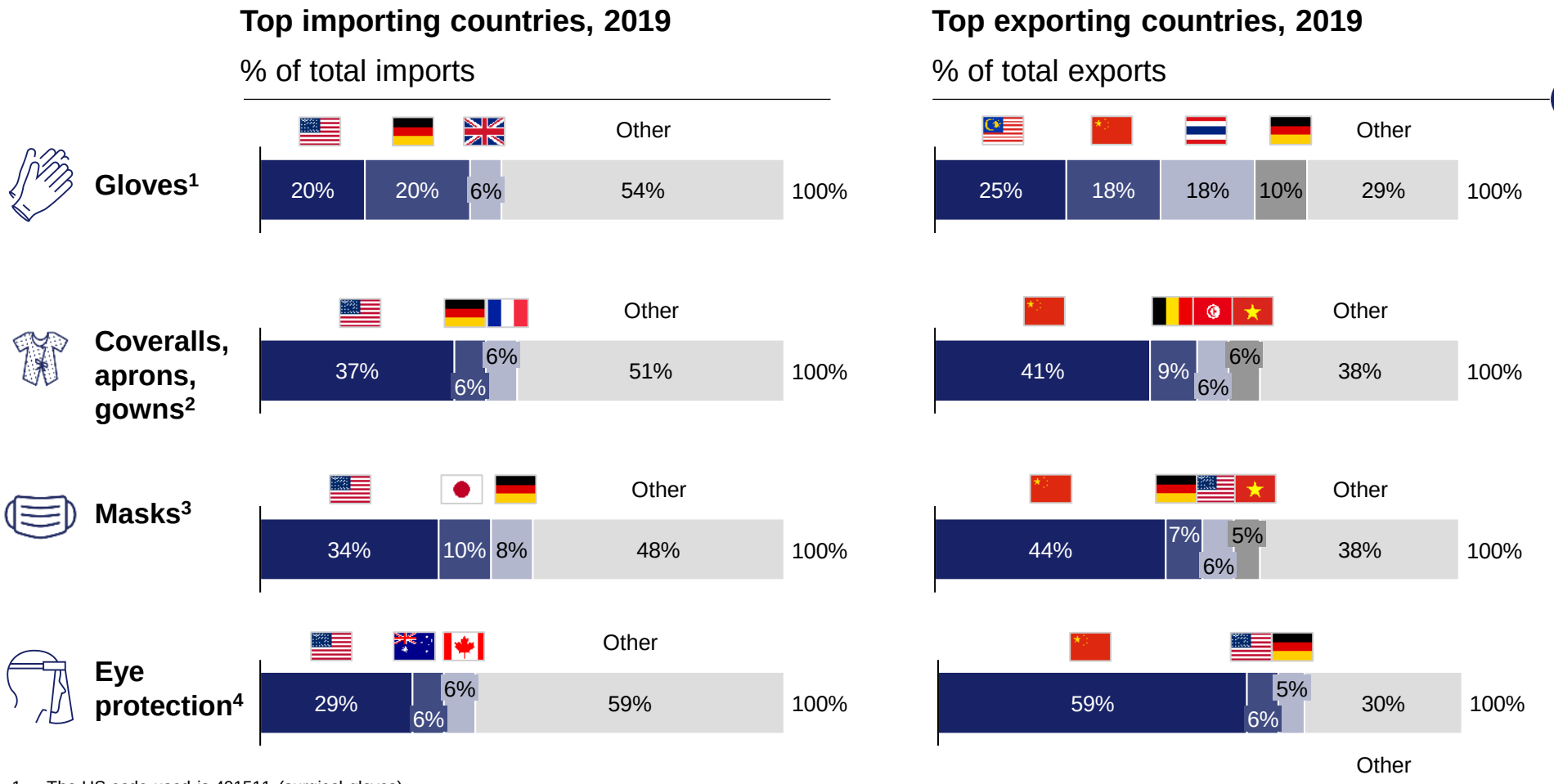


1. Figures by the Malaysian Rubber Glove Manufacturers Association (MARGMA)
2. In 2019, respirators accounted for ~60% of the medical masks market and surgical masks accounted for ~40%, according to interviews with industry experts

Source: Mordor Intelligence (updated in November 2020), Statista Research Department, Industry experts interviews (November 2020), Malaysian Rubber Glove Manufacturers Association (MARGMA)

1| Despite a relatively high level of concentration in global PPE production, there is significant interdependence in trade of medical PPE

SELECTION OF MEDICAL PPE CONSIDERED – NON-EXHAUSTIVE



Key insights

Despite global **PPE exports being concentrated** (the top 5 countries account for ~50% of exports), there is a **strong interdependence** in PPE trade: every country depends on another for at least one PPE type

The biggest PPE **exporters have themselves been severely hit by COVID-19**, pushing governments to **impose export restrictions** impacting the entire world

1. The HS code used is 401511 (surgical gloves)
2. The HS code used is 621010 (garments made up of felt or non-wovens) and may not consider exclusively medical coveralls, aprons, and gowns
3. The HS code used is 630790 (made-up articles of textile materials) and considers broader categories of goods in which masks are included
4. The HS code used is 900490 (Spectacles, goggles and the like, corrective, protective, or other) and considers broader categories of goods in which face shield and medical googles are included

Source: ITC Trademap, OECD

1| While global leaders still represent ~40% of the market, local/specialty players have emerged in both direct sales and contract manufacturing

ONLY MEDICAL PPE CONSIDERED – NON-EXHAUSTIVE

Type of player		Description	Geographical footprint	Preferred distribution channel	Examples of players (non-exhaustive)
Manufacturing	**Global leaders** (~40% of the market)	Large players supplying a **broad range of PPE** (without necessarily manufacturing them all)	Manufacturing facilities **across the world** to support different requirements and standards across regions	Distribution through **major and well-established distributors** across the world	3M, DuPont, Honeywell, Kimberly-Clark Professional
	Local players	Mid-sized players supplying **a limited range of PPE** and relying strongly on partnerships	Manufacturing facilities in usually just **1 country or region**	Distribution through **distributors** or through **large manufacturers (CM)**[1]	Dräger, Sundström
	Specialty players	Mid-sized players supplying **a single PPE type** (e.g. gloves)	Manufacturing facilities in usually just **1 country or region**	Distribution through **retailers** across the world or through **large manufacturers (CM)**[1]	Top Glove, Cardinal Health, Showa, Ansell
Distribution[2] **(to end user)**	**Distributors** (~60% of market)	Largest distribution channel – usually specialized in pharma and medical supplies			McKesson, Medline
	E-commerce (~25% of market)	Growing distribution channel, allowing distributors to better serve customers			amazon, Alibaba.com
	Key accounts (~15% of market)	Major hospitals and companies who purchase PPE directly from manufacturers			

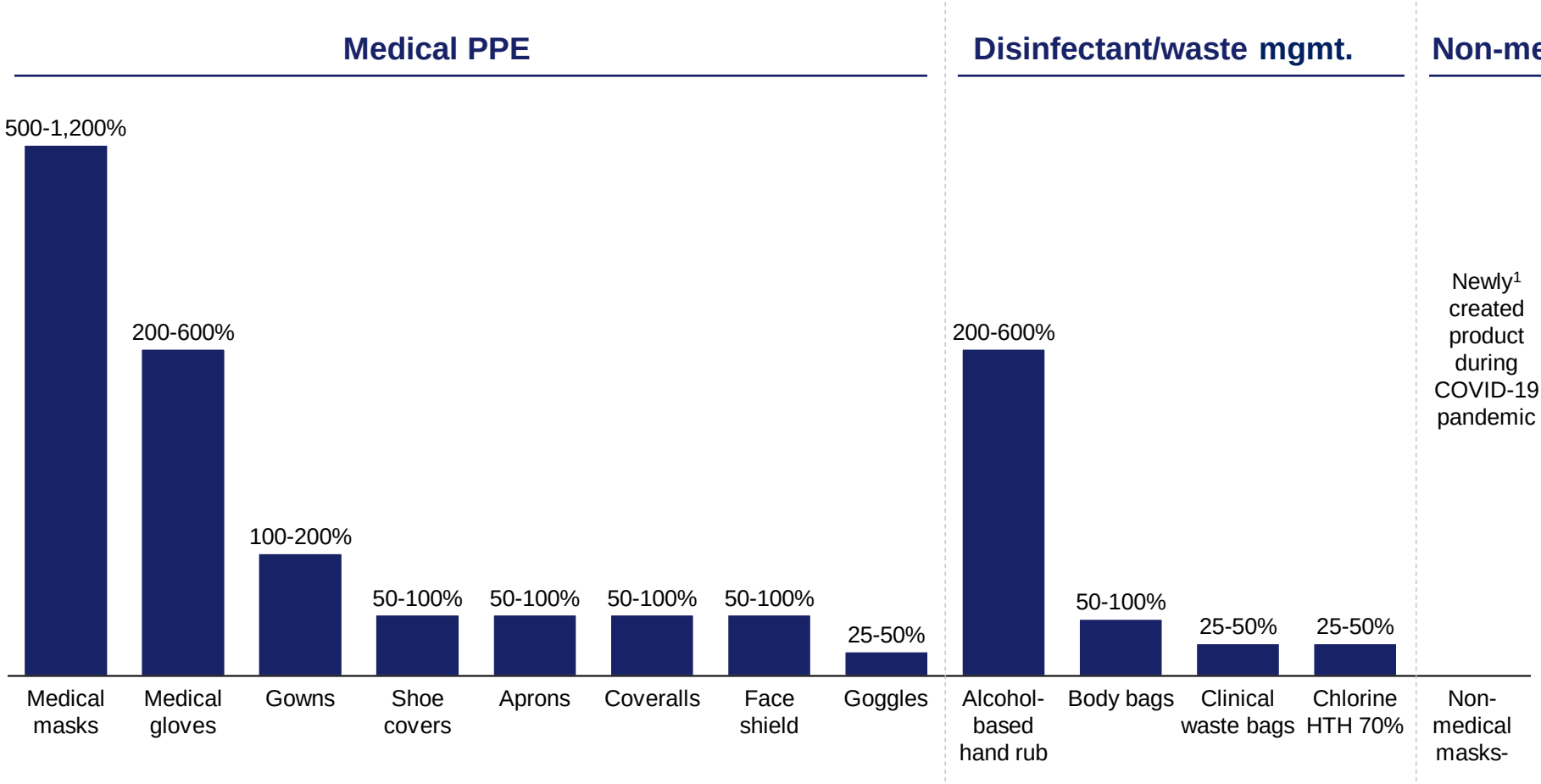
1. Contract manufacturing – local players and specialty players sometimes supply to large manufacturers who then brand with their own name
2. Governements managed very small distribution channels pre-crisis but grew rapidly during the pandemic

Source: interviews with experts (November 2020), press search

2| COVID-19 triggered a huge surge in global PPE production: medical mask manufacturing spiked by as much as 1,200%

NON-EXHAUSTIVE – DIRECTIONAL ESTIMATES BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020

Estimated peak increases in global production during the COVID-19 crisis, %



> Global PPE production capacity has at least trebled during the COVID-19 crisis
>
> **– former General Manager of leading PPE manufacturer**

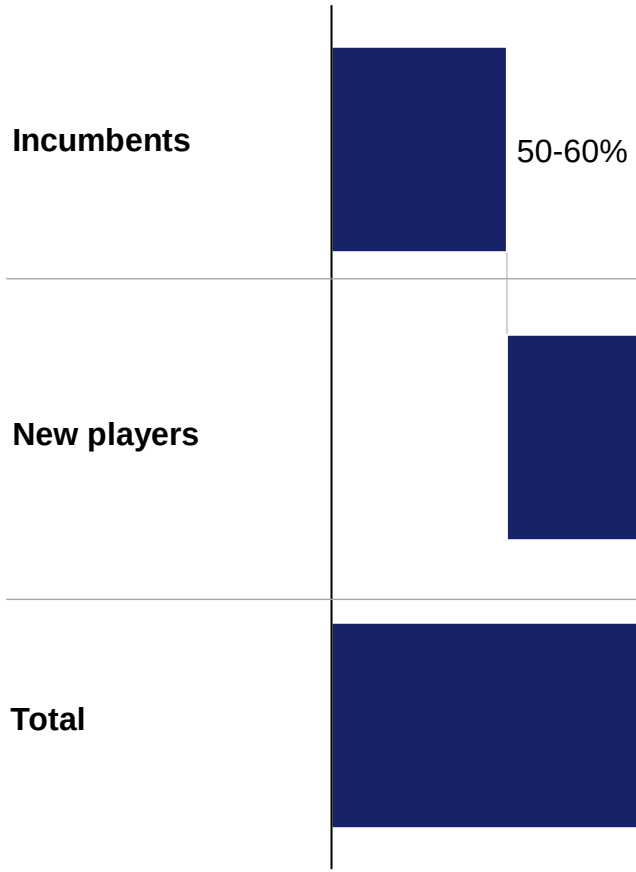
1. Production pre-COVID-19 was negligible compared to current production

Source: Industry experts interviews (November 2020), press search

2| Around half of this surge in production capacity was delivered by incumbents and the other half came from new entrants to the market

NON-EXHAUSTIVE AND ILLUSTRATIVE – ESTIMATES BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020

Share of new production capacity added during COVID-19 pandemic, estimates



Examples (non-exhaustive)

- **3M** increased its PPE production by 3x
- **DuPont** doubled its production of gowns
- **Top Glove** increased its production by ~20%

2 types of new players: companies in adjacent industries converting their production capacities, and new local players

- **Ford** started producing 200k gowns/week repurposing airbag material
- **National Safety Apparel** started producing 1.5m face masks a week

Main insights from interviews

Most incumbents consider their capacity addition to be temporary, as most have either increased their utilization or deployed idle machine/production lines

New players have invested in new machinery and equipment but only earned acceptable returns on their investment due to surges in market price

A significant part of this production surge has come from targeting new customer segments beyond health systems (e.g. consumers, non-healthcare workers)

Before COVID-19, 90% of medical PPE was targeted at health system customers, but currently it is closer to 50% being sold to medical customers and 50% to non-medical customers

– former Life Safety Product Manager at leading PPE manufacturer

Source: Industry experts interviews (November 2020), press search

2| Increased PPE market prices have allowed new entrants to achieve significant returns on their investment

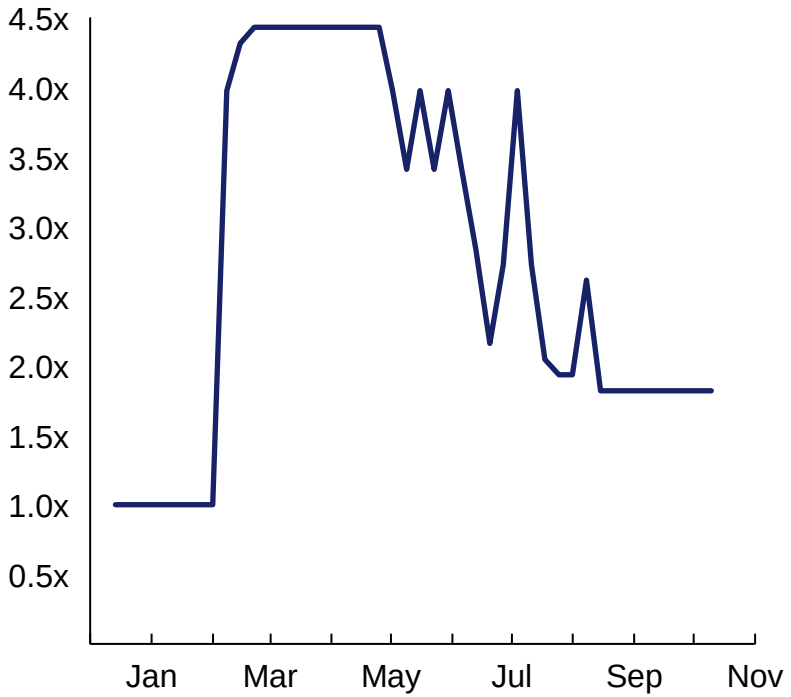
NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF NOVEMBER 2020

Selected UK PPE unit prices

Type of PPE	2019 (Feb-Jul)	2020 (Feb-Jul)	Change
Face masks	£0.11	£0.40	3.6x
Respirators	£0.94	£2.51	2.7x
Gowns and overalls	£0.33	£4.50	13.8x
Gloves	£0.02	£0.12	6.2x
Eye protection	£0.60	£1.82	3.0x
Hand hygiene	£1.12	£6.14	5.5x

Price for face mask product on Amazon.com

(illustrative example, compared to January 2020)



Main insights

During the pandemic, PPE unit prices dramatically increased before dropping to a level which remains above pre-crisis level (as of end-November 2020)

"

[…] prices for PPE may remain high, up to 4x the costs for masks and gloves in January

– CFO of a US healthcare network, November 2020

"

Due to high prices, new players who've invested in equipment and machinery are experiencing a high ROI and will probably take the money and get out of the market once the pandemic is gone

– PPE expert, November 2020

Source: UK National Audit Office, "The supply of personal protective equipment (PPE) during the COVID-19 pandemic", 25 November 2020; https://3cmls.co/US/B07VGKQ1PV

2| Conversely, quality issues have arisen because of accelerated testing processes, limited testing capacity and fraud

NON-EXHAUSTIVE AND ILLUSTRATIVE

Representative testing approach and standards for N95 masks

Approach

Test of finished goods

Raw material testing	In-line inspection	Sample testing before shipment	Sample testing in laboratory
Steps to ensure quality of non-woven fabric inputs	Automated optical or manual inspection before packaging		

Test equipment manufacturers (examples)

- TSI: Automated-filter tester (e.g. TSI 8130A), most commonly used by manufacturers
- Air Techniques International: Protective Mask Leakage Tester (PMLT) for full design testing of masks or 100X Automated Filter Tester

Test standards

- Filtration efficiency standard is set by multiple regulatory agencies: US NIOSH-42CFR84; Europe EN 149-2001; China GB2626-2006; Japan JMHLW-2000 JIS T8150: 2006; others as equivalent according to CDC guidance
- Other testing criteria, such as bacterial filtration efficiency, pressure drop and microbial limit may be considered for regulatory approval
- In-line testing for mask design can be carried out by optical inspection systems

Main insights from interviews

During the COVID-19 crisis, quality issues have arisen due to 3 main factors

- Compressed testing procedures to accelerate delivery time, with some steps skipped (e.g. sample testing)
- Limited testing capacities (the TSI machines were a particular constraint) and use of less efficient alternative methods
- Fraudulent behaviors by manufacturers who labelled their products as finished despite not passing tests

> Researchers at ECRI […] found that 60-70% of imported N95 masks do not filter 95% of aerosol particulates, contrary to what their name suggests
>
> **– ECRI, 22 September 2020**

> Smaller new players usually achieve lower end quality and target less quality-sensitive PPE (e.g. shoe covers)
>
> **– former Life Safety Products Manager of leading PPE manufacturer**

Source: press search, interviews with industry experts (November 2020), ECRI (Emergency Care Research Institute)

2| In order to enhance autonomy, governments have actively supported local manufacturers in increasing their capacity

NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF MID-DECEMBER 2020

Country/region	**Examples of government interventions** (non-exhaustive)
 **India**	In June 2020, the government **relaxed manufacturing standards for PPE makers** to enable more of them to be brought within the scope of the Bureau of Indian Standards (BIS) product certification scheme, which will in turn result in a **greater quantity of BIS-certified PPE being made available to users**
 **China**	The government has introduced measures to support production of face masks by helping with raw materials purchasing and hiring of workers as well as offering tax breaks for manufacturers
 **US**	In July 2020, the US Department of Commerce's National Institute of Standards and Technology (NIST) awarded a total of $**50m in emergency funding** to help **manufacturers increase PPE production**, reach new suppliers and recover from supply chain interruptions
 **Morocco**	The government has mobilized funds to support mask production, resulting in ~20 textile plants repurposing their production capacity
 **European Union**	The European Commission has temporarily waived customs duties and VAT on the import of medical devices and protective equipment from third party countries into member states

"[…] a study by Ministry of Health and Family Welfare (MoHFW) undertaken in February-March for understanding the gaps in the existing infrastructure, resources, and overall for end-to-end production, testing and packaging of the PPE kits as per the WHO quality standards […] MoHFW then focused on developing a PPE supply chain, getting special approvals […], facilitating interstate logistics, streamlining international coordination and enabling round-the-clock support to the manufacturers on operational issues

– Press article (The Economic Times), October 2020

"We have built robust and resilient supply chains from scratch and thanks to an absolutely phenomenal effort from UK businesses, almost three-quarters of demand for PPE will soon be met by UK manufacturers

– UK Health Minister (Matt Hancock) September 2020

Source: Asian Development Bank, European Commission, Press Search

3| The increase in capacity has put the PPE supply chain under pressure, especially with regards to raw materials

NON-EXHAUSTIVE – BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020

Focus of next pages | High supply pressure | Medium supply pressure | Low supply pressure

Mapping of bottlenecks along the PPE value chain

Most pressure → *Least pressure*

Value chain	Respirators	Medical gloves	Surgical masks	Disposable gowns	Alcohol-based hand rub	Coveralls	Shoe covers	Body bags	Aprons	Chlorine HTH 70%	Clinical waste bags	Goggles	Face shield	Cloth masks
Raw materials sourcing	Shortage of melt-blown non-woven	Pressure on nitrile	Shortage of melt-blown non-woven	Pressure on non-woven and composite fabric	Shortage of alcohol	Pressure on non-woven and composite fabric	Pressure on non-woven and composite fabric	Pressure on PU, PVC, HDPE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Manufac-turing[1]	Pressure on labour	Machinery lead time of 1 year	Pressure on labour	Pressure on labour	Pressure on labour	Pressure on labour	Pressure on labour	Pressure on labour	Pressure on labour	n.a.	n.a.	n.a.	n.a.	n.a.
Distribution	• Trade restrictions forced a couple of countries to stop exporting PPE, putting pressure on importers who were compelled to build local capacity • Disruptions of transport and logistics have made delivery of PPE to final customers more complicated and resulted in delays even at domestic level													

1. High pressure on manufacturing usually comes from technology solutions with machines manufactured by very few players over long lead times

Source: Industry experts interviews (November 2020), Asian Development Bank

3| For respirators, supply pressure arises mainly from shortages of melt-blown non-woven, a critical ingredient

NON-EXHAUSTIVE – BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020
SEE APPENDIX FOR DETAILED DEEP-DIVE ON THE MELT-BLOWN MARKET

Highly supply pressure | Medium supply pressure | Low supply pressure

Respirators have 6 components with 3 layers of protection

- **Nose clip**
- **Exhalation valve**
- **3 layers: middle layer of melt-blown fabric**
- **Inside and outside layer of non-woven fabric**
- **Elastic head/ear band**

Respirators and surgical masks have a similar production process, with 2 differences (enhanced filtering through high efficiency melt-blown and one of the layers passing through high temperature)

Value chain step	Description	Reasons for supply pressure (non-exhaustive)
Raw materials	**2 main raw materials** • Spunbond non-woven fabric (for inner and outer layers) • Melt-blown fabric (for the middle layer)	High **pressure on melt-blown non-woven fabric** due to • Limited number of players in the high quality melt-blown industry • Limited access to polymer inputs • Production capacity constraints
Manufacturing	**3 steps in manufacturing** • Assembly • Sterilization and testing • Packaging	• Pressure on labour (reinforced by social distancing requirements in plants)
Distribution	**4 major sales channels** • Distributors • Government agencies • Private hospitals • Retail sales	• Establishment of temporary trade restrictions and export bans by some countries during pandemic • Transport and logistics disruption

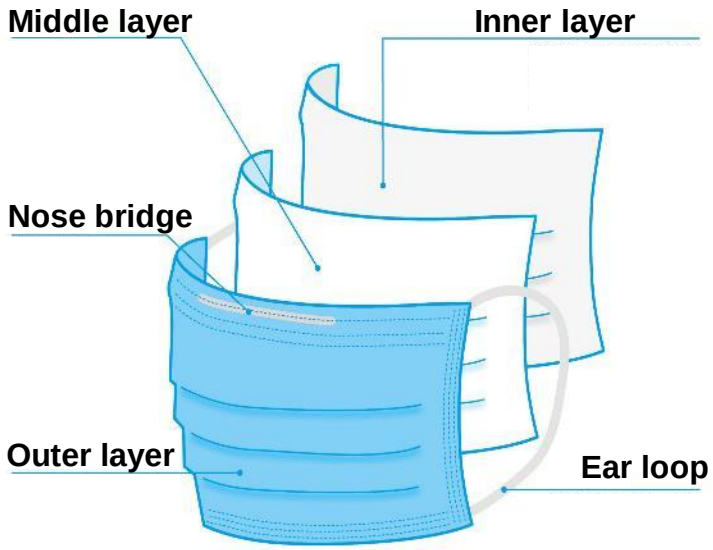
Source: Industry experts interviews (November 2020)

3| For surgical masks, supply pressure also arises mainly from shortages of melt-blown non-woven

NON-EXHAUSTIVE – BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020
SEE APPENDIX FOR DETAILED DEEP-DIVE ON THE MELT-BLOWN MARKET

High supply pressure | Medium supply pressure | Low supply pressure

Medical masks have 5 components with 3 layers of protection



Value chain step	Description	Reasons for supply pressure
Raw materials	**2 main raw materials** • Spunbond non-woven fabric (for inner and outer layers) • Melt-blown fabric (for the middle layer)	High **pressure on melt-blown non-woven fabric** due to • Limited number of players in the high quality melt-blown industry • Limited access to polymer inputs • Production capacity constraints
Manufacturing	**3 steps in manufacturing** • Assembly • Sterilization and testing • Packaging	• Pressure on labour (reinforced by social distancing requirements in plants)
Distribution	**4 major sales channels** • Distributors • Government agencies • Private hospitals • Retail sales	• Establishment of temporary trade restrictions and export bans by some countries during pandemic • Transport and logistics disruption

Source: industry expert interviews (November 2020)

3| For gloves, supply pressure is driven by both shortages of nitrile and scarce specialist manufacturing capacity

NON-EXHAUSTIVE – BASED ON INTERVIEWS WITH INDUSTRY PLAYERS, AS OF MID-DECEMBER 2020

High supply pressure | Medium supply pressure | Low supply pressure

Gloves can have different components

Latex or nitrile

Value chain step	Description	Reasons for supply pressure
Raw materials	**2 main raw materials** • Latex • Nitrile	**Pressure on nitrile** as the world is highly dependent on Malaysia, which handles the majority of nitrile production
Manufacturing	**3 steps in manufacturing** • Production • Quality control • Packaging	**Limited production capacity (highly automated and complex production line)** due to • High investment requirement • Plant constraints (it takes up to 18 months to build a production line) • Air-controlled environment required to meet quality standards of many countries
Distribution	**4 major sales channels** • Distributors • Government agencies • Private hospitals • Government agencies	• Establishment of temporary trade restrictions and export bans by some countries during pandemic • Transport and logistics disruption

Source: Industry experts interviews (November 2020), press search

Contents

Modelling of global PPE demand for 2020-25

A **Demand for PPE for 2020-25 is forecast across 5 main demand segments** – non-COVID-19-related usage, hospitals and clinics, immunization, workforce (non-healthcare) and the general public. **Each demand segment includes different products** (medical PPE, non-medical PPE, and disinfectant products and biological waste management)

- **Business as usual demand** is a projection of 2019 figures[1] at an adjusted growth rate through to 2025
- **Demand from hospitals and clinics as well as from immunization campaigns** is modelled until end-2022 based on regional vaccination scenarios with different coverage and efficacy rates; for each region, this demand is driven by the number of hospital days and vaccinated people, the daily number of healthcare workers and other staff[2] per patient, and PPE usage rate among healthcare workers and other staff[2]
- **Demand from the non-healthcare workforce and the general public**, estimated until 2025, is highly sensitive to regional inputs such as return to work timelines, adoption rate (percentage of people wearing PPE) and usage rate (volume of PPE used per day), especially for regions with larger populations

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B **Global demand for PPE is estimated to have increased by 300-400% between 2019 and 2020[1]. This peak is expected to be sustained in 2021 driven by demand among consumers and non-healthcare workers. Demand from both these groups should fall by 2022, and as a result overall demand, growth rates and product mix may return to historic levels.**

- While surgical masks are expected to account for ~40% of global demand in 2021 (125-160bn units), it could drop by ~85% in 2025 (20-25bn units) due to expected herd immunity and the associated decline in the use of PPE among non-healthcare workers and the population at large
- The trajectory is somewhat different for gloves. While the spike in peak demand for gloves in 2021 may be lower than for other categories (a jump of 120-180% between 2019 and 2021), the category will remain a strong driver of overall PPE market growth through 2025 (115-165bn units, i.e. ~60% of total demand)

C **While North America was the primary consumer of PPE in 2017-19** (~30% of total demand in 2019), **Asia may take over this position by 2025. Indeed, Asian countries are estimated to account for ~40% of total 2025 demand due to continuing use of PPE by consumers and non-healthcare workers**

- By 2021, Asian countries could account for ~70% of global demand for surgical masks, driven by their large population and high (~60-80%) adoption rate
- By 2025, PPE demand is expected to be dominated by gloves in Western countries and Africa (~70%). In Asia, the higher demand for surgical masks (15-25% in Asia vs. 5% in Western countries and Africa) suggests gloves may account for only ~55-65% of total demand for PPE

1. Based on historic market data adjusted for impact of COVID-19 (e.g. cancellation of elective surgeries)
2. Including cleaners, ambulance, and biomedical engineers

Source: interviews with public health experts (November-December 2020), Mordor Intelligence, Press search, Governments official statements, WHO, ILO, World Bank, YouGov

Contents

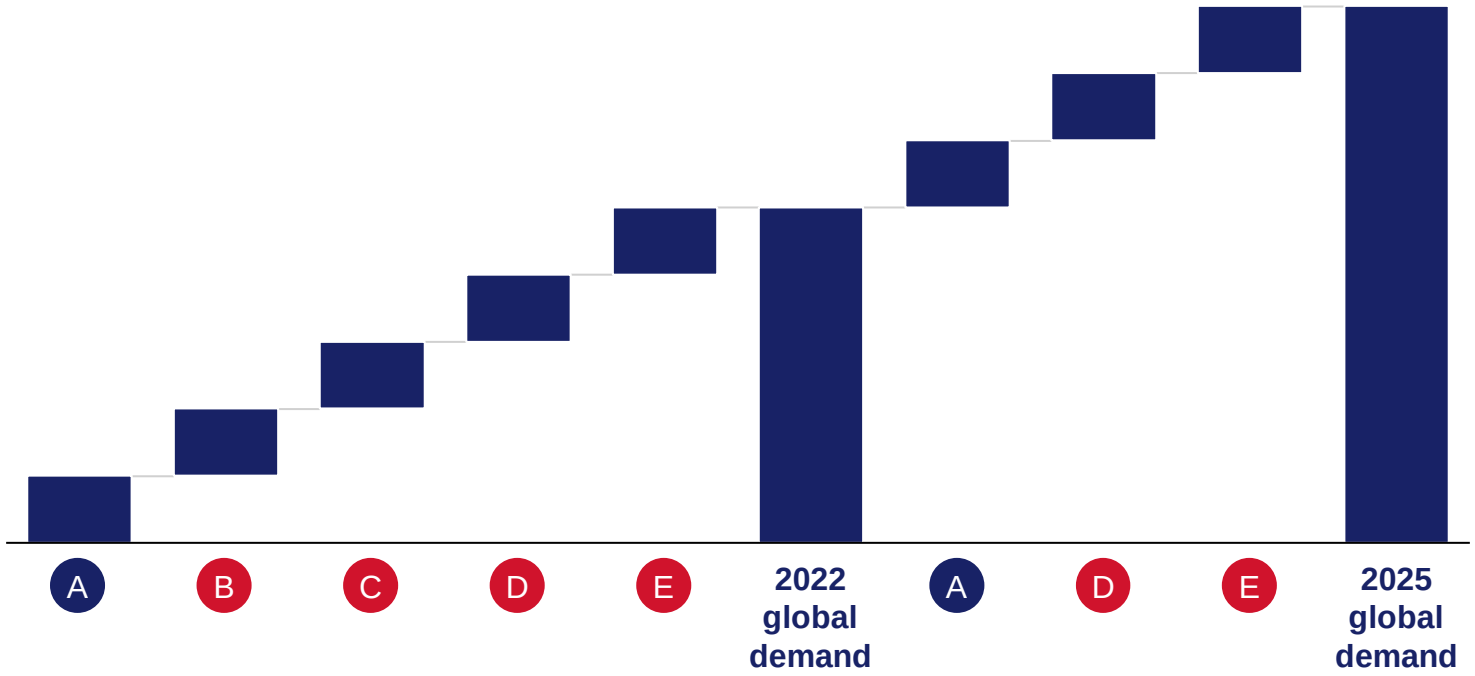
We identified 5 main segments of global PPE demand over the next 5 years

Demand combining business as usual and COVID-19-driven demand

CONCEPTUAL – DUMMY NUMBERS

X Non-COVID-19-related segment X COVID-19-related segment

Development of global demand for PPE and disinfectant/waste management products[1], 2019, 2022, and 2025, bn units



Global demand for PPE can be divided into 5 main segments

A **Non-COVID-19 usage**: business as usual demand, based on historic 2019 market reports, and adjusted for impact of COVID-19 (e.g. cancellation of elective surgery)

B **Hospitals and clinics**: demand driven by hospitalisations due to COVID-19

C **Immunization**: demand driven by COVID-19 vaccination campaigns

D **Non-healthcare workers**: demand from non-healthcare workers returning to work, depending on activity type

E **Consumers**: demand from the general public for daily activities

Out of these drivers, B and C are expected to last until Q4 2022, while A, D, and E may continue to grow until Q4 2025 due to (i) natural baseline growth and (ii) potential enduring habits in PPE use among non-healthcare workers and the general public

1. PPE and disinfectant/waste management products refer to the following: surgical masks, respirators, aprons, gowns, coveralls, eye protectors, gloves, body bags, cleaning equipment, clinical waste bags, shoe covers and cloth masks

Source: interviews with public health experts (November-December 2020), Mordor Intelligence (updated in November 2020), EpiModel, WHO, ILO, World Bank, YouGov, press search, official government statements

Each demand segment includes different products

Product mapping by demand segment

X Non-COVID-19-related segment X COVID-19-related segment ✓ Included in demand assessment

	Medical PPE								Non-med. PPE	Disinfectant products/biological waste management			
	 Surgical masks and respirators	 Gowns	 Aprons	 Coveralls	 Goggles	 Face shield	 Medical gloves	 Shoe covers	 Cloth mask	 Body bags	 Clinical waste bags	 Chlorine HTH 70%	 Hand sanitizers
A Non-COVID-19 usage	✓	✓	✓	✓	✓	✓	✓	✓					
B Hospitals and clinics	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
C Immuniza-tion	✓	✓				✓	✓						✓
D Workforce	✓					✓	✓						✓
E Consumers	✓						✓		✓				✓

Source: WHO standards, review of official government recommendations, interviews with experts (November-December 2020)

We have estimated each segment's demand with a separate methodology and have used of a wide range of sources

Methodologies used to estimate each demand driver

SEE NEXT PAGES FOR FURTHER DETAILS ON EACH SEGMENT'S METHODOLOGY AND ASSUMPTIONS

X Non-COVID-19-related segment X COVID-19-related segment

Segment	Overall methodology	Most important independent variables	Sources	Impact timeline 2022	Impact timeline 2025
A **Non-COVID-19 usage**	Use of **historic market data** to derive baseline demand Projection of 2019 figures at an **adjusted growth rate compared to historic growth rate through to end-2025**	Projected growth rate during 2020-25 – **2 scenarios** • **Historic growth of -2%** to account for the fact that the market has reached a critical size • **Historic growth of +1%** to account for potential changes in usage habits	Mordor Intelligence, Market report, November 2020 Interviews with experts (November-December 2020)		✓
B **Hospitals and clinics**	Projection of **hospitalisation days** due to COVID-19 in each region up to Q4 2022 Conversion of hospitalisation days into **number of healthcare workers** (regional data of HCW/bed) and then into **PPE usage** (global WHO norms)	Vaccine scenarios for each region – **2 main variables** • **Efficacy**: from 60% to 95%, i.e., range of modern technology (e.g. Pfizer) vs. older one (e.g. AZ) • **Coverage**: from 30% to 70%, accounting for government's regulation, public reluctance, logistics difficulties and funding constraints	McKinsey EPI model WHO and World Bank database Interviews with 15+ global public health experts	✓	
C **Immuniza-tion**	Projection of **immunized population per region up to Q4 2022** Conversion of immunized population into **healthcare workers** and **PPE usage**	Vaccine scenarios (see above)	Government and corporate public statements	✓	
D **Workforce**	**Segmentation of each region's workforce** by type of job (physicality and level of interaction) Ramp-up of **% of workers back to work** from Q2 2020 to Q4 2022 By type of worker and for each PPE, **assumptions about adoption rates** (scale-down for each region from Q4 2020 to Q4 2022) and usage rate (assumed standard for all regions)	Adoption rates by archetype • **Current adoption rates** from 1%-100% depending on region and PPE • **New normal adoption rates** (from Q4 2022 onwards) assumed as 0%-10%	ILO Interviews with experts		✓
E **Consumers**	**Segmentation of each region's population** by age group By age group and for each PPE, assumptions about **adoption rates** (scale-down for each region from Q4 2020 to Q4 2022) and usage rate (assumed standard for all regions)	Adoption rates by age group • **Current adoption rates** from 1%-80% depending on region • **New normal adoption rates** (from Q4 2022 onwards) assumed as 0%-10%	YouGov Interviews with experts		✓

Source: WHO guidelines, review of official government recommendations, interviews with experts (November-December 2020), Mordor Intelligence

A| We have modelled baseline demand using historic market reports and adjusted for the impact of COVID-19

METHODOLOGY **SEE APPENDIX FOR DETAILED FIGURES**

	Breakdown of baseline demand	Sources used	Country data[1]	Regional data	Global data
Unadjusted historic PPE demand	**Historic annual market in value**	Mordor Intelligence		✓	
	Pre-COVID-19 cost per PPE	UK National Audit Office analysis of Department of Health & Social Care data			✓
	Historic annual market in volume				
Adjustment for impact of COVID-19	**% hospital visits requiring at least 1 surgical intervention**	Scientific reviews			✓
	% elective surgery	Scientific reviews			✓
	% decrease in elective surgery	Duluth News Tribune 2020			✓
	2020 baseline demand				

For the purpose of this exercise, we used UK prices[2] as an estimate of global prices but price variations can be observed at country level

For the purpose of this exercise, we used US data[3] as a standard but discrepancies can be observed at country level

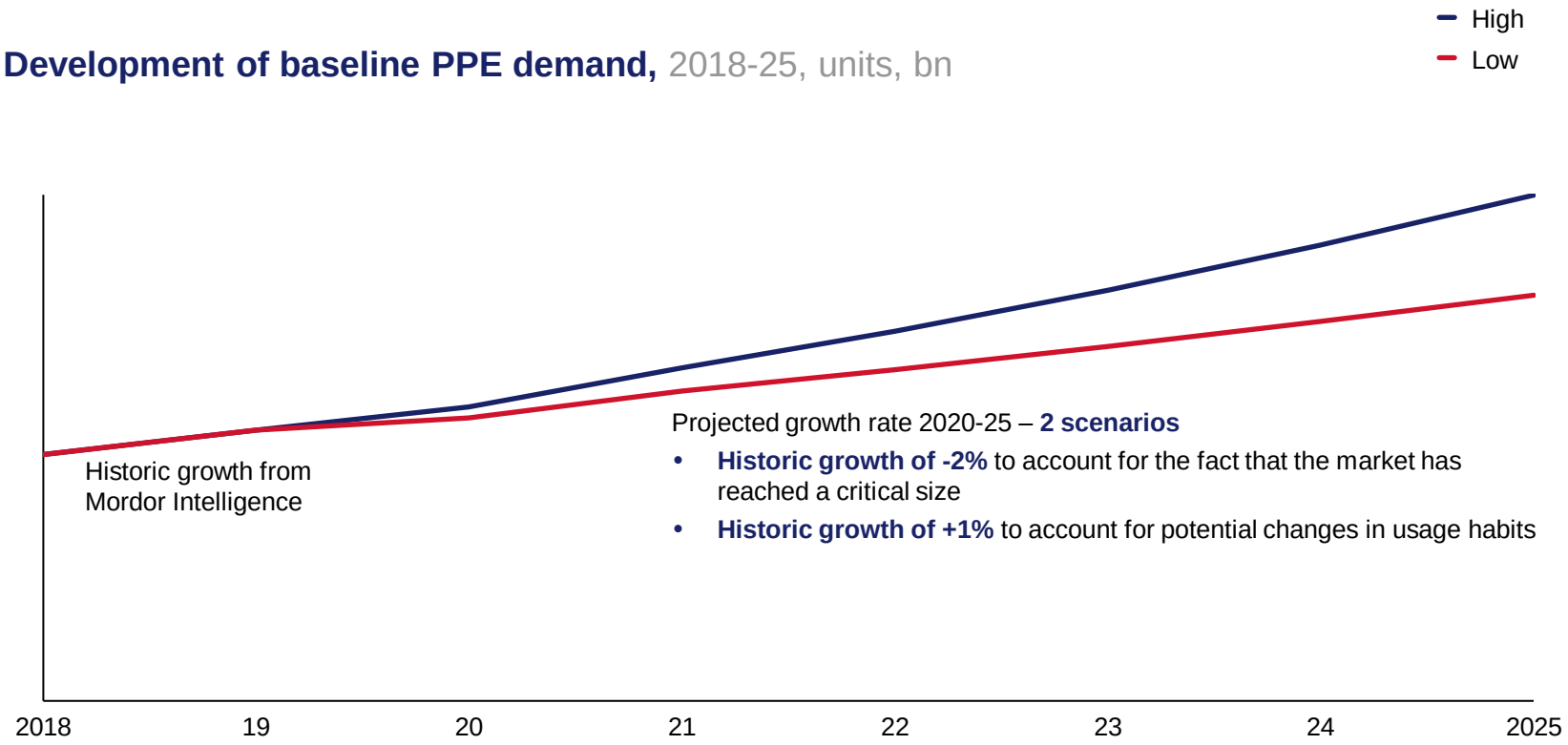
1.The EPI model is built at country-level but for the purpose of this exercise, we aggregated at regional level; 2. Including cleaners, ambulance personnel and biomedical engineers
2.UK Department of Health & Social Care data for 2019 prices
3.Research paper on elective surgery based on US data (2014 and 2018)

Source: Mordor Intelligence (updated in November 2020), “Emergency-to-Elective Surgery Ratio: A Global Indicator of Access to Surgical Care”, Prin et al., 2018, “Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals”, McDermott et al., 2014, Duluth News Tribune

A| Baseline projected growth rate has been indexed against historic growth rate

CONCEPTUAL – DUMMY NUMBERS

Development of baseline PPE demand, 2018-25, units, bn



End user market and product mix ratios are assumed **consistent over time**

Source: Mordor Intelligence (updated in November 2020), “Emergency-to-Elective Surgery Ratio: A Global Indicator of Access to Surgical Care”, Prin et al., 2018, “Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals”, McDermott et al., 2014, Duluth News Tribune

B| Health system PPE demand by 2022 is estimated by modelling the number of hospitalisations

METHODOLOGY **SEE APPENDIX FOR DETAILED ASSUMPTIONS ON NUMBER OF HEALTHCARE WORERS AND OTHER STAFF BY BED AND THEIR DAILY PPE USAGE RATE**

● Focus of the next page

Breakdown of clinic and hospital demand	Source used	Country data[1]	Regional data	Global data
Quarterly number of hospital days due to COVID-19	McKinsey EPI models	✓		
Healthcare workers and other staff[2] by bed	World Bank database		✓	
Usage rate per PPE per patient, healthcare workers and other staff[2]	Global WHO norms			✓
Quarterly PPE usage by hospitals and clinics				

For the purposes of this exercise, we used global WHO norms but in a country-level exercise, these could be adjusted to reflect local clinical data/local observations

1. The EPI model is built at country-level but for the purposes of this exercise we aggregated at regional level
2. Including cleaners, ambulance personnel and biomedical engineers

Source: WHO, EPI model, official government statements, pharmaceutical companies' official statements, interviews with experts (November-December 2020)

B| Regional hospitalisation trajectories by 2022 are driven by local variations in vaccination efficacy and coverage

METHODOLOGY **SEE NEXT PAGES FOR FURTHER DETAILS ABOUT PRELIMINARY KNOWLEDGE REGARDING VACCINE EFFICACY AND COVERAGE**

Independent variables	Description	Major regional factors influencing the variables	Main sources used
Vaccine efficacy 	Efficacy is the performance of the vaccine **under ideal and controlled circumstances** (i.e., published results of clinical trials) In real-world conditions, achieved efficacy (i.e., effectiveness) **can be lower**	**Access to different vaccine types** (e.g. 95% for Pfizer-BioNTech and Moderna vs. 70% for AstraZeneca)	Results from Phase 3 COVID-19 vaccine trials Expert interviews
Vaccine coverage 	Coverage is the **proportion of the total population** who receive a COVID-19 vaccine	**Government policies** for enforcing vaccine usage **Public reluctance** at being immunized **Existing supply contracts**/ bilateral agreements to secure vaccine procurement **Global production capacity**	Duke University Ipsos global consumer survey Expert interviews

Implications for the demand model

We built **regional vaccination scenarios**, adjusting both efficacy and coverage for the different regions, in turn depending on 2 main factors

- A**ccess to the different vaccines**, including potential financial difficulties in purchasing the most expensive vaccines
- **Logistics constraints** (e.g. large populations, lack of or limited ultracold chain)

For each region, we triangulated the modelled demand in doses with **national procurement commitments** (bilateral agreements and COVAX) and **global production capacity** for each[1]

These scenarios also assumed the following technicalities

- **12-month ramp-up** from regulatory approval to maximum coverage
- **Infinite** vaccine-induced immunity duration
- **Equal vaccine distribution** across age groups

1. The production capacity of AstraZeneca, Pfizer and Moderna are estimated at ~5.3bn doses in 2021, which could cover ~2.6bn people

Source: EPI model, interviews with public health experts (November-December 2020), official statements from vaccine manufacturers (as of December 9, 2020)

B| Preliminary studies from vaccine manufacturers suggest an efficacy range from 70% to 95%

Overview of available data on Phase III trials of select COVID-19 vaccine candidates

NON-EXHAUSTIVE – AS OF NOVEMBER 30, 2020

	moderna	Pfizer BIONTECH	AstraZeneca
MoA	mRNA	mRNA	Viral vector
Dose schedule	2 doses, 4 weeks apart	2 doses, 3 weeks apart	2 doses, 1 month apart
Efficacy target	60%	60%	60%
Efficacy in clinical trial	94.5%	95%	70%[1]
Thermostability	-20ºC shipped/stored for 6 months; 2-8ºC for 30 days	-70ºC shipped/stored for 6 months; 2-8ºC for 5 days	2-8ºC, normal cold chain
Announced manu-facturing capacity	30m doses by end-2020 1bn doses in 2021	50m doses by end-2020 1.3bn doses in 2021	3bn doses in 2021
Pricing	~$20 per dose	$10-50 per dose	$3-4 per dose

1. 3 efficacy levels reported from the trial – an overall efficacy of 70%, a lower one of 62% and a high of 90%

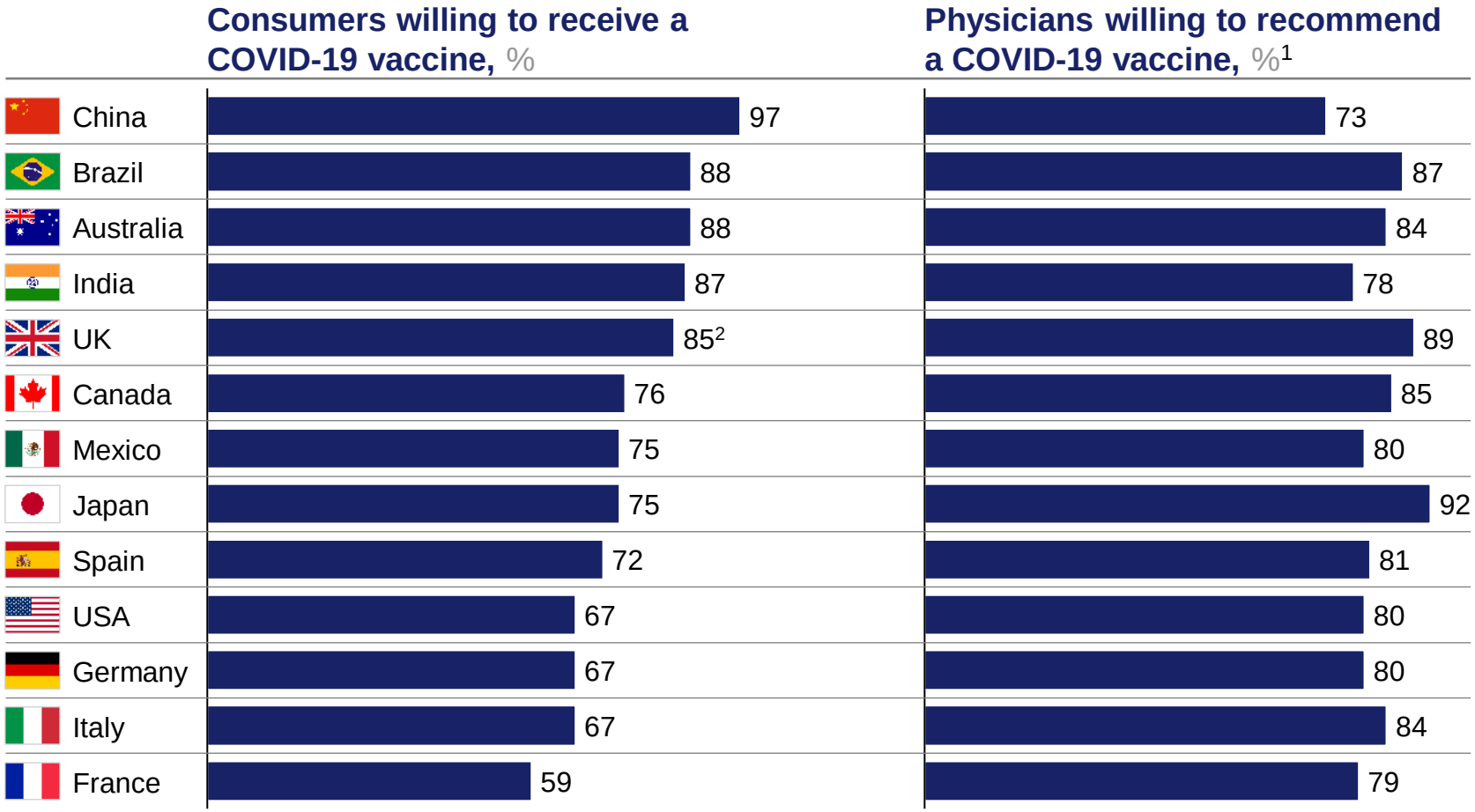
Source: clinicaltrials.gov, Moderna press release, Pfizer, AstraZeneca, The Guardian, press search

mRNA vaccines come with potential supply chains constraints: -20°C to -70°C temperature requirements make their distribution challenging for some developing countries

AstraZeneca has pledged to provide the vaccine on a not-for-profit basis for the “duration of the pandemic” and in perpetuity to low- and middle-income countries

B| To achieve full vaccine coverage, some consumer resistance headwinds must be overcome…

NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF AUGUST 24, 2020



1. Based on a vaccine profile with 70% efficacy, moderate safety profile, 12 months duration of immunity, 2-dose regimen, novel platform technology (e.g. DNA/RNA vaccine), 9 months since first patient dosed in trials and established pharmaceutical manufacturer

Source: Ipsos global consumer survey, July-August 2020, Sermo COVID-19 global physician survey, August 2020 (includes GPs and specialists, n=1,837)

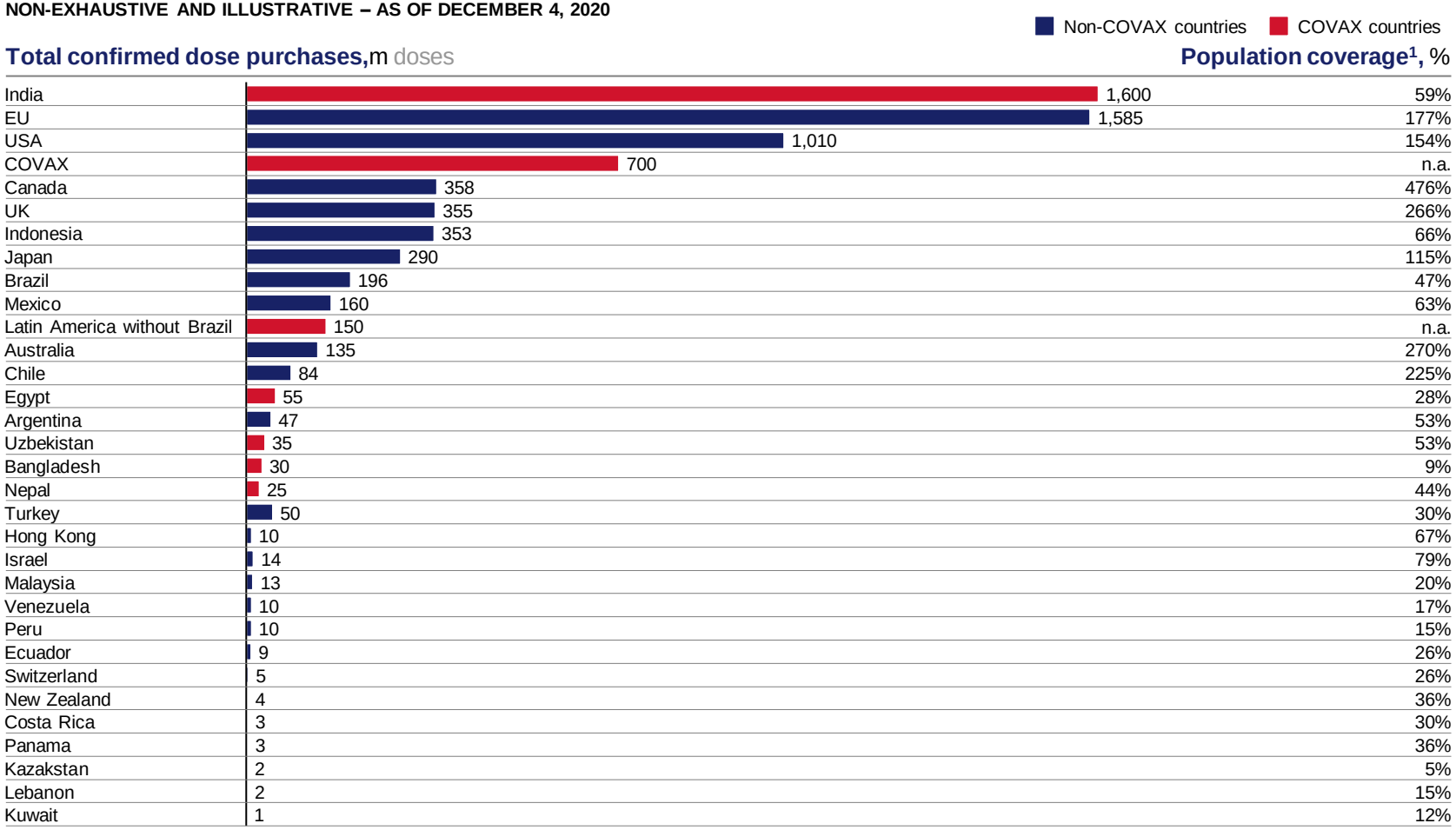
Consumer acceptance of COVID-19 vaccines varies by geography, though in the **majority of surveyed countries** it is **above 70%**

Physician willingness to recommend vaccination is generally 80% or higher, which is significant given their influential role

Due to these geographical differences, it is necessary to estimate **adoption rates based on local data**

B| … along with limits set by dosage secured through bilateral agreements and COVAX

NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF DECEMBER 4, 2020



Total **7.3bn doses**

1.Calculation based on a 2-dose vaccine
2.Depending on vaccines successfulness
3.COVAX aims to provide ~2Bn doses by the end of 2021 to protect high-risk populations around the world; in the longer term, the goal is to provide funded countries with enough doses to cover 20% of their population

Source: Duke Global Health Innovation Centre (Launch & Scale Speedometer), national press searches

Current models predict that there will be enough vaccines to **cover 30-50% of the world's population in 2021**[2]

However, **inequities in terms of global allocation** are to be expected

- High-income countries hold ~50% of confirmed dose purchases
- Countries with manufacturing capacity (e.g. India and Brazil) have negotiated large market commitments in advance with leading vaccine candidates as part of their manufacturing agreements
- Low-income countries will be mostly reliant on the 20% population coverage from COVAX[3]

B| For each region, we model 2 scenarios to show alternative hospitalisation trajectories through to Q4 2022

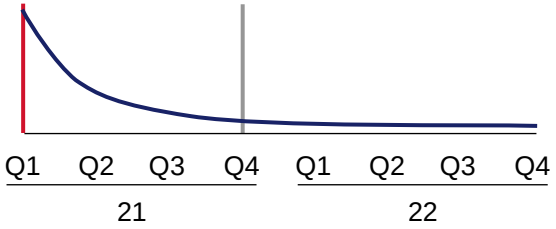
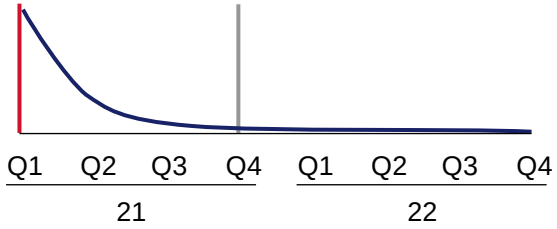
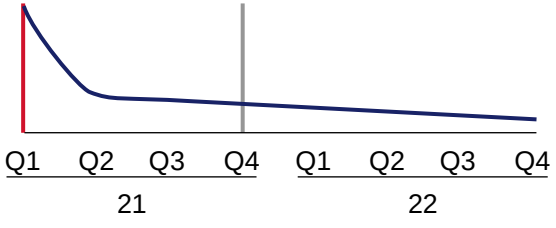
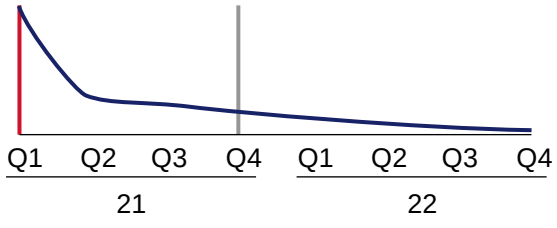
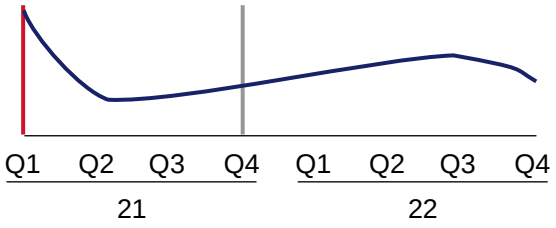
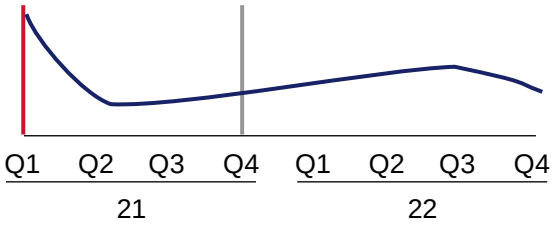
Overview of hospitalisation scenarios by region; pessimistic versus optimistic

DIRECTIONAL AND ILLUSTRATIVE

Point when target coverage is achieved

Point when vaccine distribution starts

hospitalisation trajectories (illustrative)

Regions	Pessimistic scenario		Optimistic scenario	
Able quickly to mobilise vaccination drive ***Relevant geographies: Europe, North America, Japan, Korea, and Pacific***		**50% coverage** by end-2021 **70% vaccine efficacy,** aligned with the AstraZeneca vaccine		**70% coverage** by end-2021 **95% vaccine efficacy,** aligned with the Pfizer and Moderna vaccines
Some logistic challenges in vaccinating large populations ***Relevant geographies: Latin America, Asia (including India and China)***		**35% coverage** by end-2021 **60% vaccine efficacy,** due to a probable mix including Chinese-manufactured vaccines		**50-60% coverage**[2] by end-2021 **80% vaccine efficacy,** due to a mix of Pfizer/Moderna and AstraZeneca
Supply chain constraints and funding challenges leading to longer vaccination process and lower vaccine efficacy[1] ***Relevant geographies: Sub-Saharan Africa***		**15% coverage** by end-2021, due to logistics and funding constraints **60% vaccine efficacy,** due to a probable mix including Chinese-manufactured vaccines		**30% coverage** by end-2021, due to logistics and funding constraints **80% vaccine efficacy,** due to a mix of Pfizer/Moderna and AstraZeneca

1.Sub-Saharan Africa may use more of the AstraZeneca vaccine as it is the cheapest ($3-4 vs. $20 for Pfizer and $10-50 for Moderna) and does not require ultracold chain facilities as is the case for the Pfizer vaccine (which must be stored at -70°C)
2.Coverage is assumed to be higher in Latin America (60%) than in Asia/MENA (50%), reflecting the existing high rate of influenza vaccination (>80% among +60 year-old in Argentina, Brazil, Chile, and Peru)

Source: EPI model, interviews with public health experts (November-December 2020), official statements from vaccine manufacturers (as of December 9, 2020)

C| Demand driven by immunization campaigns up to 2022 is estimated by modelling the number of individuals being vaccinated

METHODOLOGY **SEE APPENDIX FOR DETAILED ASSUMPTIONS AS TO HOW MANY PEOPLE WILL BE VACCINATED**

● Focus of the next page

Breakdown of the demand for clinics and hospitals

Breakdown of the demand for clinics and hospitals	Sources used	Country data[1]	Regional data	Global data
Quarterly number of vaccinated population	McKinsey EPI models	✓		
Healthcare workers required for that number of vaccines administered	Expert interviews		✓	
PPE usage rate for each healthcare workers	Standard global WHO assumptions			✓
Quarterly volume of PPE usage required for vaccination				

For the purposes of this exercise, we used global WHO norms but in a country-level exercise, these could be adjusted to reflect local clinical data/local observations

1. The EPI model is built at country-level but for the purposes of this exercise we aggregated at regional level

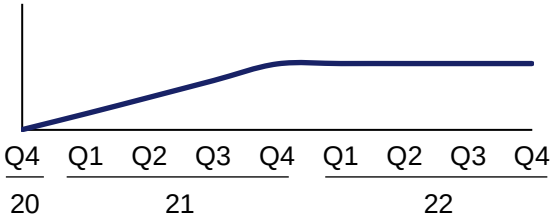
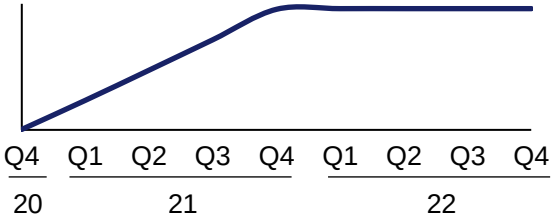
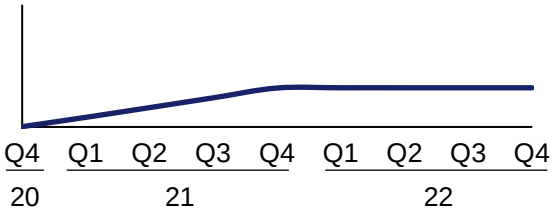
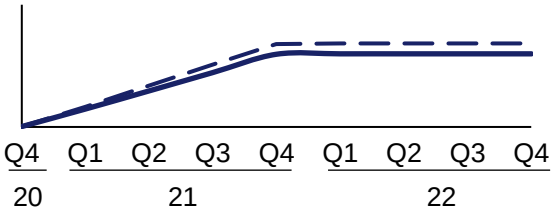
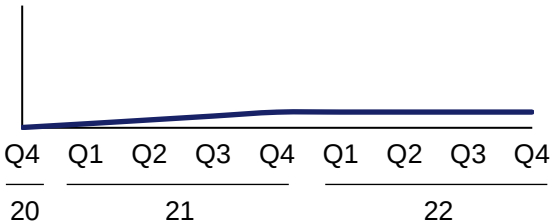
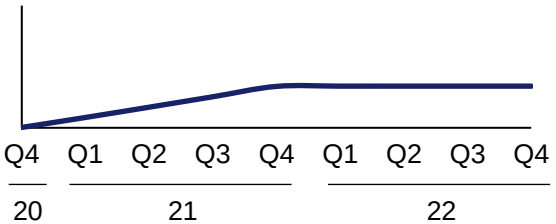
Source: WHO, EPI model, official government statements, pharmaceutical companies' official statements, interviews with experts (November-December 2020)

C| For each region, we model 2 scenarios to show alternative immunization trajectories through to Q4 2022

Overview of immunization scenarios by region; pessimistic versus optimistic

DIRECTIONAL AND ILLUSTRATIVE

Immunization trajectories – cumulative vaccinated individuals (illustrative)

Region archetypes	Pessimistic scenario		Optimistic scenario	
Able quickly to mobilise vaccination drive ***Relevant geographies: Europe, North America, Japan, Korea, and Pacific***		**50% coverage** by end-2021 **70% vaccine efficacy,** aligned with the AstraZeneca vaccine		**70% coverage** by end-2021 **95% vaccine efficacy,** aligned with the Pfizer and Moderna vaccines
Some logistic challenges in vaccinating large populations ***Relevant geographies: Latin America, Asia (including India and China)***		**35% coverage** by end-2021 **60% vaccine efficacy,** due to a probable mix including Chinese-manufactured vaccines		**50-60% coverage**[2] by end-2021 **80% vaccine efficacy,** due to a mix of Pfizer/Moderna and AstraZeneca
Supply chain constraints and funding challenges leading to longer vaccination process and lower vaccine efficacy[1] ***Relevant geographies: Sub-Saharan Africa***		**15% coverage** by end-2021, due to logistics and funding constraints **60% vaccine efficacy,** due to a probable mix including Chinese manufacturers' vaccines		**30% coverage** by end-2021, due to logistics and funding constraints **80% vaccine efficacy ,** due to a mix of Pfizer/Moderna and AstraZeneca

1.Sub-Saharan Africa may use more of the AstraZeneca vaccine as it is the cheapest ($3-4 vs. $20 for Pfizer and $10-50 for Moderna) and does not require ultracold chain facilities as is the case for the Pfizer vaccine (which must be stored at -70°C)
2.Coverage is assumed to be higher in Latin America (60%) than in Asia/MENA (50%), reflecting the existing high rate of influenza vaccination (>80% among +60 year-old in Argentina, Brazil, Chile, and Peru)

Source: : EPI model, interviews with public health experts (November-December 2020), official statements from vaccine manufacturers (as of December 9, 2020)

D| Non-healthcare workforce demand for PPE by 2025 is driven by the level of social interaction and physicality of the different jobs

Overview of methodology used to estimate the demand arising from non-health labour

SEE APPENDIX FOR DETAILED ASSUMPTIONS ON BACK-TO-WORK PROPORTION, ADOPTION RATES AND USAGE RATES

Focus of the next page

The non-healthcare workforce can be segmented into 3 archetypes

	Description	Examples (non-exhaustive)
Archetype 1	High social interaction and physicality (e.g. heavy lifting)	Waiters Physical trainers Construction
Archetype 2	High social interaction but low physicality	Grocery Retail Education Transportation
Archetype 3	Low social interaction and low physicality	Finance and other services jobs

For each archetype, PPE demand is estimated at regional level up to Q4 2025, based on 4 independent variables

Elements	Sources
# workers by archetype	International Labour Organization
% back to work	Interviews with experts[1] Survey of working professionals[2]
Adoption rate by PPE element by archetype (i.e., proportion of workforce that will use that PPE)	Interviews with experts[1] Survey of working professionals[2]
Usage rate by PPE (i.e., number of units per day)	WHO recommendations YouGov Interviews with experts[1]
Quarterly PPE usage for each non-healthcare worker	

1.November-December 2020
2.Survey held in the US, 28 May-3-June 2020; n=1,021

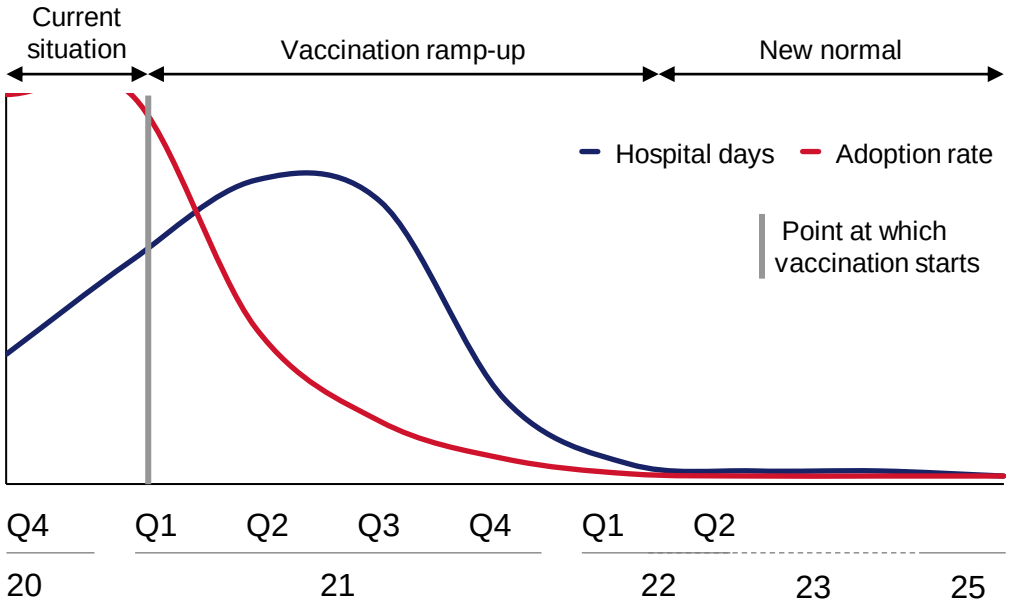
Source: ILO, WHO, YouGov, interviews with public health experts (November-December 2020), Survey held in the US, May 28-June 3, 2020; n=1,021

D| The adoption rate for non-healthcare workforce is indexed to the EPI curve; usage rates will vary by type of worker

Overview of assumptions used to estimate adoption and usage rates for non-healthcare labour

DIRECTIONAL AND ILLUSTRATIVE **SEE APPENDIX FOR DETAILED ASSUMPTIONS ON BACK-TO-WORK PROPORTION, ADOPTION RATES AND USAGE RATES**

Adoption rate will scale down once vaccination starts, with a different "new normal" defined for each region



High adoption rate due to coercive measures

Vaccines arrive. PPE adoption rate decreases faster than hospitalisations as government measures and personal incentives for wearing PPE are low

Hospitalisation rate is close to 0 but some additional PPE demand persists due to new consumption habits – this new normal will last from Q1 2023 to Q4 2025

Adoption and usage rates will vary depending on worker archetype and region

Degrees of surgical mask usage

Archetypes	Regional adoption rates (illustrative, non-exhaustive) North America	China	SSA	Usage rate
Archetype 1 High social interaction and physicality	Current: 60-70% New normal: 1-2%	Current: 60-70% New normal: 5-10%	Current: 10-15% New normal: 0%	1-4 Units/day
Archetype 2 High social interaction but low physicality	Current: 60-70% New normal: 1-2%	Current: 60-70% New normal: 5-10%	Current: 10-15% New normal: 0%	1-2 Units/day
Archetype 3 Low social interaction and low physicality	Current: 50-60% New normal: 1-2%	Current: 50-60% New normal: 5-10%	Current: 5-10% New normal: 0%	0.5-1 unit/day

Source: EPI model, WHO, YouGov, interviews with public health experts (November-December 2020), survey of working professionals (held in the US in May 28-June 3, 2020; n=100)

E| Consumer demand for PPE through to 2025 will be driven by demographics

Overview of methodology used to estimate consumer demand

SEE APPENDIX FOR DETAILED ASSUMPTIONS ABOUT ADOPTION AND USAGE RATES

Focus of the next page

The population can be segmented into 4 age segments

	Behaviour
Under 15	No PPE usage
15-19	High usage rate due to outdoor lifestyle and school usage
20-65	Medium usage rate; PPE mainly used in the workplace
Over 65	Low usage rate due to a more indoor lifestyle

For each age category, PPE demand can be estimated at the regional level up to Q4 2025, based on 3 independent variables

Elements	Sources
# population by age range	UN Population Division
Adoption rate by PPE by age range (i.e., proportion of the population that will use PPE)	YouGov Interviews with experts[1] Survey of general public[2]
Usage rate by PPE (i.e., units per day)	WHO recommendation Interviews with experts[1] Survey of general public[2]
Quarterly PPE usage for consumers	

1.November-December 2020
2.Survey carried out in the US, 28 May-3 June 2020; n=1,021

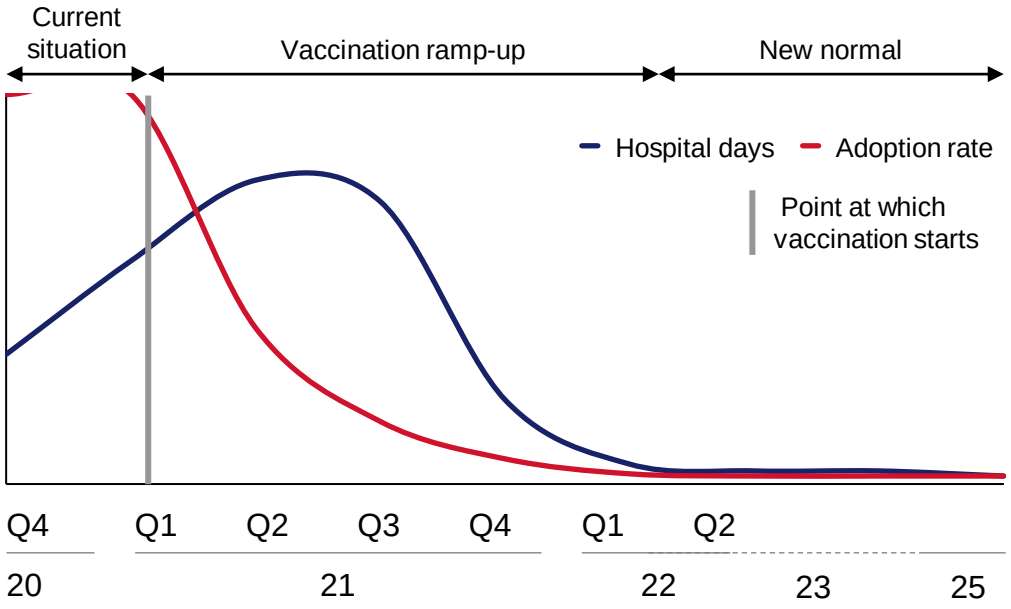
Source: UN Population Division, WHO, YouGov, interviews with public health experts (November-December 2020), survey carried out in the US, 28 May – 3 June 2020; n=1,021

E| Each age segment will exhibit different adoption and usage rates; adoption rates can be indexed to the EPI curve

Overview of assumptions used to estimate adoption and usage rates for the general public

DIRECTIONAL AND ILLUSTRATIVE **SEE APPENDIX FOR DETAILED ASSUMPTIONS ON ADOPTION RATES AND USAGE RATES**

Adoption rates will scale down once vaccination starts, with a different "new normal" defined for each region



High adoption rate due to coercive measures

Vaccines arrive. PPE adoption rate decreases faster than hospitalisations as government measures and personal incentives for wearing PPE are low

Hospitalisation rate is close to 0 but some additional PPE demand persists due to new consumption habits – this new normal will last from Q1 2023 to Q4 2025

Adoption and usage rates will vary by age segment and regions

Example of surgical mask usage

Age segment	Regional adoption rates (illustrative, non-exhaustive) North America	China	SSA	Usage rate
15-19	Current: 40-50% New normal: 1-2%	Current: 40-60% New normal: 4-5%	Current: 10-15% New normal: 0%	2-3 Units/ week
20-65	Current: 30-40% New normal: 1-2%	Current: 30-60% New normal: 3-4%	Current: 5-10% New normal: 0%	1-2 Units/ week
Over 65	Current: 25-40% New normal: 1-2%	Current: 25-50% New normal: 3-4%	Current: 5-10% New normal: 0%	1-2 Units/ week

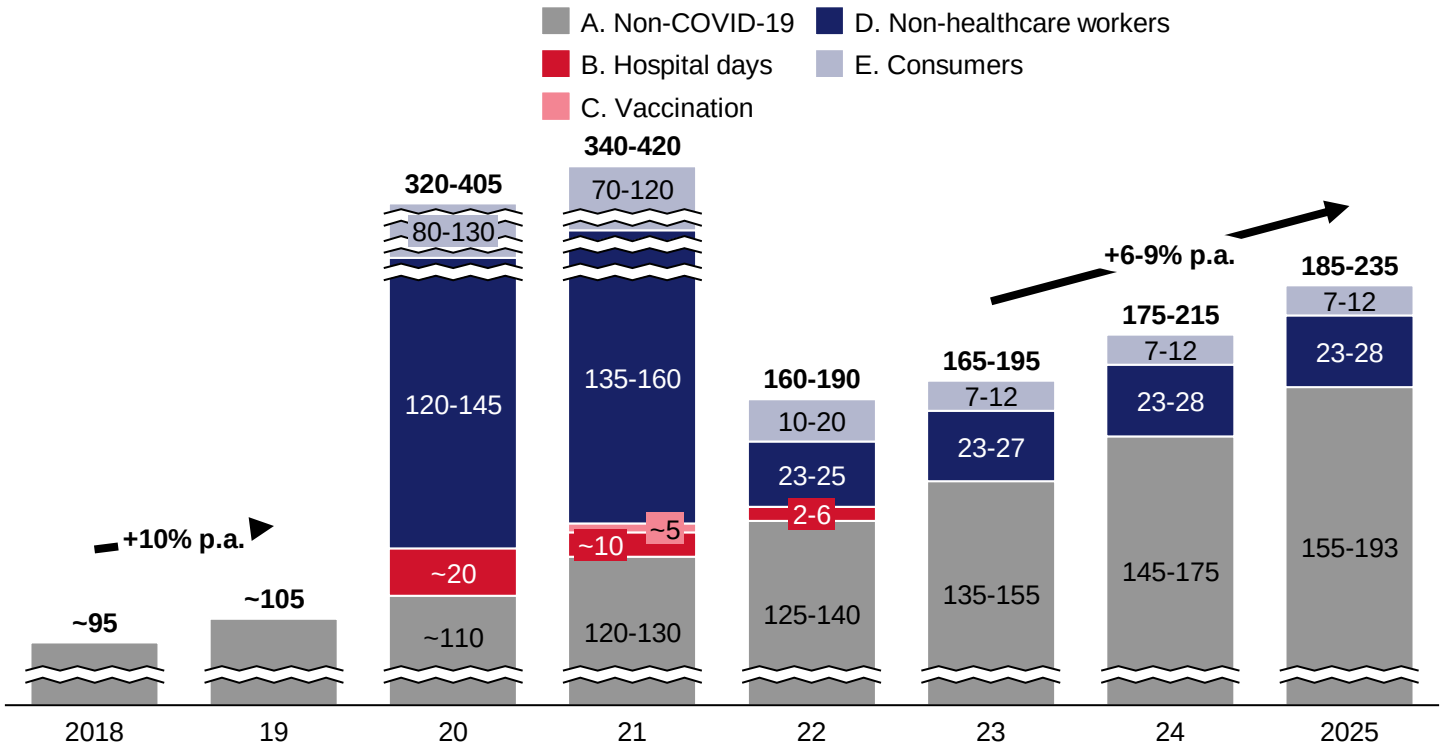
Source: EPI model, WHO, YouGov, interviews with public health experts (November-December 2020), survey of working professionals (held in the US in May 28-June 3, 2020; n=100)

Contents

Consumers and non-healthcare workers will drive global PPE demand to peak at 340-420bn units in 2021 before it resumes its historic growth rate

ESTIMATES – AS OF 16 DECEMBER 2020

Total estimated[1] volume PPE demand, 2018-25, units, bn[2]



1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID-19 baseline demand based on 2 growth scenarios (historic growth -2% to account for critical size of the market vs. historic growth +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare workers and consumer demand depend on adoption rate assumptions ("high" vs. "low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg
3.Surgical masks adoption rate is assumed to be 10% for consumers in Sub-Saharan Africa while 80% represents the adoption rate for non-healthcare workers in China and North America

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

Key insights

Global PPE demand is expected to peak in 2020-21, driven by a surge in consumer and non-healthcare worker demand, which will account for ~60-70% of total demand

- Non-healthcare worker and consumer demand is critically dependent on surgical mask adoption rates (from 10-80%[3] depending on geography)
- Demand increases are also driven by health system demand (5%), which in turn depends on vaccination scenarios

In 2022, PPE demand is expected to drop due to the sharp decline in consumer and non-healthcare worker demand

- Surgical masks adoption rates are expected to drop to 0-10% depending on geography
- Demand from health systems could fall alongside increased vaccine coverage

From 2023 onwards, global demand may well resume its historic growth rate

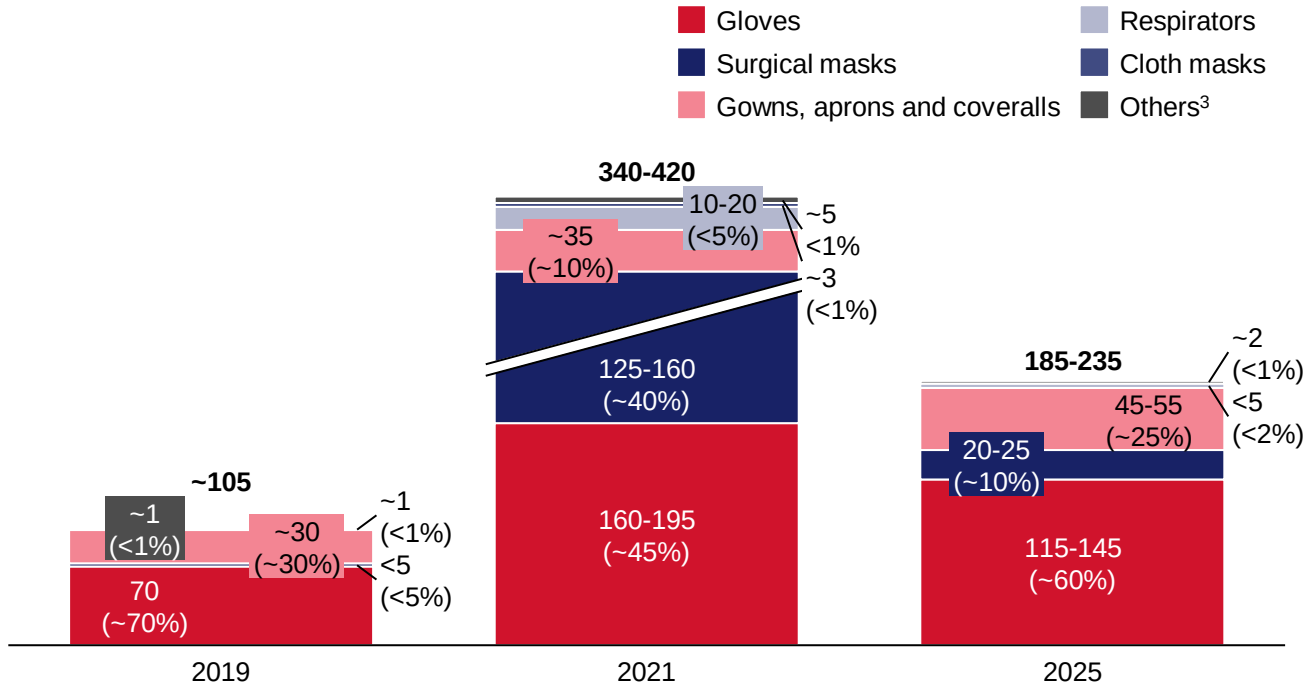
- Consumer and non-healthcare worker demand may stabilize at 30-40bn units a year, driven by a "legacy effect"
- Baseline demand is expected to grow by 7-11% p.a. throughout 2022-25, depending on which growth scenario is selected[1]

Consumers & non-healthcare workers will drive surgical mask demand to peak at 125-160bn units in 2021 before dropping by ~40% p.a. in 2021-25

ESTIMATES – AS OF 16 DECEMBER 2020

Total estimated PPE[1] demand by category

2019-25, units, bn[2] (% of total demand by volume)



Key insights

The crisis has **shifted category mix significantly**: masks will drive the demand surge in 2021, accounting for 40% of total demand in 2021 (vs. less than 5% in 2019)

- Surgical mask demand accounts for ~50% of non-healthcare worker and ~70-80% of consumer demand
- The surge in surgical mask demand vs. other products is explained by higher adoption rates among consumers (40-50%[4] vs. 0% for medical gloves) and non-healthcare workers (40-70% vs. 0-60%[4] for medical gloves)

By 2025, category mix should return to a more typical distribution pattern with gloves constituting ~60% of demand

- With increased immunity, surgical mask demand is expected to decrease sharply, falling back to ~10% of total demand in 2025 reflecting declining adoption rates among consumers and non-healthcare workers (0-10% depending on geography)

1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID-19 baseline demand based on 2 growth scenarios (historic growth -2% to account for critical size of the market vs. historic growth +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare workers and consumer demand depend on adoption rate assumptions ("high" vs. "low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg
3.Eye protection (face shields and goggles), shoe cover, and disinfectant products/biological waste management (i.e., hand sanitizer, chlorine, body bags and clinical waste bags)
4.Excluding Sub-Saharan Africa adoption rate, depending on geography, worker archetype and population age

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

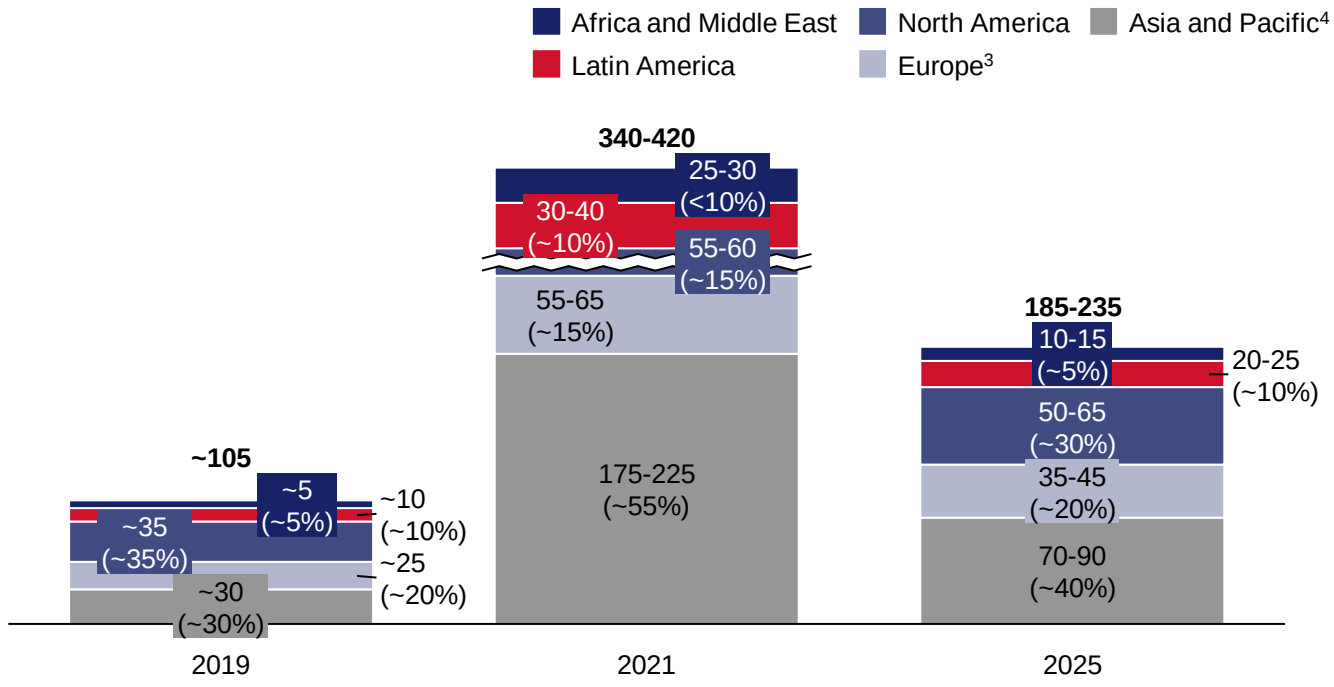
Contents

We expect consumers & non-healthcare workers to drive a significant shift in the weight of global PPE demand away from North America and towards Asia

ESTIMATES - AS OF 16 DECEMBER 2020

Total estimated[1] PPE demand by region,

2019-25, units, bn[2] (% of total demand by volume)



1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare workers and consumer demands depend on adoption rate assumptions ("high" vs. "low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litter, and chlorine is per kg
3.Including Russia and Central Asia
4.Including China and India

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

Key insights

While **North America has been the largest historic source of demand** (~35% of global demand in 2019), by 2021, **Asia is expected to account for ~50%** of total PPE demand

- ~60% of consumer and non-healthcare worker demand is driven by Asian countries[3] due to higher adoption rates for surgical masks in that region (~60-80%) and large populations

By 2025, **end-market mix may more closely resemble historic distribution patterns**, but with Asian markets still remaining the largest for PPE

- Asian leadership is driven by a stronger "legacy effect" of PPE use among consumers and non-healthcare workers (~10% vs. <3% in other geographies)

Europe

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

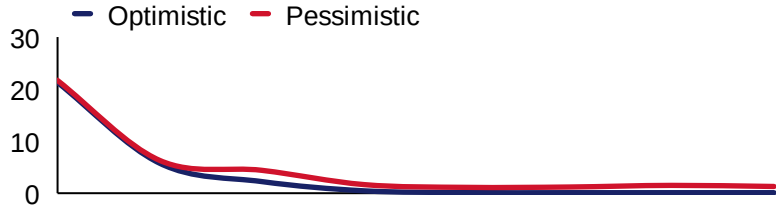
Epidemiological profile

Total **cases** **~20m** Total **deaths** **~450k**

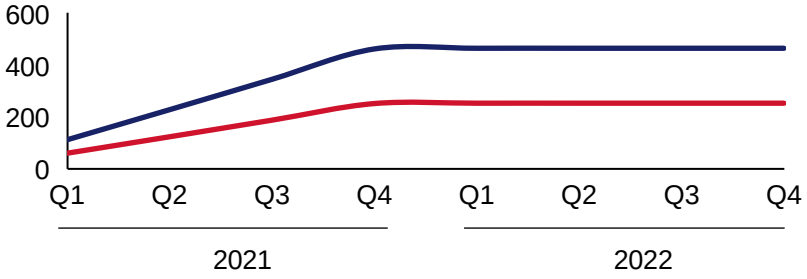
Vaccine scenario

- *Optimistic: **70% coverage** by end-2021 and **95% efficacy***
- *Pessimistic: **50% coverage** by end-2021 and **70% efficacy***

Hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

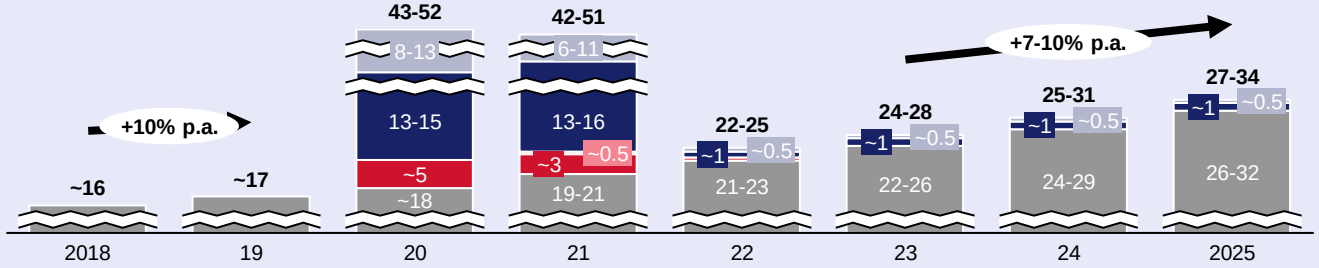


PPE demand, 2018-25

Propagation trend[1]

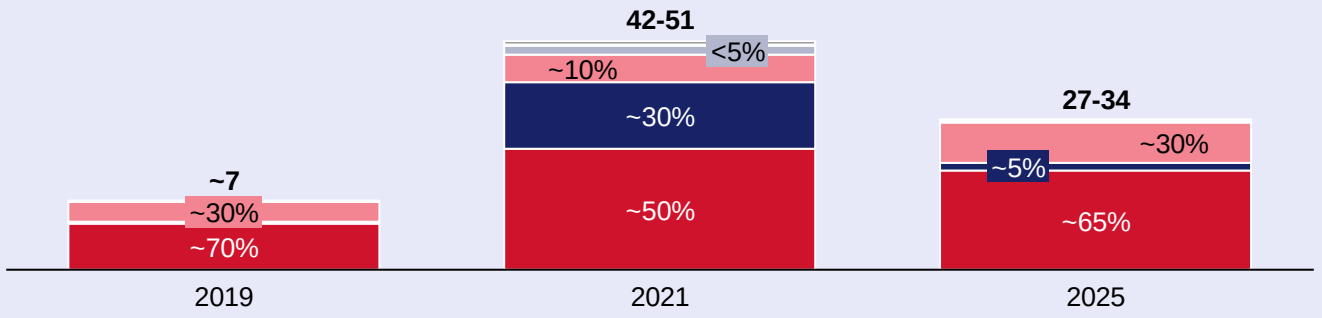
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



1. Increasing: > 10% increase in cumulative incremental cases over last 7 days, compared to incremental cases over last 8-14 days; stabilizing: ~ 10%; decreasing: < -10%
2. Range reflects 2 scenarios (“high” vs. “low”): non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits) hospital days and vaccination scenarios depend on vaccination scenario (“pessimistic” vs. “optimistic”), and non-healthcare worker and consumer demand depend on adoption rate assumptions (“high” vs. “low”)
3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

North America

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

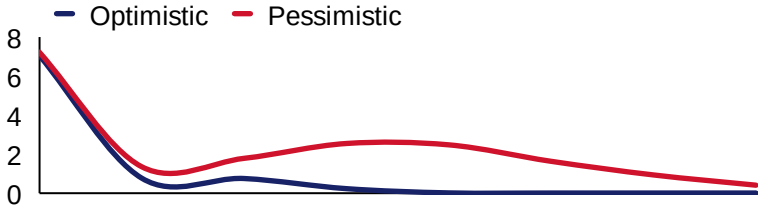
Epidemiological profile

Total **cases** **~17m** Total **deaths** **~300k**

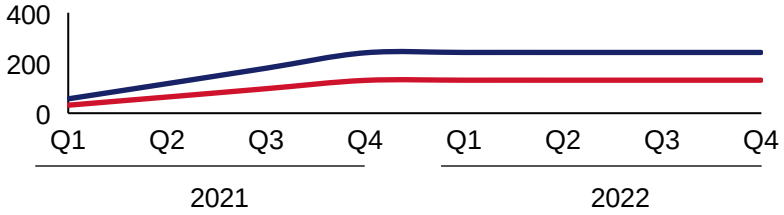
Vaccine scenario

- *Optimistic: **70% coverage** by end-2021 and **95% efficacy***
- *Pessimistic: **50% coverage** by end-2021 and **70% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

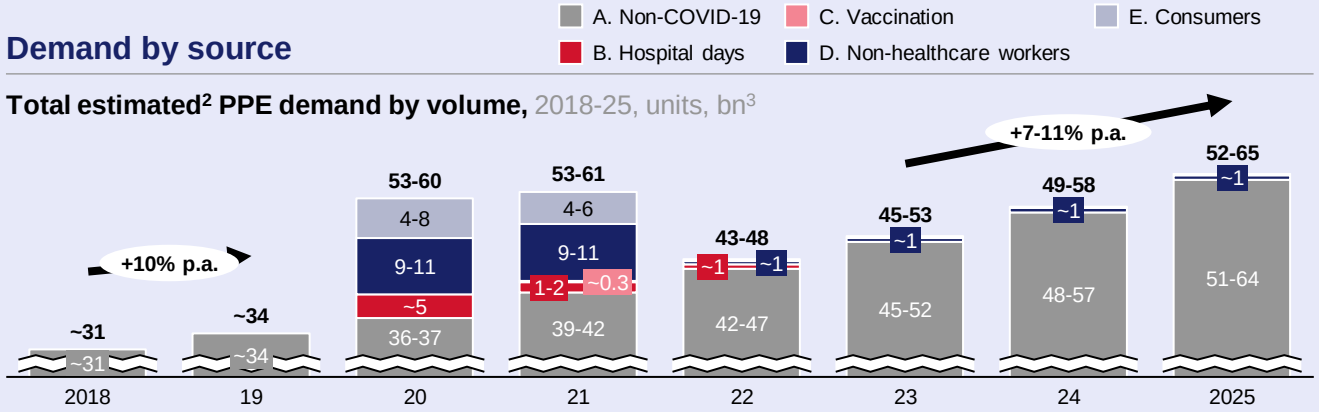


PPE demand, 2018-25

Propagation trend[1]

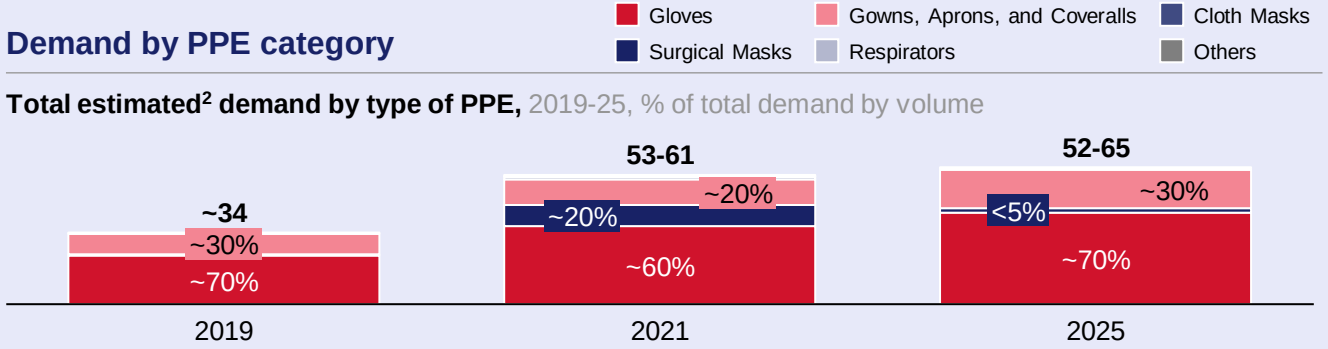
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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2.Range reflects 2 scenarios ("high" vs. "low"): non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits) hospital days and vaccination scenarios depend on vaccination scenario ("pessimistic" vs. "optimistic"), and non-healthcare worker and consumer demand depend on adoption rate assumptions ("high" vs. "low")
3.Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Latin America and Caribbean

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

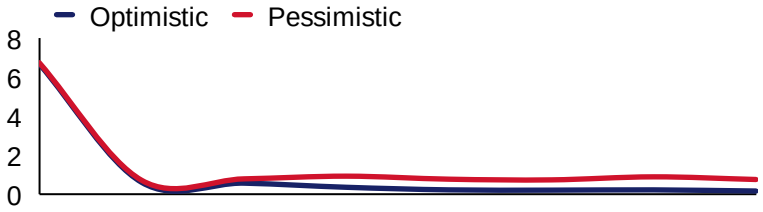
Epidemiological profile

Total **cases** **~14m** Total **deaths** **~470k**

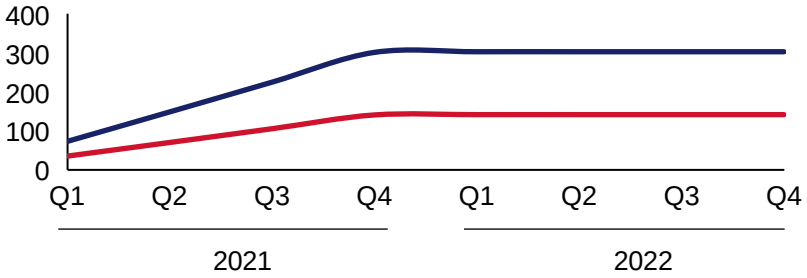
Vaccine scenario

- *Optimistic: **60% coverage** by end-2021 and **80% efficacy***
- *Pessimistic: **35% coverage** by end-2021 and **60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

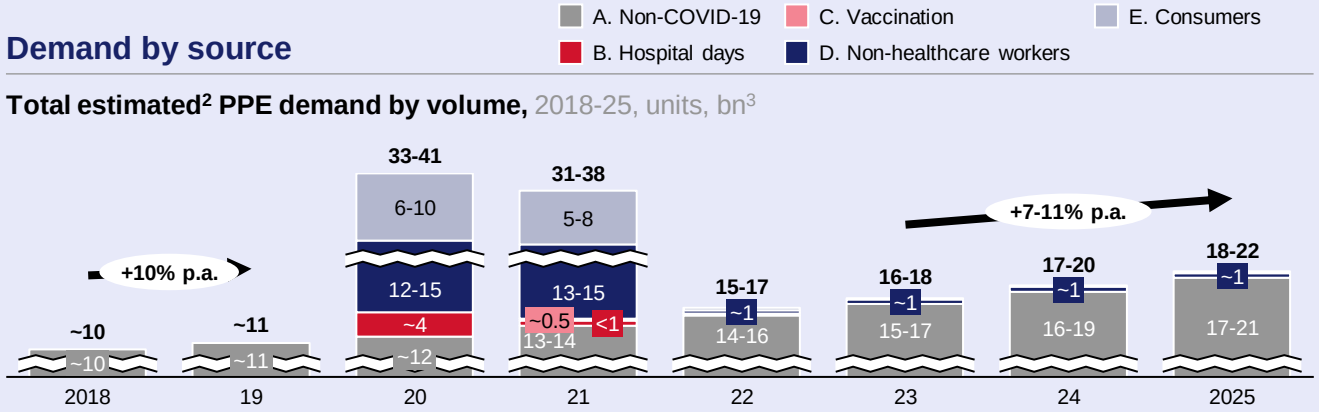


PPE demand, 2018-25

Propagation trend[1]

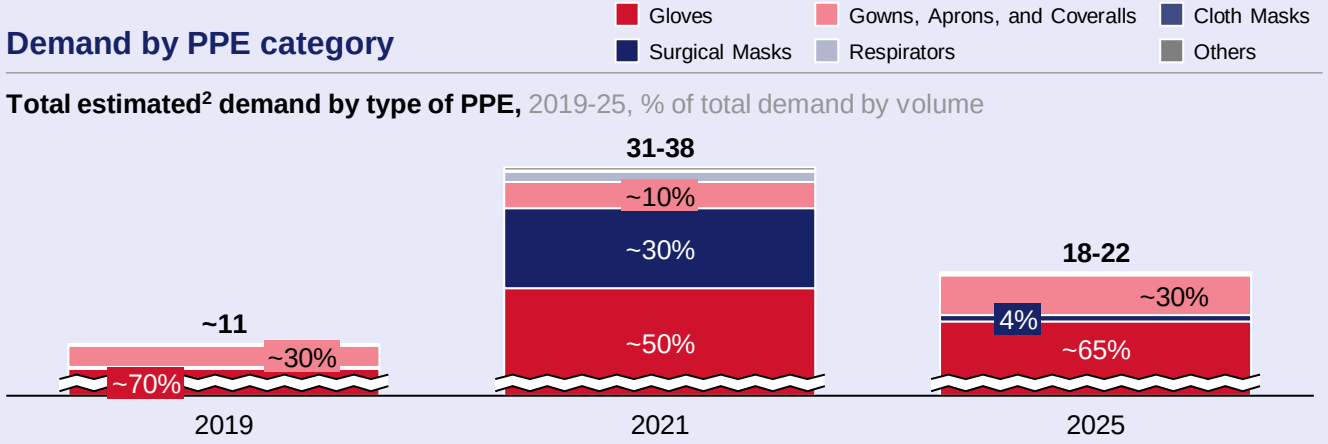
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Sub-Saharan Africa

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

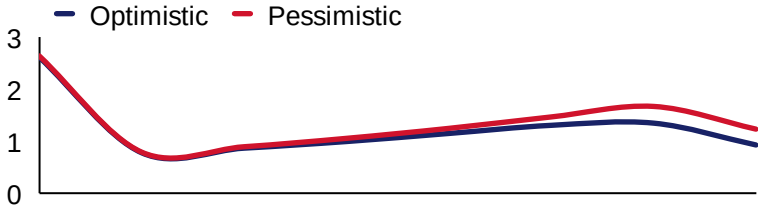
Epidemiological profile

Total **cases** **~1.6m** Total **deaths** **~35k**

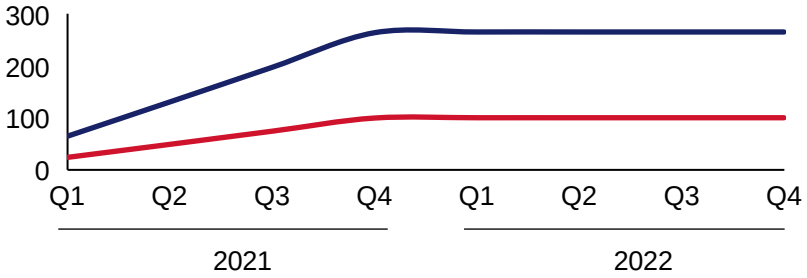
Vaccine scenario

- *Optimistic: **30% coverage** by end-2021 and **80% efficacy***
- *Pessimistic: **15% coverage** by end-2021 and **60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

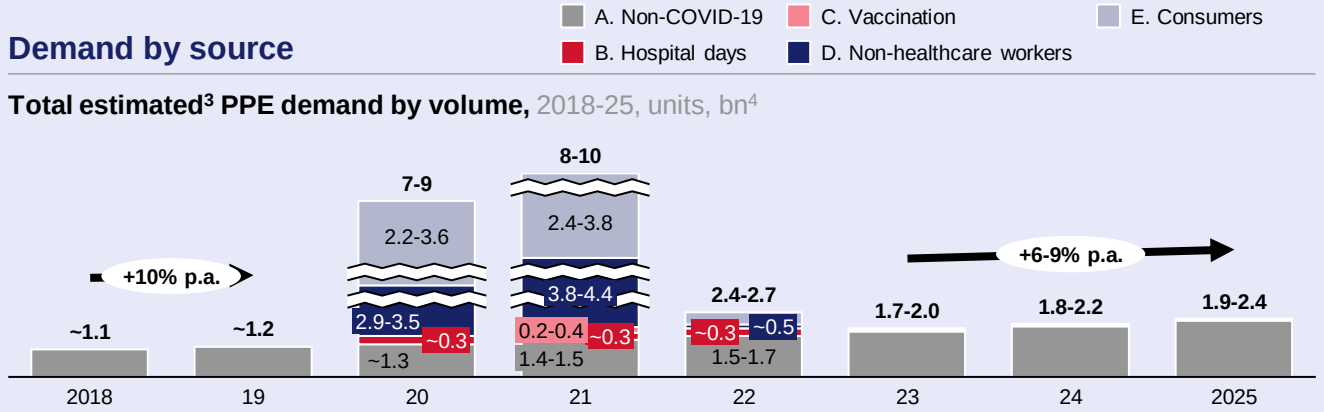


PPE demand, 2018-25

Propagation trend[2]

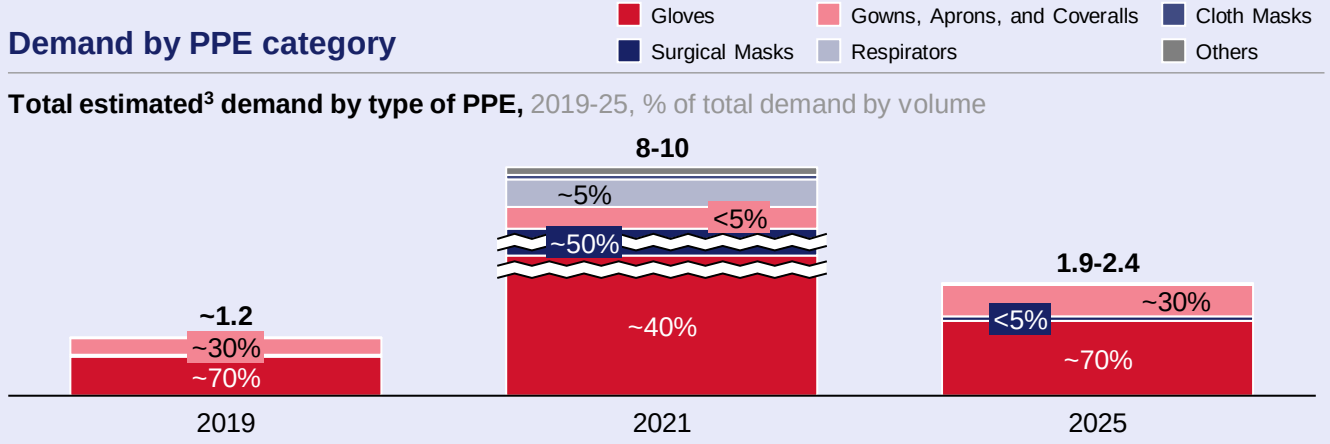
Demand by source

Total estimated[3] PPE demand by volume, 2018-25, units, bn[4]



Demand by PPE category

Total estimated[3] demand by type of PPE, 2019-25, % of total demand by volume



1. All African countries excluding North African countries (i.e., Morocco, Algeria, Tunisia, Libya, and Egypt)
2. Increasing: > 10% increase in cumulative incremental cases over last 7 days, compared to incremental cases over last 8-14 days; stabilizing: ~ 10%; decreasing: < -10%
3. Range reflects 2 scenarios (“high” vs. “low”): non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits) hospital days and vaccination scenarios depend on vaccination scenario (“pessimistic” vs. “optimistic”), and non-healthcare worker and consumer demand depend on adoption rate assumptions (“high” vs. “low”)
4. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Middle East and North Africa

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

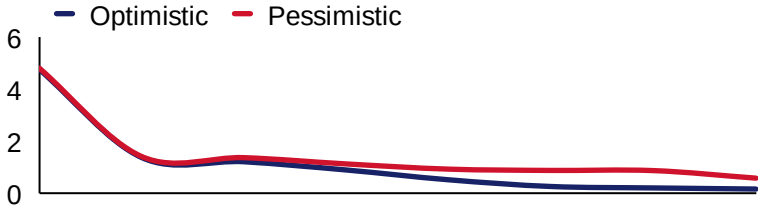
Epidemiological profile

Total **cases** **~4.5m** Total **deaths** **~100k**

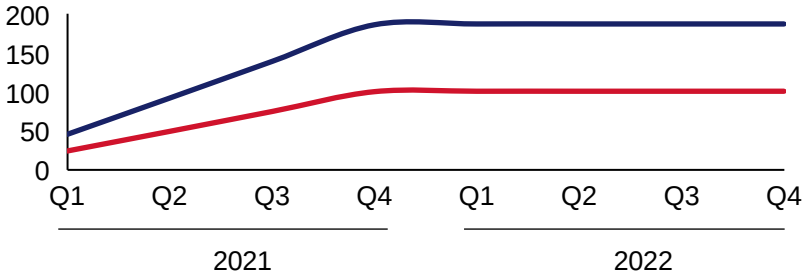
Vaccine scenario

- *Optimistic: **50% coverage** by end-2021 and **80% efficacy***
- *Pessimistic: **35% coverage** by end-2021 and **60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

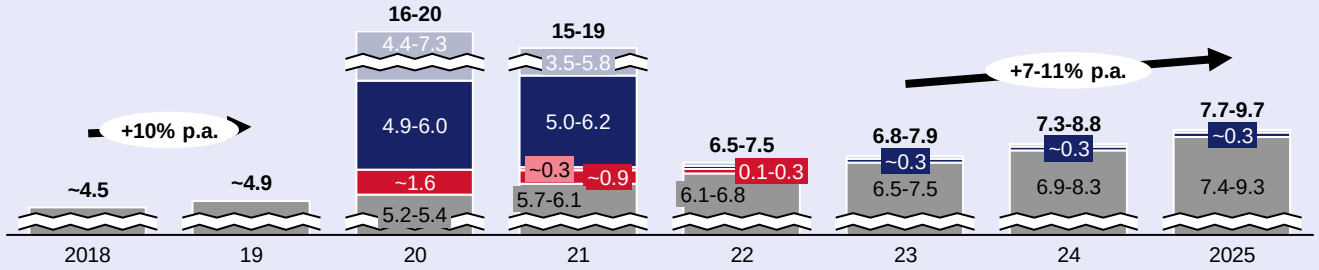


PPE demand, 2018-25

Propagation trend[1]

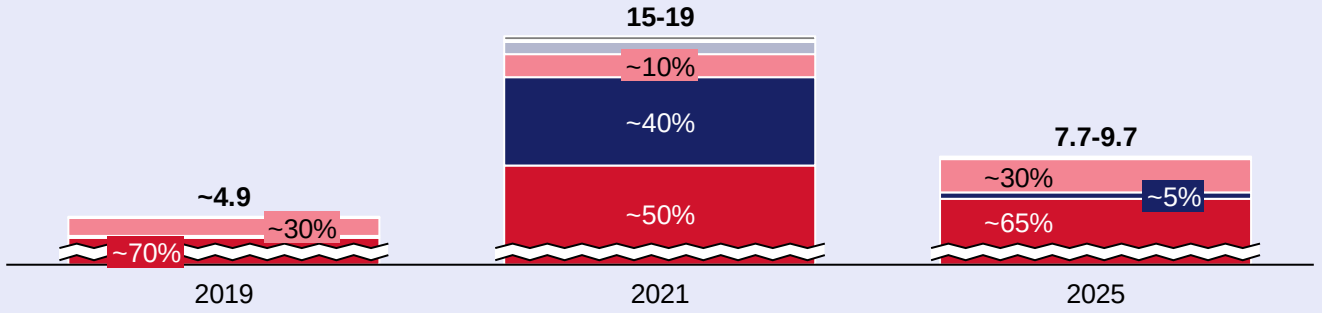
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



1. Increasing: > 10% increase in cumulative incremental cases over last 7 days, compared to incremental cases over last 8-14 days; stabilizing: ~ 10%; decreasing: < -10%
2. Range reflects 2 scenarios (“high” vs. “low”): non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits) hospital days and vaccination scenarios depend on vaccination scenario (“pessimistic” vs. “optimistic”), and non-healthcare worker and consumer population demand depend on adoption rate assumptions (“high” vs. “low”)
3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

China

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

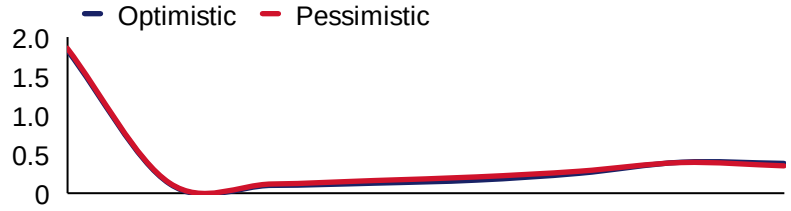
Epidemiological profile

Total **cases** **~0.1m** Total **deaths** **~5k**

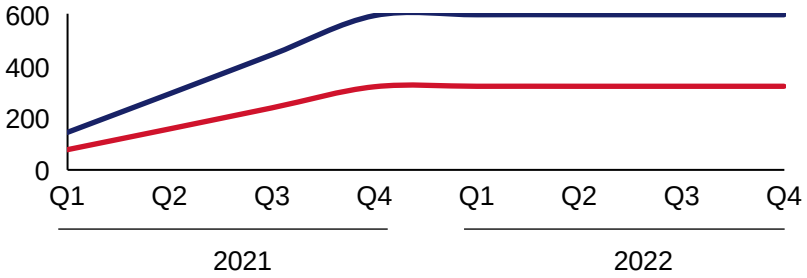
Vaccine scenario

- *Optimistic:* ***50% coverage*** *by end-2021 and* ***80% efficacy***
- *Pessimistic:* ***35% coverage*** *by end-2021 and* ***60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

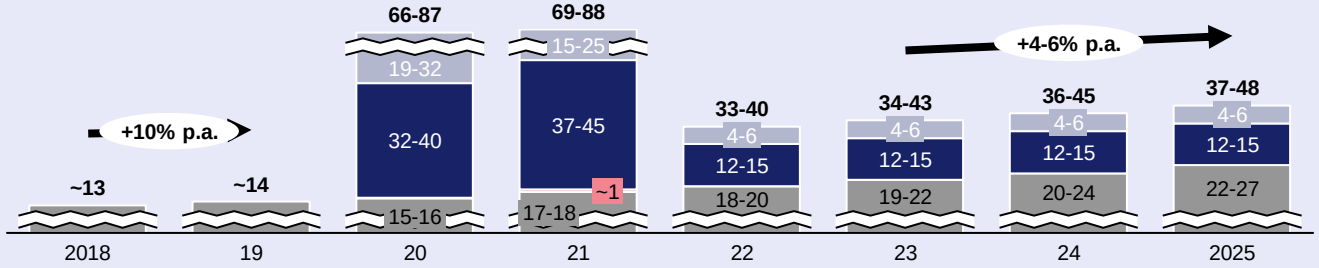


PPE demand, 2018-25

Propagation trend[1]

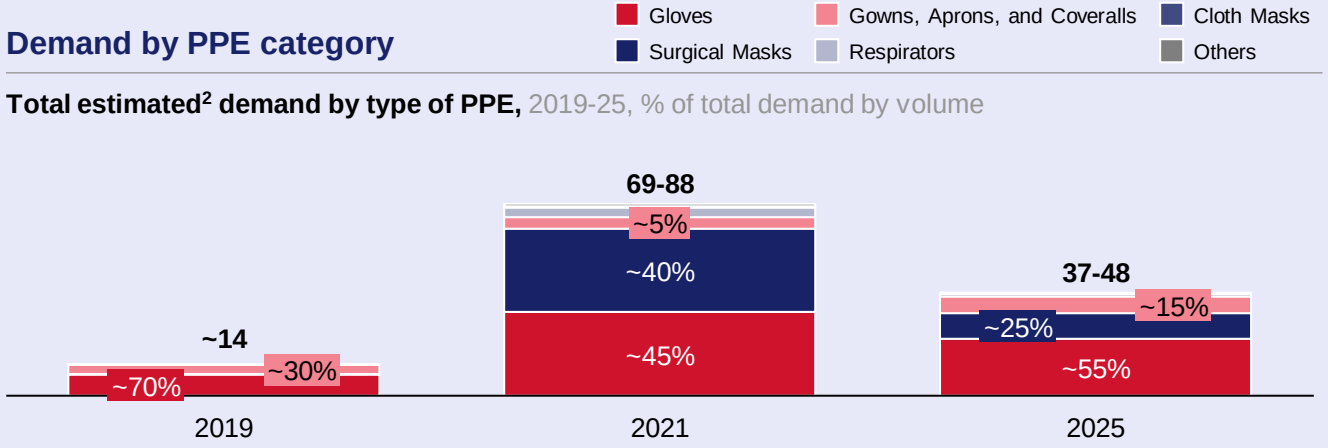
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Indian subcontinent

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

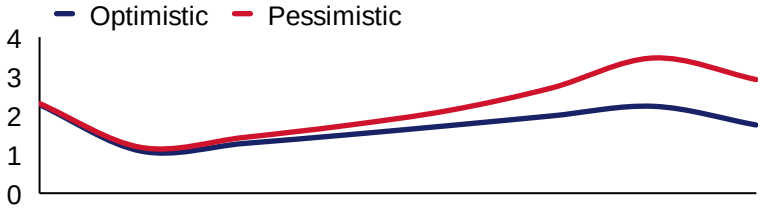
Epidemiological profile

Total **cases** **~10m** Total **deaths** **~160k**

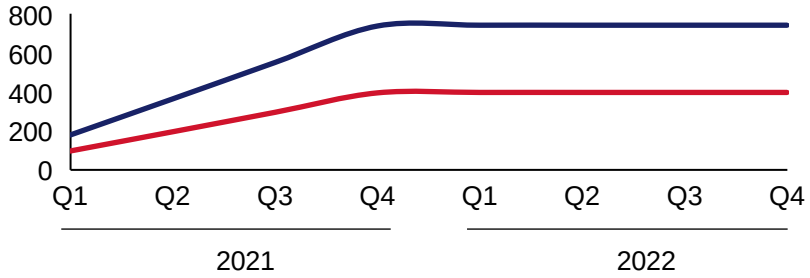
Vaccine scenario

- *Optimistic:* ***50% coverage*** *by end-2021 and* ***80% efficacy***
- *Pessimistic:* ***35% coverage*** *by end-2021 and* ***60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

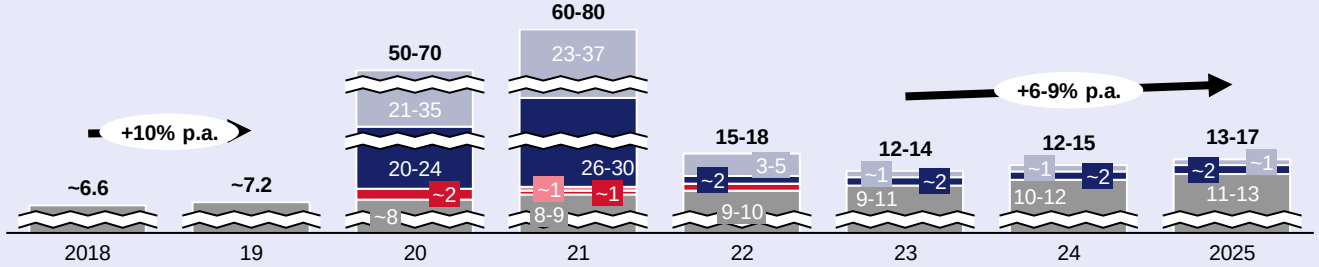


PPE demand, 2018-25

Propagation trend[1]

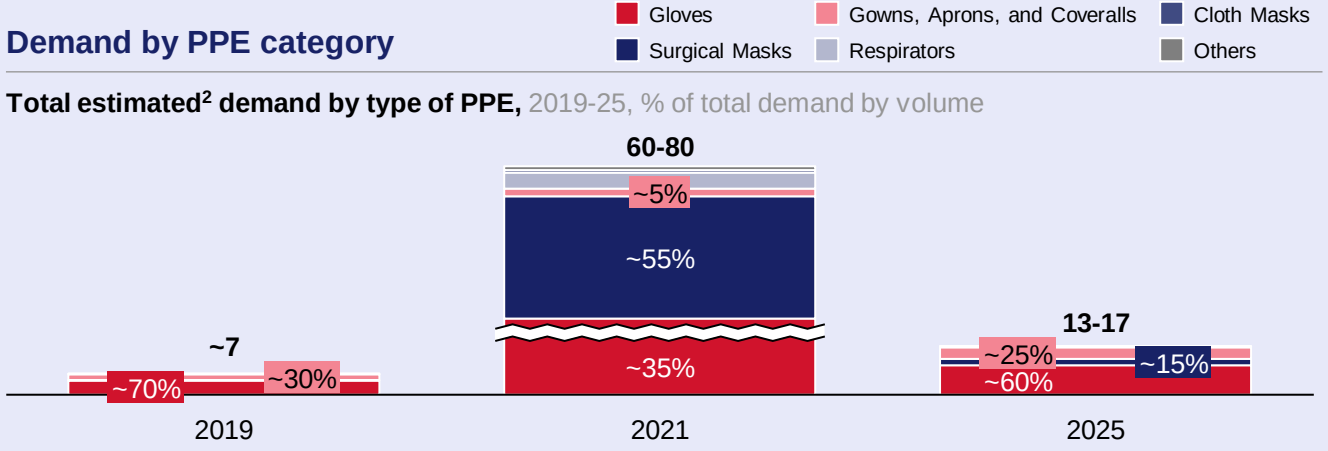
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Japan, Korea, and the Pacific

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

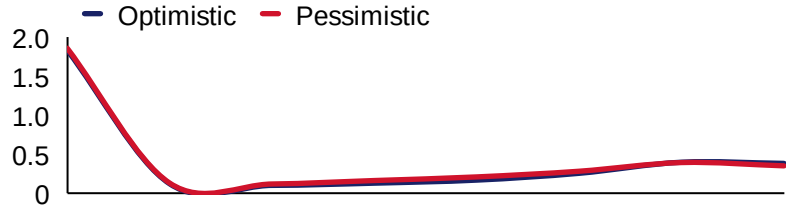
Epidemiological profile

Total **cases** **~30k** Total **deaths** **~4k**

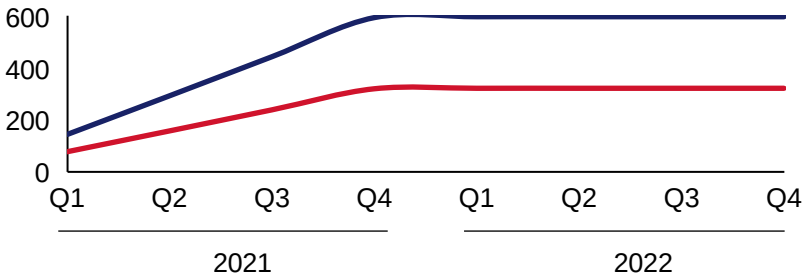
Vaccine scenario

- *Optimistic: **70% coverage** by end-2021 and **95% efficacy***
- *Pessimistic: **50% coverage** by end-2021 and **70% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

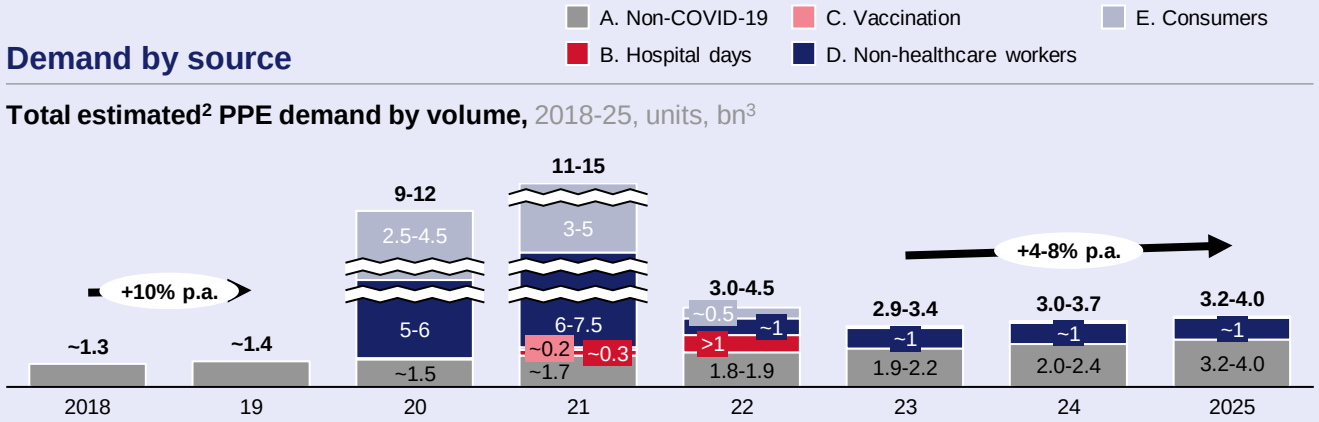


PPE demand, 2018-25

Propagation trend[1]

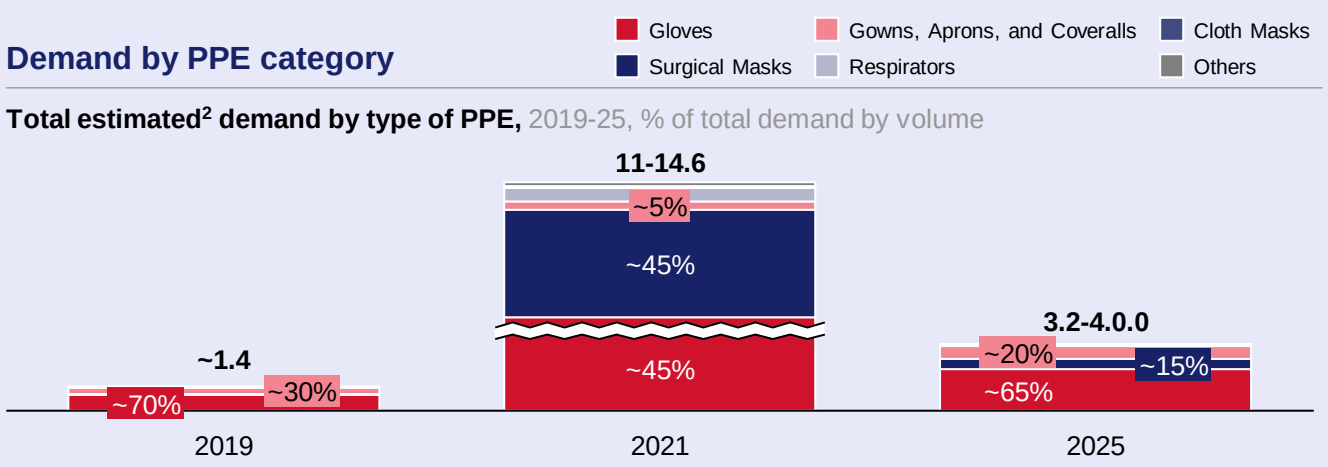
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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Source: Johns Hopkins, EPI model

Rest of South East Asia

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

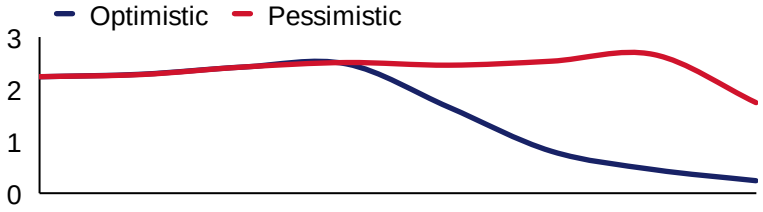
Epidemiological profile

Total **cases** **~1.3m** Total **deaths** **~30k**

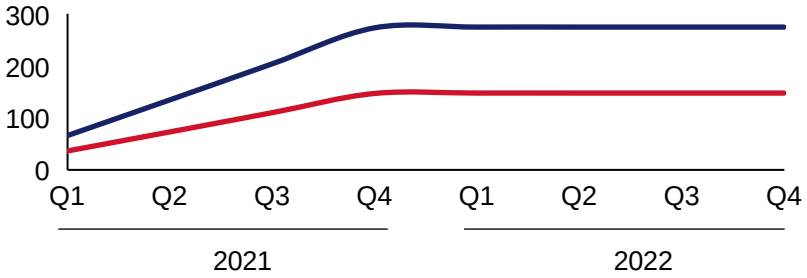
Vaccine scenario

- *Optimistic: **50% coverage** by end-2021 and **80% efficacy***
- *Pessimistic: **35% coverage** by end-2021 and **60% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

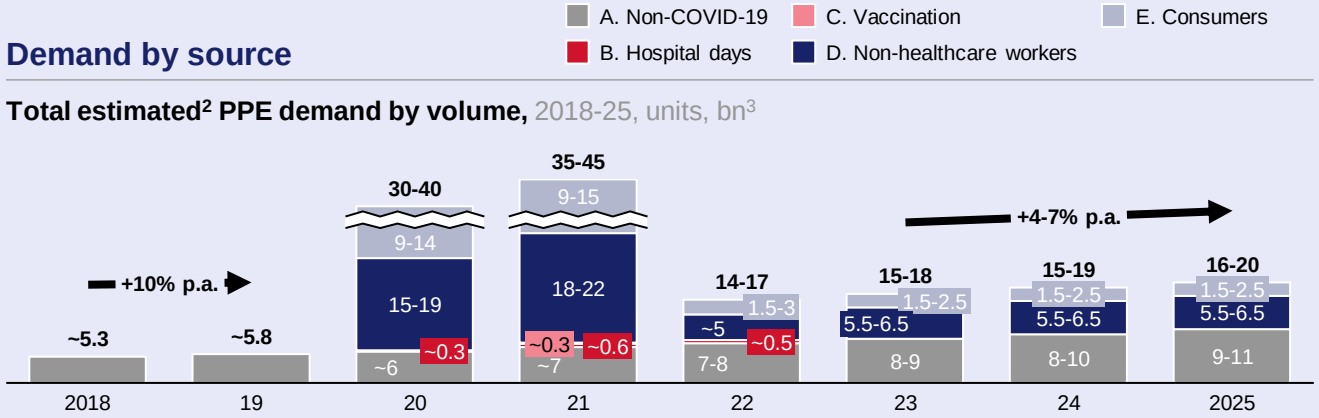


PPE demand, 2018-25

Propagation trend[1]

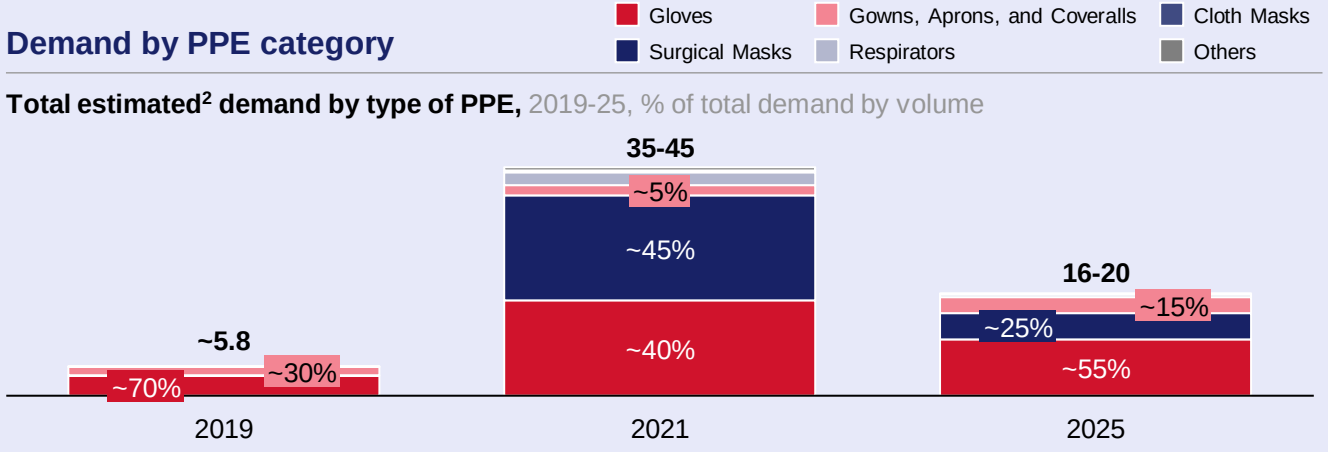
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Russia and Central Asia

ESTIMATES **SEE APPENDIX FOR DETAILS OF COUNTRIES INCLUDED**

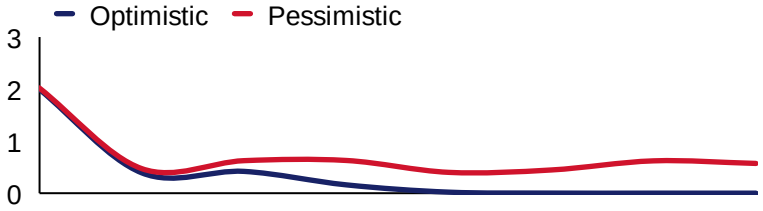
Epidemiological profile

Total **cases** **~3m** Total **deaths** **~50k**

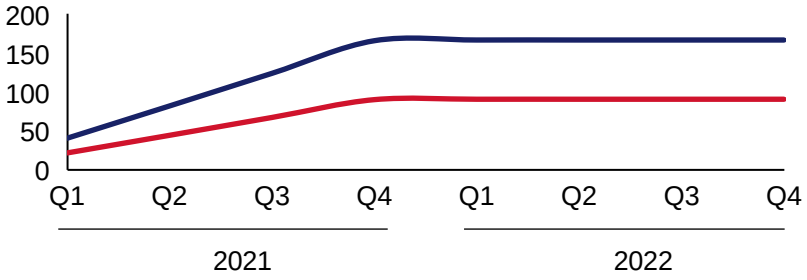
Vaccine scenario

- *Optimistic: **70% coverage** by end-2021 and **95% efficacy***
- *Pessimistic: **50% coverage** by end-2021 and **70% efficacy***

hospitalisation days, days, m



Cumulative vaccinations (successful), people, m

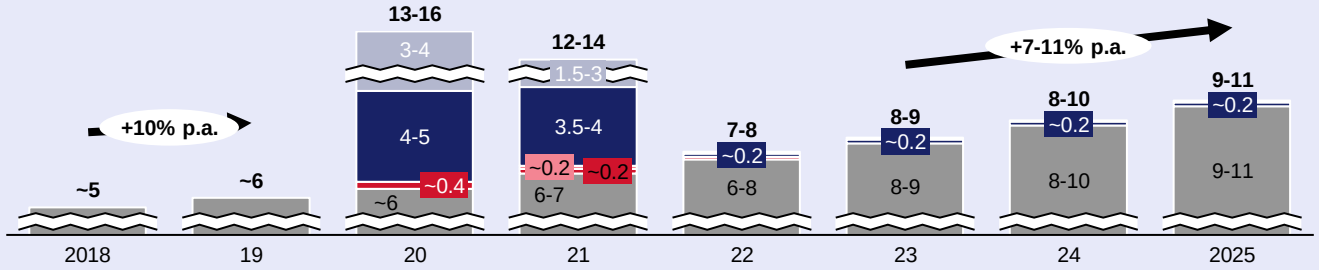


PPE demand, 2018-25

Propagation trend[1]

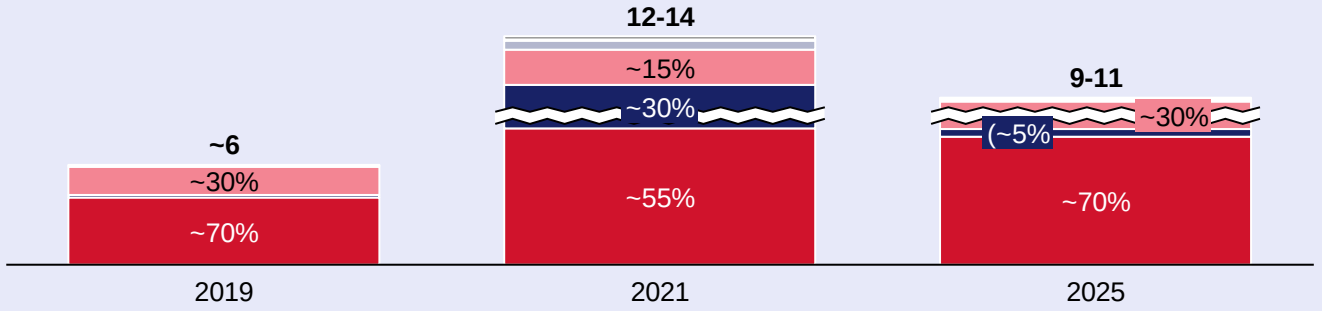
Demand by source

Total estimated[2] PPE demand by volume, 2018-25, units, bn[3]



Demand by PPE category

Total estimated[2] demand by type of PPE, 2019-25, % of total demand by volume



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2. Range reflects 2 scenarios (“high” vs. “low”): non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits) hospital days and vaccination scenarios depend on vaccination scenario (“pessimistic” vs. “optimistic”), and non-healthcare worker and consumer demand depend on adoption rate assumptions (“high” vs. “low”)
3. Unit is per item or per pair in case of gloves, hand sanitizer is per litre and chlorine is per kg

Source: Johns Hopkins, EPI model

Contents

Emerging perspectives on short to medium term PPE market dynamics

1. **We expect the 2020 demand peak triggered by the COVID-19 pandemic to be sustained in 2021, leading to 2 potential scenarios**: (i) established players continue to capture the greatest share of this new demand, as they are already cost-competitive, have ramped up capacity and already meet quality requirements, (ii) new entrants are able to capture a degree of market share, provided that they can remain cost-competitive, manage to meet quality standards and receive government support

2. **Interviews with industry experts suggest that there is a risk of oversupply arising in the next few months, as fresh production capacity is now able to cover PPE needs in most geographies[2] and as first demand growth is expected to slow down in 2021 and then second volumes actually drop in 2022; therefore, the prospects for new entrants may seem limited**

   2a. Some countries are already showing early signs of oversupply, as governments have built up significant stockpiles, especially masks (e.g. UK and France already have excess stock) and export restrictions are progressively being lifted, allowing a global rebalancing of supply and demand. As a result, some major players (especially in China) are already scaling back their production after a peak in Q2 2020

   2b. As prices return to pre-crisis levels, it will be harder for new, small-scale players to remain cost-competitive with established players (who have themselves achieved further scale economics during the pandemic); these difficulties may be even more acute for local players, as market economics may trump national autonomy ambitions in the medium term. Thus thorough business plans will need to be constructed for any manufacturing project to prove its long-term viability

3. **In this context, PPE manufacturers (including large incumbents and small or new ones) can consider 3 strategic moves: securing their short and medium term demand in selected geographies/with selected buyers, diversifying into other activities across the value chain and concentrating on innovation**

   3a. **Securing their short and medium term demand in geographies where they are cost-competitive through various channels** including (i) immediate opportunities from national online tender platforms and private hospitals (small volumes, specific products) and regional online pooled tender platforms (e.g. EU state grouped procurement platform, Africa Medical Supply Platform), (ii) longer-term contracts with public and private GPOs[1], distributors and international organizations (e.g. UNICEF SD) currently looking to expand their supplier lists for the coming years, and (iii) adjacent non-COVID-19-related markets (e.g. construction) – channels are similar across geographies, with potential per channel varying from one geography to another

   3b. **Diversifying into other activities across the value chain**: some opportunities for new businesses may arise from market segments which have been suffering from the most significant pressures, in part due to (i) shortages of melt-blown non-woven fabrics for masks, (ii) shortages of alcohol for hand sanitizers and (iii) shortages of glove production lines

   3c. **Concentrating on innovation**: the growth in PPE usage among consumers, especially of masks, has spurred innovation among manufacturers and could be an opportunity for further development (e.g. connected masks)

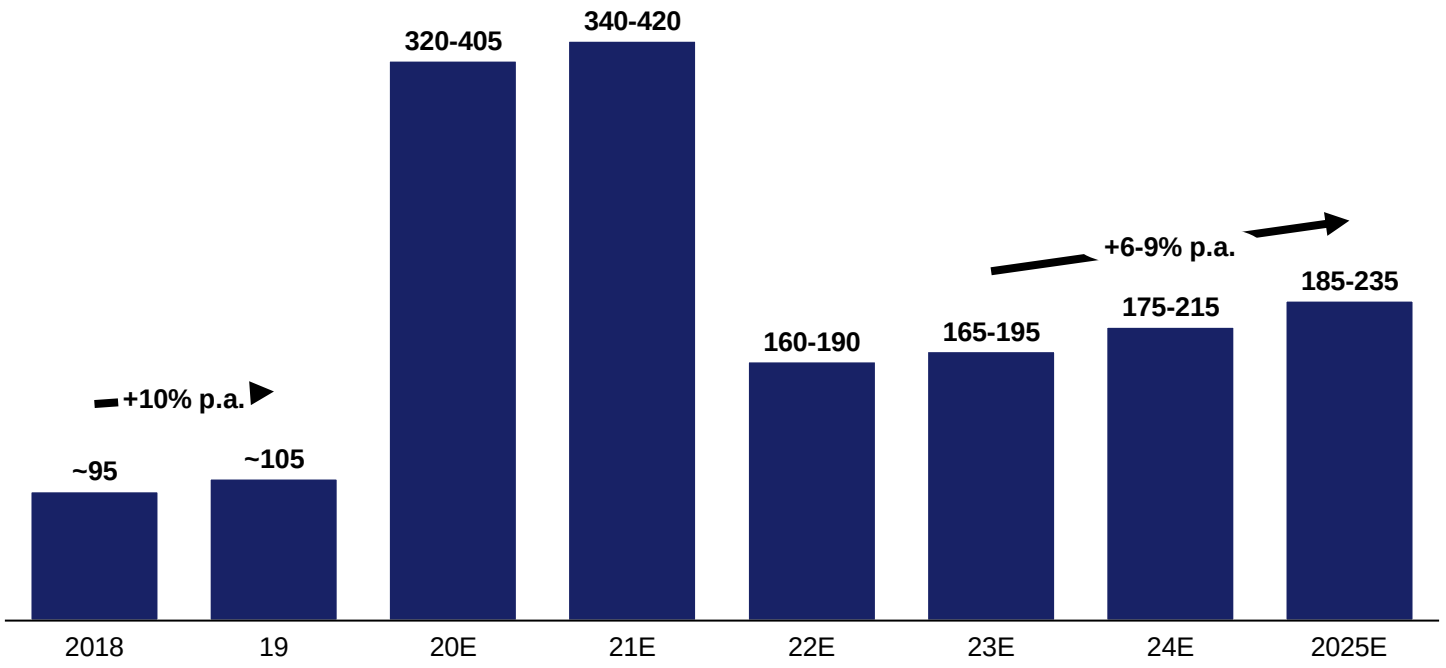
1. Group Purchasing Organizations
2. From our interviews, some tensions still remain regarding gloves

Source: ITC Trade Map, OECDE, Mordor Intelligence, Asian Development Bank, interviews with industry experts (November-December 2020), official government statements, press search

1| The 2020 demand peak triggered by COVID-19 will persist into 2021, and is up for capture by both incumbents and new players

ESTIMATES – ONLY MEDICAL PPE CONSIDERED – AS OF MID-DECEMBER 2020

Global estimated[1] PPE demand by volume, 2018-25, units, bn[2]



Key messages

The 2020 demand peak triggered by the COVID-19 pandemic is expected to persist into 2021, leading to 2 potential scenarios

- Incumbents continue to capture the lion's share of this new demand as they are already cost-competitive, have been able to ramp up their production capacity during the crisis and already meet quality requirements
- New entrants may be able to capture a degree of market share, provided that they can remain cost-competitive, manage to meet quality standards, and receive government support (especially in guaranteeing offtake)

1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID-19 baseline demand depends on 2 growth scenarios (historic growth of -2% to account for critical size of the market vs. historic growth of +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare worker and consumer demands depend on adoption rate assumptions ("high" vs. "low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre, and chlorine is per kg

Source: Mordor Intelligence (updated in November 2020)

2a| Despite supply bottlenecks at the start of the crisis, several countries have now built stockpiles and are showing early signs of oversupply

NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF NOVEMBER 2020

Both France and the UK have accumulated large stocks of PPE

Before the crisis, France was producing 3 million masks a week [...] In June, 25 million masks were produced each week in France [...] 40 million masks did not find takers. […] it is estimated that 10% of the companies involved in this production have stocks on their hands
– Press article (France Culture), June 2020

"Stocks of masks manufactured in France are largely sufficient to meet local demand […] In the Auvergne-Rhône-Alpes region alone, we have a stock of 3 million masks and enough fabric to manufacture an additional 19 million"

– Regional general delegate (Pierric Chalvin), July 2020

Mask oversupply has succeeded the lack of supply in the French textile industry. […] Some companies have actually had to lay off employees because of oversupply

– Press article (France Info), July 2020

"The government is now in a position where it has sufficient contracted supplies to meet demand, and the total volume of offers it has is far greater than any foreseeable future requirement

It is therefore no longer accepting offers for PPE. It has also closed down all existing offers submitted that are surplus to requirements"

– Contractsfinder.service.gov.uk

Volume and value of PPE ordered in the UK has started to ramp down from June, given stock supply

– National Audit Office analysis of Department of Health & Social Care information

Interviews with industry experts suggest a potential oversupply risk

"The UK is already facing an oversupply situation on surgical masks

– Procurement Director at a government agency, November 2020

"We will find ourselves in an oversupply market once the pandemic is over. Australia alone can now supply all of Europe's pre-COVID-19 needs

– PPE industry expert, November 2020

"Since the second wave in Europe, there has been a slight increase in orders, but without comparison with last March and April. Countries have built up stocks and are now relying on them

– PPE industry expert, November 2020

Source: press search, interviews with industry experts (November-December 2020)

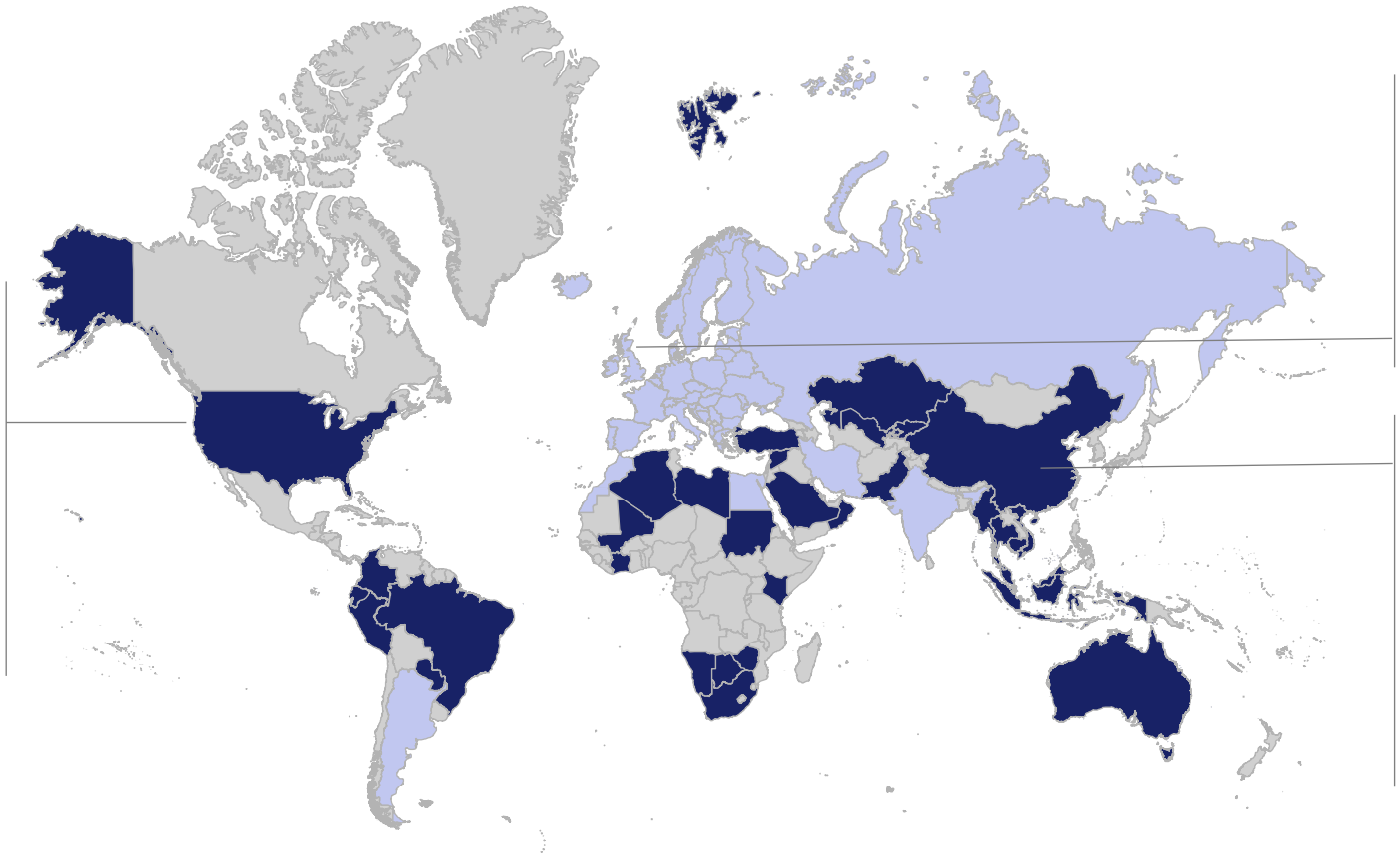
2b| The progressive lifting of export restrictions imposed in March has eased supply pressure and rebalanced global supply and demand

NON-EXHAUSTIVE AND ILLUSTRATIVE – AS OF NOVEMBER 30, 2020

PPE export restrictions worldwide as of November 2020

Countries with active export restrictions

Countries with export restrictions which have been terminated



In April 2020, the US banned exports for 5 categories of PPE (including respirators, gloves and masks)

In August, the export ban was renewed until December 2020

In April 2020, the UK decided to introduce a specific license to allow exports of PPE beyond the EU and EFTA member states

In April 2020, China banned medical supplies exports from firms not licensed to sell them nationally.
At the end of April, a new set of regulations was introduced which made manufacturers subject to export authorisations

Source: International Trade Center website (access in November 2020)

3a| PPE manufacturers can try to secure their short and medium term demand in geographies where they are cost-competitive through various channels to be investigated systematically in each of these geographies

Demand supplied to	Typical channels	Description
Public healthcare provision and rest of government	**International organizations' procurement arms**	International organizations procuring from manufacturers on their own behalf to distribute to beneficiary governments (typically central/federal level), or on behalf of these individual governments
	Regional online tendering platform	Digital procurement platform allowing groups of governments (typically central/federal) to pool needs and jointly procure, or post individual procurement needs for medical supplies from manufacturers
	Distributors and/or GPOs supplying to public sector	Private distributors supplying to public entities (e.g. ministries, public hospitals, local governments/authorities, public GPOs) or private GPOs suppling to distributors or directly to these public entities, through competitive tendering/bidding
	Direct tendering from public sector	Direct procurement by public entities (e.g. ministries, public hospitals, local governments/authorities, public GPOs) through tenders open to manufacturers – typically through online national tendering/bidding platform
Private healthcare provision	**Distributors and/or GPOs supplying to private sector**	Private distributors supplying to private entities (e.g. private hospitals and pharmacy chains) through competitive tendering/bidding
	Direct tendering from private sector	Direct procurement by private entities (.g. private hospitals and pharmacy chains) through tenders open to manufacturers

Source: Interviews with industry experts (November-December 2020)

3a| Example – In Africa, 2 of the 6 typical channels seems the most promising for manufacturers and may be highest priority to explore

NON EXHAUSTIVE AND ILLUSTRATIVE

Limited → High

Demand supplied to	Typical channels	Examples of organizations involved	Level of opportunity[1]
Public healthcare provision and rest of government	International organizations' procurement arms	unicef, UN	UNICEF stating open to enriching its supplier catalogue in 2021 directly with manufacturers
	Regional online tendering platform	African Union, AFRICA CDC, AFREXIMBANK, UNECA	African Medical Supply Platform (AMSP) launched in 2021 to pool volume from public sector across continent
	Distributors and/or GPOs supplying to public sector	Central pharmacies and public procurement authorities (public GPOs) from several African countries	Several central state reported to be overall over-stocked with PPE at end of 2021 (e.g. French-speaking Africa); some exception also reported (e.g. Ethiopia)
	Direct tendering from public sector	Ministries of Health of several African countries	
Private healthcare provision	Distributors and/or GPOs supplying to private sector	Imperial beyond possibility, UbiPharm, STURROCK AND ROBSON AFRICA, UPD WE DELIVER HEALTHCARE	Inconsistencies in distributors reporting willingness to enlarge PPE supplier list
	Direct tendering from private sector	EURACARE ADVANCED DIAGNOSTICS, nisa HOSPITAL	Expectedly smaller volumes

1. Qualitative assessment based on expert interviews - current as Nov-Dec 2020

Source: Interviews with industry experts (November-December 2020)

3a| Example – In Europe, distributor and GPO channels seems the most promising for manufacturers to supply both public and private sectors moving forward and may be highest priority to explore

NON EXHAUSTIVE AND ILLUSTRATIVE

Limited → High

Demand supplied to	Typical channels	Examples of organizations involved	Level of opportunity[1]
Public healthcare provision and rest of government	International organizations' procurement arms	n/a	n/a to European countries overall
	Regional online tendering platform	Ted	Launch of pan-European med product procurement platform, few tenders open from local authorities and various public entities (e.g. schools)
	Distributors and/or GPOs supplying to public sector	Distributors: MEDLINE, HARTMANN; GPOs: AMGROS, resah, AGKAMED, SCR Piemonte	Distributors and GPOs reported to be looking to enlarge their supplier list with cost-competitive options closer than Far East
	Direct tendering from public sector	consip, PARIS, Regione Lombardia	Few tenders open from local authorities and various public entities (e.g. schools) on national platforms,, sometimes directly accessible to manufacturers (vs. distributors/GPOs)
Private healthcare provision	Distributors and/or GPOs supplying to private sector	Distributors: MEDLINE, HARTMANN; GPOs: AMGROS, resah, AGKAMED, SCR Piemonte	Distributors and GPOs reported to be looking to enlarge their supplier list with cost-competitive options closer than Far East
	Direct tendering from private sector	BMI Healthcare, Aspen Healthcare, Ramsay Générale de Santé, ASKLEPIOS, Gruppo San Donato	Some opportunities flagged by private hospitals in UK on specific niche products (gloves, gowns) when NHS undersupplying; probably low volumes

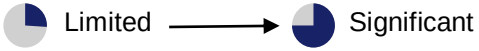
1. Qualitative assessment based on expert interviews - current as Nov-Dec 2020

Source: Interviews with industry experts (November-December 2020)

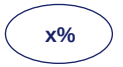
3b| New businesses could target 3 potential diversification opportunities across the PPE value chain

NON-EXHAUSTIVE – FROM EXPERT INTERVIEWS, AS OF MID-DECEMBER 2020
THOROUGH BUSINESS PLANNING REQUIRED TO ASSESS FURTHER THE 3 OPPORTUNITIES

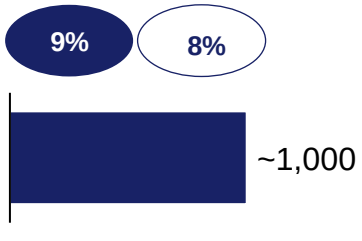
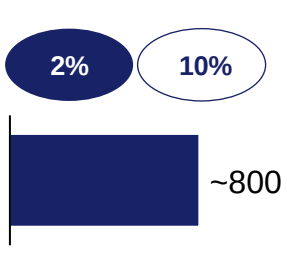
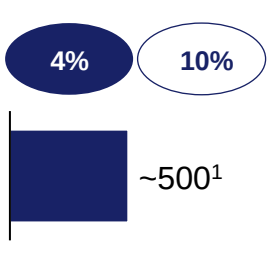
Level of opportunity



Historic CAGR 2017-19



Forecast CAGR 2020-25

Opportunities	Market size 2019, Estimates, $m	Market opportunity: high-level and directional assessment	Barriers to entry (non-exhaustive; see further details next pages)
i Melt-blown manufacturing		 Supplying smaller mask manufacturers	• Regulation • Raw material and machinery shortage • Consolidated market • Importance of scale
ii Gloves machinery manufacturing		 Manufacturing semi-automated machines requiring less technical knowledge and expertise	• Technical knowledge and expertise • Brand recognition needed • Highly fragmented market concentrated in China for semi-automated machines manufacturers
iii Alcohol manufacturing (for hand sanitizer)		 Purchasing a low- quality alcohol factory (e.g. for gasoline end use) and upgrading it to a high-quality alcohol plant to supply hand sanitizer manufacturers	• Importance of scale • High capex required • Brand recognition needed • Proximity to feedstocks required • Regulation

1. Global market size in volume is estimated at 200m gallons in 2019 and average price is estimated at $2.50/gallon

Source: industry expert interviews (December 2020)

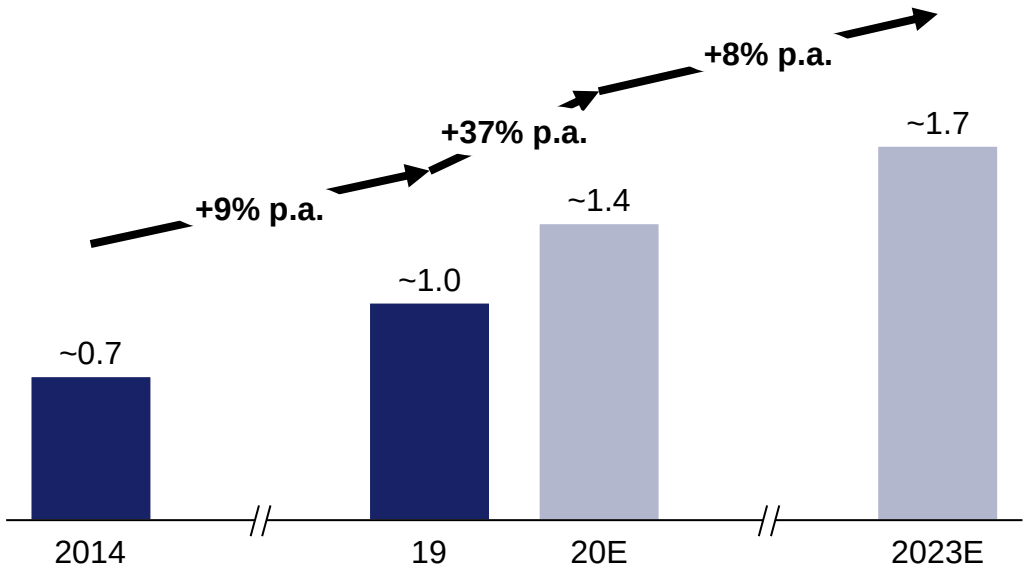
3b.i| Melt-blown manufacturing: to be successful, new entrants will need to achieve scale and secure raw materials and machinery

THOROUGH BUSINESS PLANNING REQUIRED TO ASSESS FURTHER THE OPPORTUNITY NON-EXHAUSTIVE – FROM EXPERT INTERVIEWS, AS OF MID-DECEMBER 2020

SEE APPENDIX FOR DEEP-DIVE ON THE MELT-BLOWN SEGMENT

Market opportunity

Melt-blown non-woven market size, estimates, $bn



Supplying small mask manufacturers who do not have access to large melt-blown producers

Could also target other end users as melt-blown non-woven is used in several industries: medical, electrical and electronics, insulation equipment, automotive and hygiene

Key success factors and barriers to entry (non-exhaustive)

Competitive industry with large players dominating the market

The melt-blown competitive landscape is consolidated
- ~10-15 large players account for ~60% of the market, including 4-5 integrated players who manufacture finished PPE (e.g. 3M, DuPont)
- ~80-90 small manufacturers operate in the US, China, and Europe, targeting small-scale local hygiene products manufacturers
- In addition, +100 small manufacturers have supplied other industries (e.g. automotive) and shifted during the crisis to target mainly the medical segment

Changing regulations and brand strength

- Regulations have changed rapidly during the pandemic, with quality standards requirements becoming more stringent

Scale and volume

- Economies of scale and volume are critical to achieve competitiveness in this industry

Limited availability of machinery and raw materials

- Only 4-5 companies manufacture high-quality machine lines for the production of high-quality melt-blown and it takes ~6 months to produce 1 line
- Polymer is the main raw material used to manufacture melt-blown non-woven and has been in short supply during the pandemic

Source: Global market insights, OECD, industry expert interviews (November 2020)

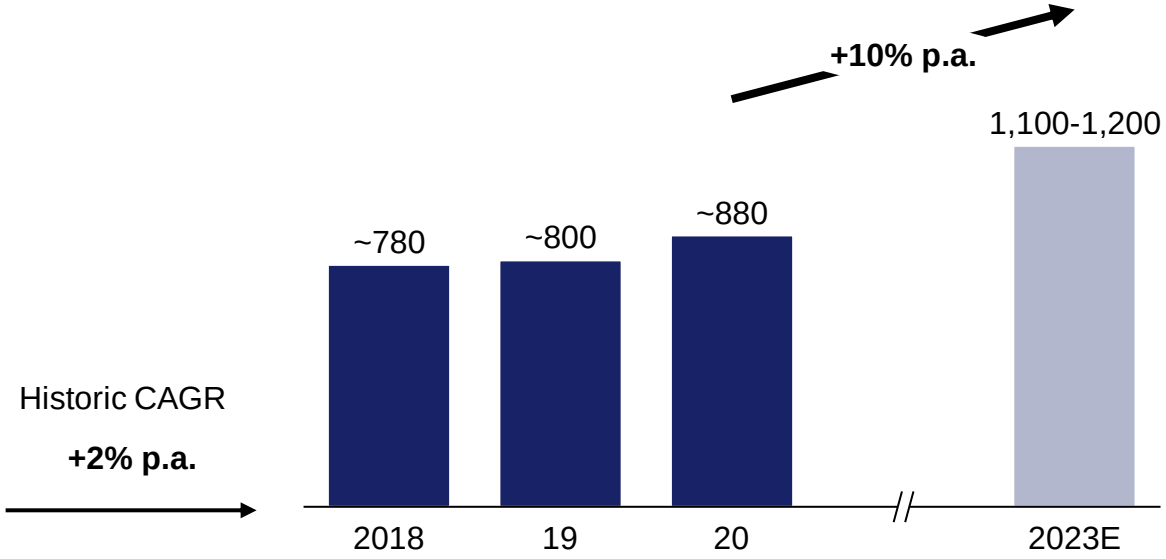
3b.ii| Glove machinery manufacturing: to be successful, new entrants will need to acquire technical expertise and quickly build brand strength

THOROUGH BUSINESS PLANNING REQUIRED TO ASSESS FURTHER THE OPPORTUNITY

NON-EXHAUSTIVE – FROM EXPERT INTERVIEWS, AS OF MID-DECEMBER 2020

Market opportunity

Gloves machinery market size, estimates, $m



Manufacturing semi-automated machines which require less technical expertise to operate and maintain (and use it to supply small- to medium-scale glove manufacturers)

Key success factors and barriers to entry (non-exhaustive)

Technical expertise and knowledge

- Technical knowledge and expertise are key, as gloves machinery is highly complex and automated (just programming the machines requires specific knowledge)
- Talent sourcing and IP protection is very important in this industry

Brand recognition

- Brand recognition is critical to build credibility in the market and prove efficiency and reliability of the machines
- Building a solid customers portfolio will be a challenge in the first years

High competition

- Highly competitive industry with a very fragmented market concentrated in China for semi-automated machines manufacturers (no clear leaders yet stand out)

Source: Industry experts interviews (December 2020)

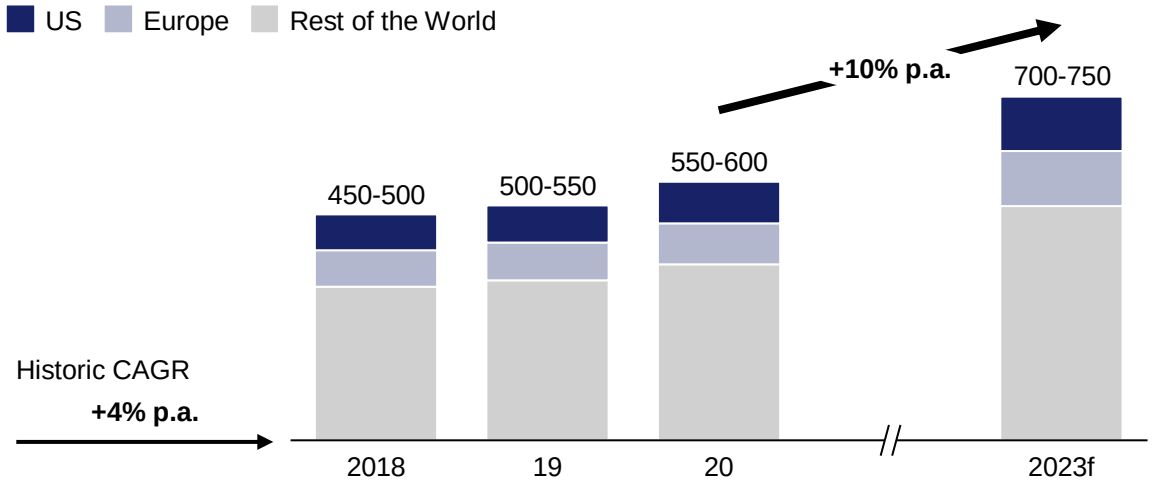
3b.iii| Hand sanitizer alcohol manufacturing: to be successful, new entrants will need quickly to build brand strength and thus scale

THOROUGH BUSINESS PLANNING REQUIRED TO ASSESS FURTHER THE OPPORTUNITY

NON-EXHAUSTIVE – FROM EXPERT INTERVIEWS, AS OF MID-DECEMBER 2020

Market opportunity

Alcohol used for hand sanitizer market size, $m (estimates from experts)



- Asia and Africa are net importers and would be the most attractive markets; US and European markets are crowded with adequate supply
- Need to diversify end users to achieve scale (as only 10-15% of high-quality ethyl alcohol is used for hand sanitizer/surface disinfectant)
- Rather than making a greenfield investment, new entrants could purchase existing low-quality alcohol production facilities (e.g. for gasoline end use) and upgrade it to a high-quality alcohol plant to supply hand sanitizer manufacturers

Key success factors and barriers to entry (non-exhaustive)

Scale and volume	• Economies of scale and volume are critical to survive in this industry (likely to achieve competitiveness 2-3 years after the purchase and upgrade of an existing low-quality alcohol plant)
Brand recognition	• Brand recognition is key to build credibility in the market (it takes ~3 years to get customer trust for a new brand on the market)
Feedstocks proximity	• Proximity of feedstocks (e.g. wheat, maize) is a critical factor for achieving cost competitiveness
Regulation	• Regulatory barriers: such a factory would be considered a pharma plant (and thus need to register with FDA or equivalent and guidelines to respect)
Capex	• Capex required: $60m minimum for a plant of 50m gallons/year capacity (purchased and upgraded) vs. $120m to set up a new plant from scratch

Source: Industry experts interviews (December 2020)

Contents

Overview of the US PPE market

1. Overview of the national market pre-COVID-19

Despite being a leading producer of several categories of PPE, the US is also heavily reliant on imports to meet domestic demand

- The US is a leading manufacturer of masks, coveralls and aprons, accounting for a 20-25% share of global production and is home to several top global players (e.g. 3M, Honeywell, Kimberly-Clark)
- However, the US still relies considerably on imports, being the largest[t] importer of masks and coveralls (imports of $360m in 2019, mostly from China) and the second largest importer of gloves (imports of $450m in 2019, mostly from Malaysia)

2. Perspectives on the COVID-19 supply/demand

The US has been one of the countries worst hit by the COVID-19 pandemic, with over 20m cases and 340k deaths (as of end-December 2020), which has driven booming demand for medical PPE

This increased demand, combined with export restrictions imposed by historic supply markets, has resulted in shortages, leading the US to scale up local PPE production (e.g. ~10x for masks, ~5x for face shields) to meet domestic needs

This increase in local manufacturing has been supported by several measures by the US government: (i) financial support for local supply chain operators through the DFC[1], (ii) use of the Defense Production Act to push manufacturers to increase production, and (iii) export bans on PPE (still active up to December 2020)

As of early December 2020, shortages still exist in some US states as the pandemic reaccelerates; conversely, early signs of oversupply of surgical masks have been observed during Q3 2020 when the pandemic slowed down temporarily (e.g. Fastenal announced it had a glut of masks, as it has built significant stockpiles)

3. Overview of the national distribution strategy

Pre-COVID-19, the PPE buyers landscape was dominated by distributors (accounting for ~60% of PPE transactions) who were selling directly to healthcare systems

Since the start of the COVID-19 crisis, this picture has changed considerably, notably because of new public sector entities:

- Federal and state governments are now the largest PPE buyers in the country (~40% of PPE transactions vs. ~10% pre-crisis)
- E-commerce channels have grown (~15% of transactions vs. ~10% pre-crisis) driven by the surge in consumer PPE usage (especially masks)

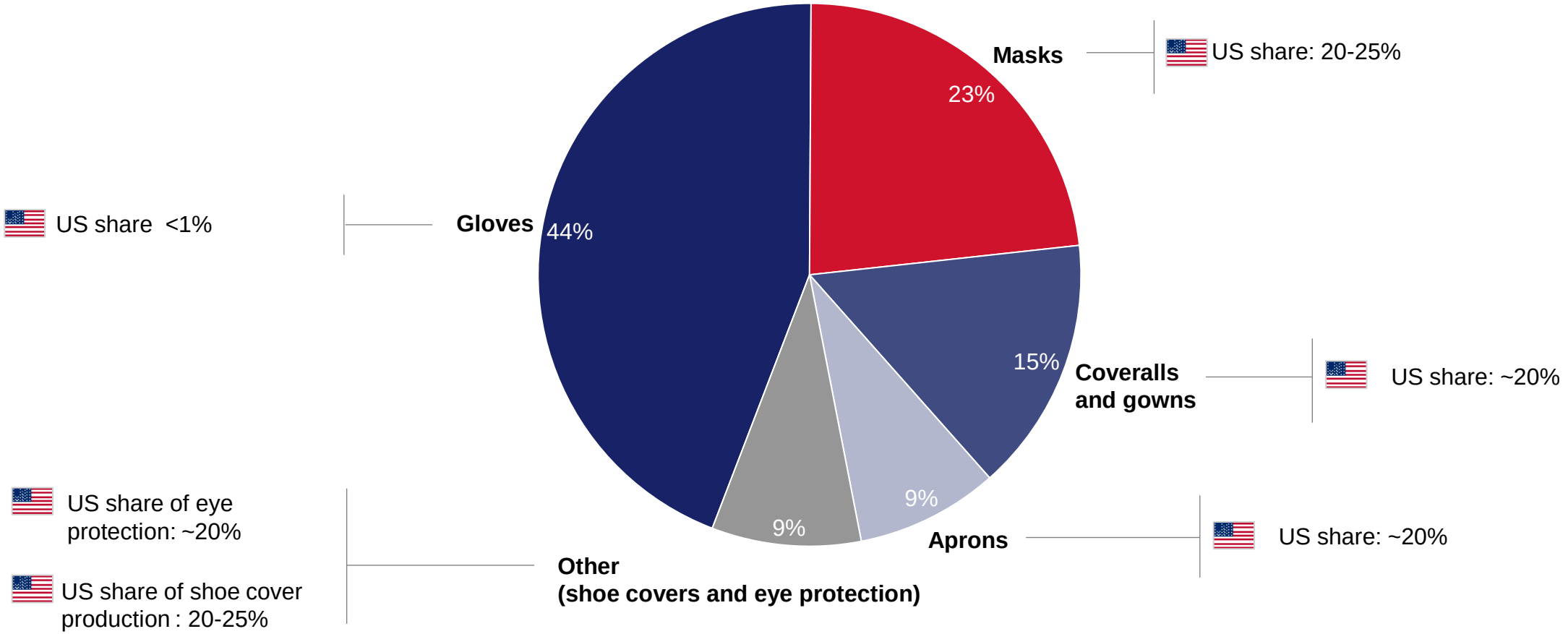
1. US International Development Finance Corporation

Source: Mordor Intelligence (updated in November 2020), Press search, interviews with industry experts (November-December 2020), Johns Hopkins Coronavirus Resource Center (data for COVID-19 cases and deaths as of December 31, 2020)

1| The US is a major manufacturer, accounting for ~20% of the global production of every category apart from gloves

MARKET ESTIMATES – ONLY MEDICAL PPE CONSIDERED

Global market by medical PPE category and mapping of the United States share of production, 2019, % of total market



Source: Mordor Intelligence (updated in November 2020), Statista research department, interviews with industry experts (November-December 2020)

1| The US is home to several top global players, including 3M, Honeywell, and Kimberly Clark

PPE suppliers present in the US

NON-EXHAUSTIVE AND ILLUSTRATIVE

Suppliers (non-exhaustive)		Revenues 2019, $m	PPE type (non-exhaustive): Surgical masks and respirators	Medical gloves	Gowns	Face shield and goggles
	Cardinal Health, Inc.	137,000		✓	✓	
Honeywell	Honeywell Safety Products	42 000		✓		
	Kimberly-Clark Professional	18 400		✓		✓
	Owens & Minor, Inc.	9 840		✓	✓	
SVS	SVS, LLC	3 500		✓		
Ansell	Ansell Protective Products, Inc.	2 500		✓		✓
Molnlycke	Molnlycke Health Care US, LLC	1 500		✓		
MSA	MSA Safety	375				✓
Lakeland	Lakeland Industries, Inc. (NasdaqGM:LAKE)	105			✓	
PRESTIGE AMERITECH	Prestige Ameritech, Ltd.	55			✓	
TRONEX	Tronex	50		✓		
impact	Impact Products	35			✓	
White Knight	White Knight Engineered Products, Inc	17			✓	
Precept	Precept Medical Products, Inc.	12			✓	
3M	3M Company (USA)	n.a.	✓			✓
AlphaProTech	Alpha Pro Tech, Ltd. (AMEX:APT)	n.a.	✓			
AMSTON	Amston Tool Company	n.a.	✓			
CROSSTEX	Crosstex International	n.a.	✓			
FABRIC SOURCES	Fabric Sources International	n.a.	✓			
MOLDEX	Moldex-Metric, Inc (USA)	n.a.	✓			
OXCO	Oxco	n.a.	✓			
Gateway	Gateway Safety, Inc.	n.a.				✓
	Laser Engineering Inc	n.a.				✓
Miller	Miller Electric Manufacturing Co.	n.a.				✓
OBERON	Oberon Company	n.a.				✓
Protex	Pro-Tex	n.a.				✓
PYRAMEX	Pyramex	n.a.				✓
SPERIAN	Sperian Eye & Face Protection, Inc.	n.a.				✓
	TIDI Products	n.a.				✓

Source: press search, calls with suppliers

1| Despite being a major PPE producer, the US relies heavily on imports to meet local demand

Exports/imports of the main PPE categories in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	US exports 2019, selection of medical PPE (non-exhaustive)			**US imports 2019,** selection of medical PPE (non-exhaustive)		
	Value, $m	**Exporter rank,** globally	**Largest export partners**	**Value, $m**	**Importer rank,** globally	**Largest import partners**
Masks[1]	36	#3	Mexico: 38% Canada: 24% Germany: 5%	360	#1	China: 72% Mexico: 11% Canada: 2%
Coveralls, gowns and aprons[2]	90	#7	Mexico: 45% Canada: 25% Australia: 6%	850	#1	China: 55% Mexico: 17% Honduras: 11%
Gloves[3]	13	#12	Mexico: 29% Canada: 27% Dominican Rep.: 9%	450	#2	Malaysia: 47% Thailand: 46% Sri Lanka.: 5%

1. The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)
2. The HS code used is 621010 (garments made up of felt or non-wovens) and may not consider exclusively medical coveralls, aprons, and gowns
3. The HS code used is 401511 (surgical gloves)

Source: ITC Trade Map

2| During 2020, US PPE production increased significantly as a consequence of COVID-19

Estimates of production increases for a selection of PPE categories during the COVID-19 crisis

NON-EXHAUSTIVE – DIRECTIONAL ESTIMATES FROM PRESS AND EXPERTS INTERVIEWS

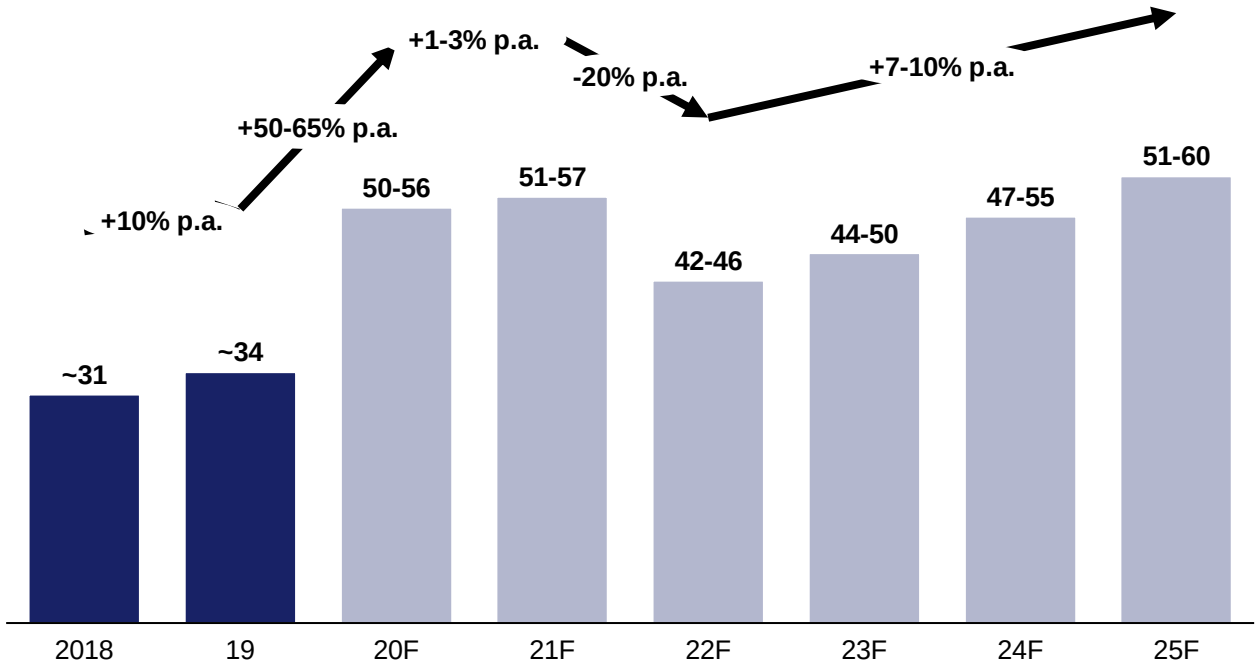
Selection of medical PPE (non-exhaustive)	**Estimated peak production increase,** %	**Market insights from press search and experts interviews** (as of December 2020)	
Masks	800-1200%	Based on the investments made by the department, Cummings [principal Deputy Assistant Secretary of Defense] told the House panel, an increase in production of 450 million [N95] masks a year will be attained by October [knowing that production pre-COVID-19 was ~45 million N95 masks a year] **– Press article (Dod news), June 2020**	3M's monthly production of N95 respirators in the U.S. alone will have increased from 22 million in 2019 to 95 million by the end of 2020, a spokesperson said **– Press article (CBS News), November 2020**
Face shield	400-600%	Bullard […] is now working around the clock to produce highly sought-after products like face shields for healthcare workers. The company has been manufacturing more than 5 times than they used to, and still trying to increase the capacity every day **– US Chamber of Commerce**	Bauer, a U.S.-based company that manufactures hockey gear, has shifted […] started mass production of face shields. Bauer is set to produce 300,000 units and has received interest in more than 1 million medical shields **– US Chamber of Commerce**
Hand sanitizer	200-500%	Hand sanitizer sales have increased more than 300% in 1 week alone, and major retailers like Target, Kroger, Publix, and Stop & Shop have set limits on how much each shopper can buy **– Press article (Today), March 2020**	Dow Chemical is expanding its efforts […] by shifting production at some of its plants around the world to making hand sanitizer. The company will use 5 facilities to produce more than 880,000 8-ounce bottles, which will be donated to health systems and governments **– US Chamber of Commerce**

Source: press search, interviews with industry experts (November-December 2020)

2| This 2020 demand peak will be sustained in 2021 but will drop in 2022 and return to historic ~10% p.a. growth during 2023-25

ESTIMATES FROM DEMAND MODEL, AS OF MID-DECEMBER 2020

Estimates [1] of US PPE demand by volume, 2018-19 historic and 2020-25 forecast, units, bn[2]



Market drivers

US demand surge in 2020 was mainly driven by

- Surgical masks (+700-800% vs. pre-crisis), which are expected to represent 10-15% of 2020 volumes (vs. 2-4% in 2019)
- Gloves (+30-40% vs. pre-crisis), which are expected to represent 60-65% of 2020 volumes (vs. 65-70% in 2019)

By 2025, the market is expected to return to historic growth rates (i.e., +10% p.a.) and category mix (60-65% of gloves, 25-30% of gowns/coveralls/aprons and 2-4% of surgical masks)

1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID baseline demand depends on 2 growth scenarios (historic growth -2% to account for critical size of the market vs. historic growth +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare worker and consumer demands depend on adoption rate assumptions ("high" vs."low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre, and chlorine is per kg

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

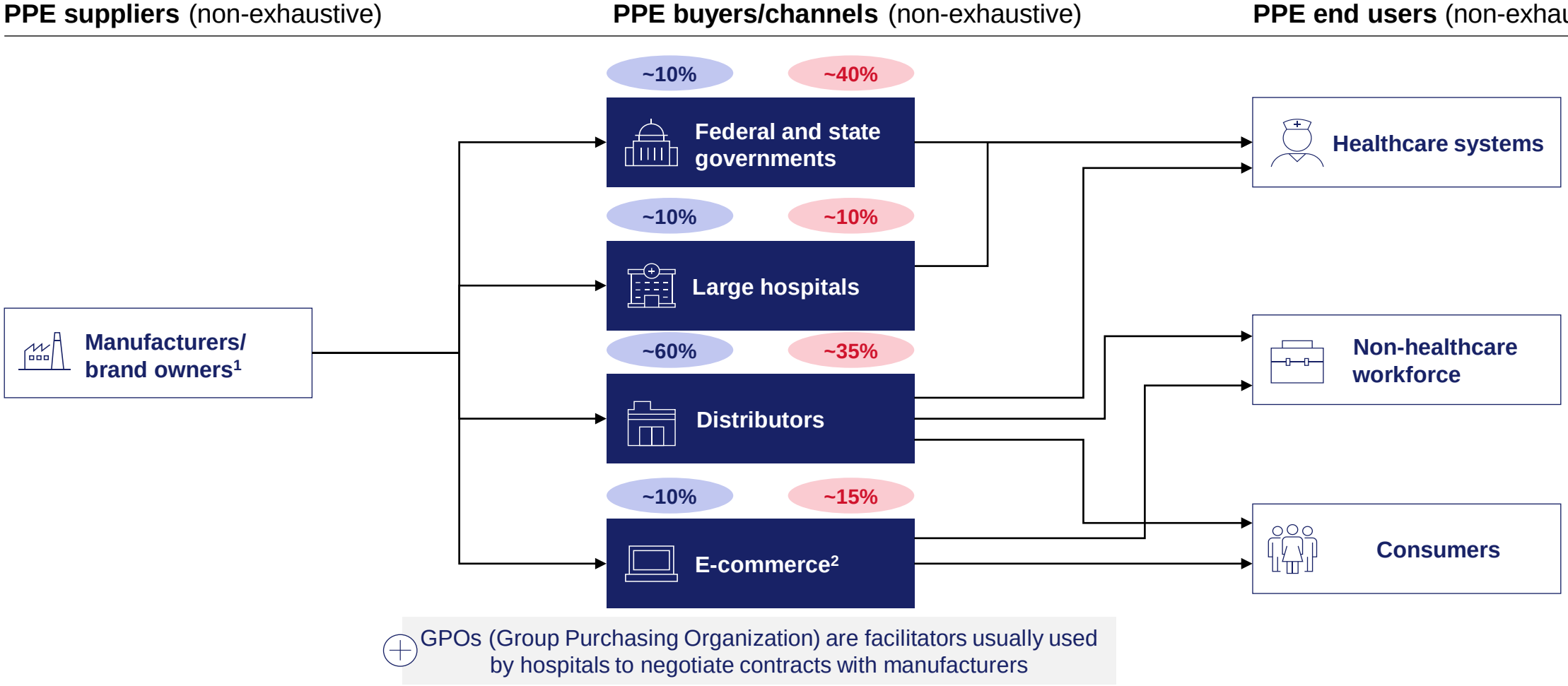
3| Over the past few months, Federal and state governments have become the largest buyers of PPE and e-commerce has grown (1/2)

High-level overview of the main PPE selling channels in the US

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

x Volume share pre-COVID-19

x Volume share during COVID-19 crisis



1. Large PPE players are called brand owners when they purchase PPE products from manufacturers and put their brand on it
2. Most of the times, e-commerce platforms are only used as channels but do not purchase products

Source: interviews with industry experts (November-December 2020)

3| Over the past few months, Federal and state governments have become the largest buyers of PPE and e-commerce has grown (2/2)

High-level overview of the main PPE selling channels in the US

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

PPE buyers/channels	High-level overview of COVID-19 impact	Procurement process (non-exhaustive)
US Government and US States	US federal and states government became the largest PPE buyers in the US as they started building stocks of PPE with the objective of avoiding future shortages	Procurement is defined by the IRP (Integrated Resource Planning) process where both the manufacturers and distributors answer to government calls for tender with their available volume and pricing States bid against each other and against the Federal government in buying PPE
Distributors	Private hospitals usually go through a distributor but they also typically engage a GPO (Group Purchasing Organization) to negotiate contracts with manufacturers	Distributors usually have a list of manufacturers/brand owners from whom they buy PPE (e.g. 3M usually contracts with ~10 large distributors) This supplier list is usually reviewed and updated annually. The process to become a distributor's supplier is strict, requires 2-3 months of work and culminates in the signing of a MSA[1], which lasts on average 3 years) Contracts are usually strict with no possibility for the manufacturer to compel the distributors to support any share of possible cost increases
Large hospitals	Large hospitals have seen their volume share remain consistent during COVID-19	Only large hospitals can go directly to manufacturers/brand owners (average minimum annual purchase volumes of $800k) and are otherwise redirected to distributors Large hospitals usually deal with a dedicated key account manager at partner manufacturers
E-commerce	E-commerce channels have emerged during the COVID-19 pandemic as private individual consumption surged dramatically (especially for masks)	E-commerce platforms (e.g. Amazon) are only used as distribution channels by manufacturers/brand owners (e-commerce platforms rarely purchase PPE on their own account)

1. Master Service Agreement

Source: interviews with industry experts (November-December 2020)

3| To secure offtakes with their largest buyers, PPE manufacturers need to comply with strict US standards

NON-EXHAUSTIVE – FROM PRESS SEARCH , AS OF MID-DECEMBER 2020

PPE type	US standard requirements
Surgical masks 	ASTM F2100
Respirators 	ASTM F3387 - 19[1]
Surgical gloves 	ASTM D3577 - 19[2]
Protective gloves 	ASTM D5250-19 (for Polyvinyl chloride gloves) ASTM D5250-19 (for rubber examination gloves)
Protective eyewear and visors 	ANSI/ISEA Z87.1[3]
Medical clothing 	ASTM F2407-20 (for surgical gowns) ASTM F3352-19 (for isolation gowns)

1. Standard practice for respiratory protection
2. Standard practice for rubber surgical gloves
3. Standard practice for occupational and educational personal eye and face protection devices

Source: press search, ASTM International

Contents

Overview of the Chinese PPE market

1. Overview of the national market pre-COVID-19

China is the largest PPE exporter worldwide for most items and relies very little on imports, making it self-sufficient for most PPE items:

- China is the largest global producer of masks, coveralls, aprons, shoe covers and eye protection, accounting for 40-60% of global production
- China is the largest global exporter of masks, coveralls, aprons and gowns worldwide, accounting for 40-45% of global exports in 2019

2. Perspectives on the COVID-19 supply/demand

China was the first country to be hit by the COVID-19 pandemic, but according to official statistics, China seems to have controlled the pandemic with fewer than 10k cases reported since March 2020

When the world was experiencing shortage of PPE kits in Q1-Q2 2020, China assumed the role of lead producer and dramatically scaled up its local production:

- +3,000 new players entered the PPE industry to join 4,000 existing manufacturers
- In total, local production increased by ~1,000% in masks and 300-500% for gloves at peak, according to local industry players

This increase in local manufacturing has been supported by several government measures such as (i) financial support for the purchase of raw materials and labour hiring, (ii) tax breaks for manufacturers and (iii) new manufacturing licenses

Following this production increase, signs of oversupply have been observed during summer 2020, especially for surgical masks

3. Overview of the national distribution strategy

Pre-COVID-19, the PPE kit buyers landscape was dominated by distributors (accounting for ~65% of PPE transactions), with a solid e-commerce presence (~20% of PPE transactions)

During the COVID-19 crisis, the Chinese buyer landscape has changed considerably, with a surge of state buyers:

- The Chinese government has become the largest buyer of PPE (~60% of transactions vs. ~5% pre-crisis), as it was building stocks
- Distributors and e-commerce shares have decreased, each of them accounting for ~15% of transactions, while large hospitals have retained their ~10% share of the market

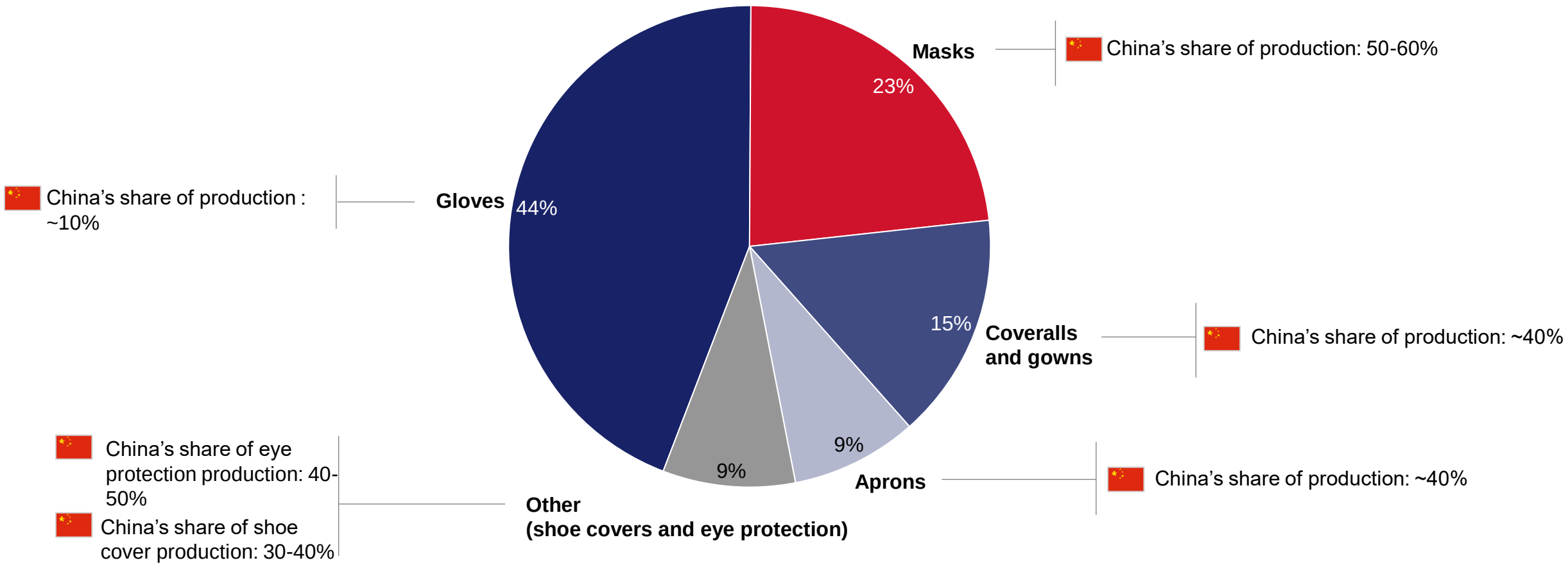
1. US International Development Finance Corporation

Source: Mordor Intelligence (updated in November 2020), Press search, interviews with industry experts (November-December 2020)

1| China is the largest global manufacturer of PPE and accounts for 40-60% of the entire market

MARKET ESTIMATES – ONLY MEDICAL PPE CONSIDERED

Global market by medical PPE category and mapping of China's share of production, 2019, % of total market



Source: Mordor Intelligence (updated in November 2020), Statista research department, interviews with industry experts (November-December 2020)

1| China is home to numerous PPE manufacturers across all product categories (1/2)

List of PPE suppliers present in China

NON-EXHAUSTIVE AND ILLUSTRATIVE

Suppliers (non-exhaustive)	Revenue 2019, $m	Local manufacturing (non-exhaustive)			
		Surgical masks and respirators	Medical gloves	Gowns	Face shield and goggles
Harbin Pharmaceutical Group Holding Co., Ltd	200			✓	
Jiangxi Hongda Medical Equipment Group	173		✓		
Jiangxi Zhonghong Pulin Medical Co., Ltd.	125		✓		
Medtecs International Corporation Limited	68			✓	
Huanghua Promisee Dental Co.,Ltd	43				✓
Chongqing Shiji Changhe Industrial Co., Ltd.	38		✓		
Shanghai Kebang Medical Latex Equipment Co., Ltd.	35		✓		
Suzhou Colour-way New Material Co., Ltd	24		✓		
Wuxi Yushou Medical Equipment Co.,Ltd.	19			✓	
Dongguan Sailang Sports Articles Co., Ltd.	14				✓
Tianrun (Zhuhai) health technology co,.Ltd.	14				✓
Fitone Group	13		✓		
Jiangxi Ideal Medical Co., Ltd.	8		✓		
Beijing Xinduhui Technology Co., Ltd.	7				✓
Shenzhen Rising Medical Co., Ltd.	7				✓
Henan Joinkona Medical Products Co., Ltd	6			✓	
Henan Yadu Industrial Co.,Ltd.	5			✓	
Xinxiang Hongda Weicai Co.,Ltd.	4			✓	
Jiangsu Raysun Medical Technology Co., Ltd.	4		✓		
Xiantao Ruifeng Sanitary Products Co.,Ltd.	3			✓	
Guilin HBM Health Protections Co., Ltd.	2		✓		
Hubei Ruikang Medical Material Co.,Ltd.	2			✓	
BanBao Co., Ltd.	1				✓
Taihe Xiaoliang Protective Equipment Co., Ltd.	1				✓
Shijiazhuang Yuhe Medical Supplies Co., Ltd.	1		✓		
HSSG International Co., Ltd	1			✓	
Hebei Sanxing Medical Latex Products Co., Ltd.	1		✓		
Anqing Jida Labor Protection materials co. LTD	n.a.	✓			
Baoji Gaosheng Medical Products Co., Ltd	n.a.	✓			

Source: press search, calls with suppliers

1| China is home to numerous PPE manufacturers across all product categories (2/2)

List of PPE suppliers present in the China

NON-EXHAUSTIVE AND ILLUSTRATIVE

Suppliers (non-exhaustive)		Revenue 2019,$m	Local manufacturing (non-exhaustive)			
			Surgical masks and respirators	Medical gloves	Gowns	Face shield and goggles
	Chengdu Shennongtang Industrial	n.a.	✓			
	Gaomiyu Poly Labor Protection Products Co., Ltd	n.a.	✓			
	Hangzhou Chixiao Tec Co., Ltd.	n.a.	✓			
	Harbin Jiesheng Technology Development co., Ltd. Medical equipment branch	n.a.	✓			
	Henna Ruike Medical Instrument Co Ltd.	n.a.	✓			
	Hubei Mingerkang Sanitary Protective Equipment co., Ltd.	n.a.	✓			
innonix	Innonix Tchnology (Shenzhen) Ltd.	n.a.	✓			
	Jiaozhou Naughty Baby Mask Factory	n.a.	✓			
	Jinzhou Fengguangrui Labor Protection Appliance Co., Ltd	n.a.	✓			
	Shandong Huazhan Labor Protection Appliance Co., Ltd	n.a.	✓			
	Sichuan Duochi Biotechnology Co. Ltd.	n.a.	✓			
	Tongcheng Jinlong Health Labor Protection Material Co., Ltd	n.a.	✓			
	Tongcheng Jinsong Labor Protection Articles Co., Ltd	n.a.	✓			
	Zhejiang Quzhou Nanhe Special Labor Protection Equipment Technology	n.a.	✓			
	Shenzhen Aurora Technology Limited	n.a.				✓
	Jinan Weiyang Medical Device Technology Co., Ltd.	n.a.				✓
ourlook	Ourlook (Zhangzhou) Optical Technology Co., Ltd.	n.a.				✓
JH	Shanghai Jheyewear Co., Ltd.	n.a.				✓
KEYGMA	Shenzhen Keygma Electrical Manufacturing Co., Ltd.	n.a.				✓
vivistar	Shenzhen Vivistar Technology Co., Ltd.	n.a.				✓
longmed	ZheJiang Longmed Medical Technology Co., Ltd.	n.a.				✓

Source: press search, calls with suppliers

1| China is the top PPE exporter worldwide, and relies very little on imports, making it self-sufficient for most components

Overview of exports/imports of main PPE categories in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	China exports 2019 , selection of medical PPE (non-exhaustive)			**China imports 2019,** selection of medical PPE (non-exhaustive)		
	Value, $m	**Exporter rank,** globally	**Largest export partners**	**Value,** $m	**Importer rank,** globally	**Largest import partners**
Coveralls, gowns, aprons[1]	900	#1	US: 40% Germany: 7% France: 6%	3	#54	Vietnam: 42% Cambodia: 21% Mexico.: 4%
Masks[2]	650	#1	US: 39% Japan: 10% UK: 5%	17	#14	Vietnam: 11% Japan: 11% Mexico.: 5%
Gloves[3]	280	#2	US: 45% Canada: 5% Japan: 4%	15	#26	Malaysia: 52% US: 18% Indonesia: 9%

1.The HS code used is 621010 (farments made up of felt or non-wovens) and may not consider exclusively medical coveralls, aprons, and gowns
2.The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)
3.The HS code used is 401511 (surgical gloves)

Source: ITC Trademap

2| Chinese PPE production increased significantly during 2020 due to COVID-19, with medical masks up by ~1,200%

Estimation of production increases on a selection of PPE during the COVID-19 crisis

NON-EXHAUSTIVE AND DIRECTIONAL – ESTIMATES FROM PRESS AND EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

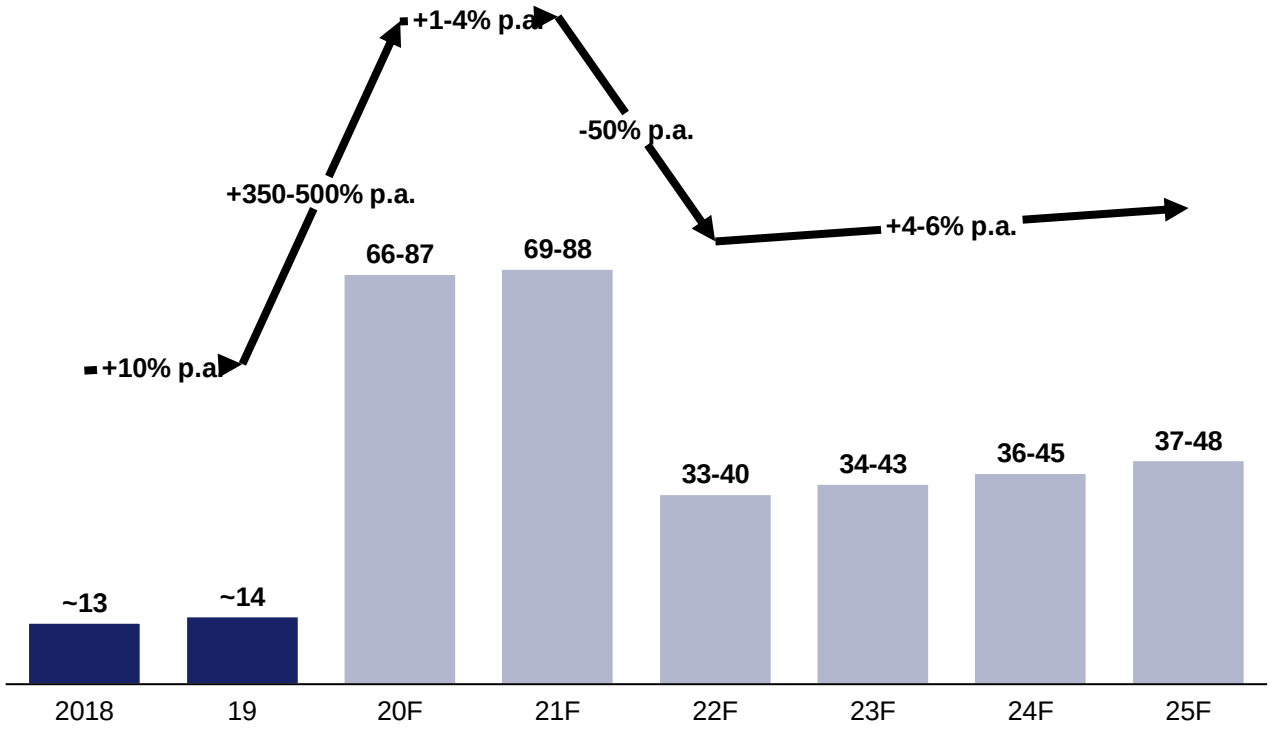
Selection of medical PPE (non-exhaustive)	**Estimated peak production increase,** %	**Market insights from press search and expert interviews** (AS OF MID-DECEMBER 2020)	
Masks	800-1,200%	China produces 200m face masks a day, more than ten times what it made at the start of February 2020. Local authorities have granted new licenses to allow more factories to produce masks, including high-grade ones used by healthcare professionals **– Mordor intelligence, November 2020**	[At the beginning of the pandemic] China boosted face masks production capacity by 450% in one month [in February] with 3,000 new entrants **– Press article (South China Morning Post), March 2020**
Gloves	200-400%	Blue Sail Medical [a large Chinese glove manufacturer] announced its semi-annual revenue forecast, with an expected […] 219.68% increase [in net profit] compared to the first half of 2019 **– Press article (Equal Ocean), July 2020**	Blue Sail Medical intends to increase its production to 36.1bn pieces per annum by end-2023 from 4.3bn pieces as of end-2019. On the other hand, Intco plans to expand its nitrile glove capacity to 59.2bn pieces per annum by end-2023, from 5bn pieces at end-2019. **– Press article (The Star), June 2020**

Source: press search, interviews with industry experts (November-December 2020)

2| 2020 demand levels will be sustained in 2021 but will drop sharply in 2022 and growth will then fall to ~4-6% in 2022-25 – lower than pre-crisis

ESTIMATES FROM DEMAND MODEL, AS OF MID-DECEMBER 2020

China's estimated[1] PPE demand by volume, 2018-19 historic and 2020-25 forecast, units, bn[2]



Market drivers

China's demand surge in 2020 was mainly driven by:

- Surgical masks (+6,000-7,000% vs. pre-crisis) which are expected to represent 40-50% of the volumes in 2020 (vs. 2-4% in 2019)
- Gloves (+150-200% vs. pre-crisis) which are expected to represent 40-45% of the volumes in 2020 (vs. 65-70% in 2019)

After a 50% volume drop in 2021-22, the market is expected to grow again in 2022-25 at a 4-6% p.a. rate:

- Surgical mask demand is expected to remain high (20-25% of volumes in 2025 vs. less than 2-4% in 2019) as consumer mask usage rates are predicted to remain high after the pandemic
- Glove share in the category mix may decrease vs. pre-crisis (60-65% of volumes in 2025 vs. 65-70% in 2019)
- Gowns/aprons/coveralls share of category mix is expected to decrease to 15-20% of volumes (vs. 25-30% in 2019)

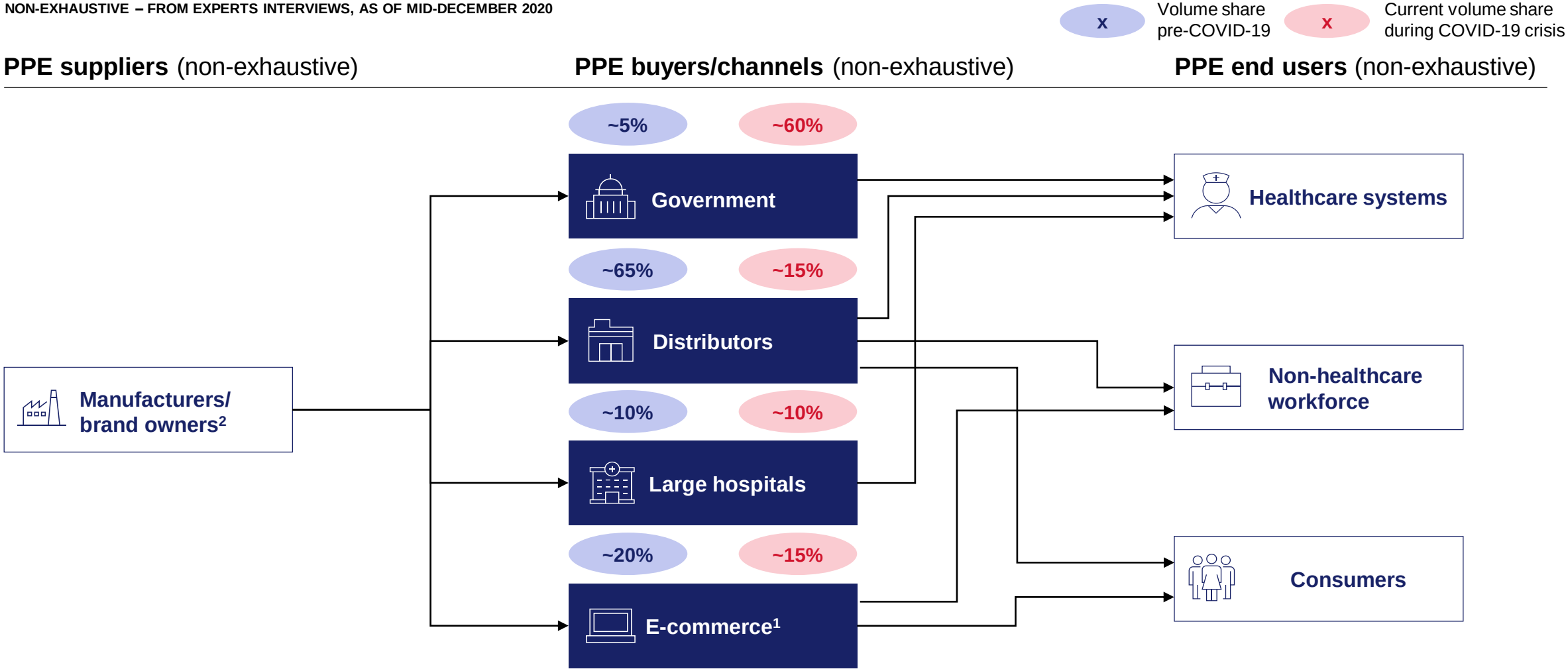
1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID baseline demand depends on 2 growth scenarios (historic growth -2% to account for critical size of the market vs. historic growth +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare worker and consumer demands depend on adoption rate assumptions ("high" vs."low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre, and chlorine is per kg

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

3| During 2020, the Chinese government became the largest PPE buyer, accounting for ~60% of PPE transactions vs. ~5% pre-crisis (1/2)

High-level overview of the main PPE selling channels in China

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020



1. Most of the time e-commerce platform is only used as channel, but do not purchase products
2. Large PPE players are called brand owners when they purchase PPE products from manufacturers and put their brand on it

Source: interviews with industry experts (November-December 2020)

3| During 2020, the Chinese government became the largest PPE buyer, accounting for ~60% of PPE transactions vs. ~5% pre-crisis (2/2)

High-level overview of the main PPE selling channels in China

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

PPE buyers/channels	High-level overview of COVID-19 impact	**Procurement process** (non-exhaustive)
Government	The government became the largest PPE buyer in China during the crisis as it started building PPE stocks It controlled ~70% of PPE transactions at the beginning of the crisis (~90% for masks) but that share is now decreasing as stocks are being built up and is estimated at ~60% AS OF MID-DECEMBER 2020	The Chinese government targets large players (e.g. 3M, Honeywell, Ansell), asks for an open book pricing and negotiates a supply agreement in line with national needs
Distributors	Distributors have historically been the largest buyers of PPE in China (~70% of PPE volumes) but they lost control of the market at the beginning of the crisis (down to less than 10% of volumes) due to the government's concerted stockpiling efforts As the government is slowing down purchases, distributors are gradually regaining control (~15% AS OF MID-DECEMBER 2020)	Distributors usually have a list of manufacturers/brand owners from whom they buy PPE (e.g. 3M usually contracts with ~10 large distributors). This supplier list is usually reviewed and updated annually The process to become a distributor supplier is quicker compared to the US and Europe and only takes about 1 month but contracts are shorter (1-year on average)
Large hospitals	Large hospitals have seen their volume share remain consistent during COVID-19, except for masks that have been overwhelmingly purchased by government	Only large hospitals can go directly to manufacturers/brand owners (minimum purchase: ~$500k), otherwise they are redirected to distributors
E-commerce	E-commerce was already a major channel pre-COVID-19 used by: • Pharmacies and small retail stores • Consumers already using PPE for pollution and environmental purposes E-commerce share dropped to 5% at the beginning of the crisis but has now recovered (~15% of volumes AS OF MID-DECEMBER 2020)	E-commerce platforms (e.g. Alibaba) are only used as a distribution channel by manufacturers/brand owners

Source: interviews with industry experts (November-December 2020)

3| To secure offtakes with these main buyers, PPE manufacturers need to comply with Chinese standards

NON-EXHAUSTIVE – FROM PRESS SEARCH, AS OF MID-DECEMBER 2020

PPE type (non-exhaustive)		Chinese standard requirements
Surgical masks		YY 0469-2011
Respirators		GB2626-2019[1]
Surgical gloves		GB7543-2006 (for sterile rubber surgical gloves) GB24787-2009 (for non-sterile rubber surgical gloves)
Protective gloves		GB28881-2012[2] GB/T 12624-2009[3]
Protective eyewear and visors		N.a.
Medical clothing		GB19082-2009[4]

1. Standard for respiratory protection - non powered air purifying particle respirator
2. Standard for hand protection - protective gloves against chemicals and micro-organisms
3. Protective gloves - general requirements and test methods
4. Technical requirements for single-use protective clothing for medical use

Source: press search, GB China National Standards, Code of China

Contents

Overview of the European (EU+UK) PPE market

1. Overview of the regional market pre-COVID-19

European PPE production is dominated by Germany, the UK and France and focuses mostly on high-quality PPE, with 2 implications:

- European manufacturers are limited competitively in global export markets and target mostly domestic and other European markets: 65-85% of PPE exports are within the EU+UK market (depending on the category)
- European countries still rely heavily on imports, especially from Asian countries, to meet domestic demand (e.g. 40-50% of masks via Chinese imports, 50-70% of gloves from Malaysia)

2. Perspectives on the COVID-19 supply/demand

Europe has been one of the regions worst-hit by COVID-19, with over 17m cases and 420k deaths (as of end-December 2020), which has led to a booming demand for medical PPE kits

This rising demand, combined with export restrictions imposed by traditional sourcing countries, has resulted in shortages, leading Europe to scale up local production of PPE kits (e.g. ~20x for masks) to meet domestic needs

This increase in local manufacturing has been supported by several government measures : (i) waivers of customs duties and VAT[1] on the import of PPE kits, (ii) export restrictions on PPE requiring a special authorization (restriction terminated end of May 2020), and (iii) large local orders of PPE by the different nation states to stimulate local production

As of late 2020, while pressure on some PPE still remains, early signs of oversupply have been observed in several countries, especially in masks (e.g. in the UK, PPE production started scaling down in June as NHS orders slowed and in France, it was estimated that 10% of mask manufacturers were struggling to sell their stocks by summer 2020)

3. Overview of the national distribution strategy

Pre-COVID-19, the PPE buyer landscape was dominated by distributors (accounting for ~70% of PPE transactions)

During the COVID-19 crisis, that picture has changed with a surge of public buyers:

- Governments saw their share increase by 3x (~15% of PPE transactions vs. ~5% pre-crisis), as they were building stocks
- Hospitals and e-commerce saw their share increase (respectively up to ~15% and up to ~20%), while distributors' share decreased to ~50% of PPE transactions (vs. ~70% pre-crisis); although distributors remain the largest buyers of PPE

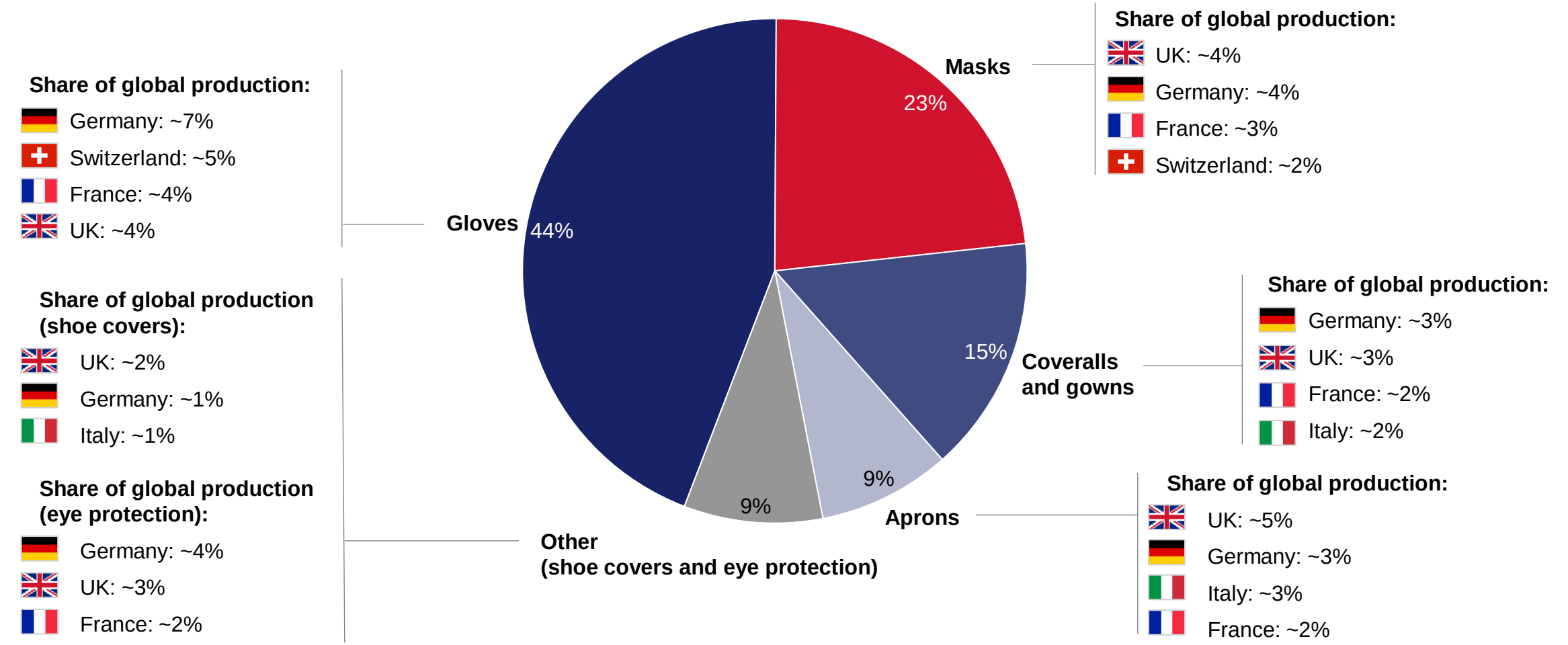
1. Value added tax

Source: Mordor Intelligence (updated in November 2020), Press search, interviews with industry experts (November-December 2020), European Centre for Disease Prevention and Control (data for COVID-19 cases & deaths as of 2020, week 52)

1| Germany, UK and France manufacture in multiple PPE categories, whereas Switzerland and Italy are present only in some

ESTIMATES – ONLY MEDICAL PPE CONSIDERED

Global market by type of medical PPE and mapping of European countries' share of production, 2019, % of total market



Source: Mordor Intelligence (updated in November 2020), Statista research department, interviews with industry experts (November-December 2020)

1| Europe is home to some top global players, including Ansell, DuPont, and Kimberly Clark

List of PPE suppliers present in Europe

NON-EXHAUSTIVE AND ILLUSTRATIVE

Suppliers (non-exhaustive)		Revenue 2019, $m	Local manufacturing (non-exhaustive)			
			Surgical masks and respirators	Medical gloves	Gowns	Face shield and goggles
DUPONT	DuPont de Nemours, Inc.	21,512		✓	✓	
Kimberly-Clark	Kimberly-Clark	18,450			✓	
	Medline Europe Ltd.	11,700		✓		✓
Dräger	Drägerwerk	3,136			✓	
Mölnlycke	Mölnlycke Health Care AB	1,666	✓	✓		
Ansell	Ansell	1,499	✓	✓	✓	
MSA	MSA	1,402	✓			
SEMPERIT	Semperit Aktiengesellschaft Holding	968		✓		
uvex	Uvex	515		✓		
SHOWA	Showa International	184		✓		
MERCATOR MEDICAL	Mercator Medical S.A. (WSE:MRC)	142			✓	
ejendals	Ejendals	133		✓		
PIP	PIP	106			✓	
LCH	LCH Medical Products	99			✓	
BEESWIFT	Beeswift	64		✓	✓	✓
Paul Boyé	Paul Boyé Technologies	60	✓		✓	
KOLMI HOPEN	Kolmi Hopen Medicom Group	52			✓	
	Etn Van Moer	49				
UNISURGE	UNISURGE International Limited	47			✓	
UNIVET	Univet	25				✓
DELTA MED	Delta Med Spa	22		✓	✓	✓
	Rubberex	22		✓		
ASID BONZ	ASID BONZ	21			✓	
UNIGLOVES	Unigloves	13		✓		
Raguse	Raguse	11			✓	
DINA - HITEX	DINA-HITEX	10			✓	
	Hase Safety Gloves	10		✓		
PLURITEX	Pluritex	3			✓	
Romed HOLLAND	Van Oostveen Medical	3		✓		
CROMPTONS HEALTHCARE	Cromptons Healthcare Limited	2			✓	
JSP	JSP	0	✓			
PORTWEST	Portwest	0	✓			

Source: press search, calls with suppliers

1| There is strong interdependency in PPE trade, with 65-85% of exports remaining within Europe

Overview of exports/imports of main PPE categories in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	European exports 2019 , selection of medical PPE (non-exhaustive)			**European imports 2019,** selection of medical PPE (non-exhaustive)		
	Value, $m (internal trades included)	**Share of exports to Europe**	**Top European exporting countries**	**Value,$m** (internal trades included)	**Share of imports from Europe**	**Top European importing countries**
Gloves[1]	430	**85%**	Germany: 36% Belgium: 20% Austria: 13%	1.095	**23%**	Germany: 41% UK: 11% Netherlands: 7%
Coveralls, gowns, aprons[2]	610	**65%**	Belgium: 33% Italy: 21% Germany: 11%	780	**30%**	Germany: 19% France: 16% Belgium.: 14%
Masks[3]	210	**80%**	Germany: 30% Netherlands: 11% France: 9%	320	**35%**	Germany: 26% France: 14% UK.: 10%

1. The HS code used is 401511 (surgical gloves)
2. The HS code used is 621010 (garments made up of felt or nonwovens) and may not consider exclusively medical coveralls, aprons and gowns
3. The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)

Source: ITC Trademap

1| Germany's PPE trade balance is negative across all categories, relying heavily on Asian imports

Overview of exports/imports of main PPE categories in Germany in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	German exports 2019 , selection of medical PPE (non-exhaustive)			**German imports 2019,** selection of medical PPE (non-exhaustive)		
	Value,$m	**Exporter rank,** globally	**Largest export partners**	**Value,$m**	**Importer rank,** globally	**Largest import partners**
Masks[1]	64	#2	France: 10% Poland: 9% Austria: 9%	81	#3	China: 53% Vietnam: 6% UK: 5%
Gloves[2]	154	#4	Austria: 19% Italy: 9.4% Poland: 8.8%	448	#1	Malaysia: 70% Thailand: 9% Austria: 6%
Coveralls, gowns, aprons[3]	69	#9	UK: 14% France: 11% Italy: 10%	146	#2	China: 66% Cambodia: 13% Belgium: 3%

1. The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)
2. The HS code used is 401511 (surgical gloves)
3. The HS code used is 621010 (garments made up of felt or nonwovens) and may not consider exclusively medical coveralls, aprons and gowns

Source: ITC Trademap

1| The UK's trade balance is positive for coveralls and gowns, but negative for masks and gloves, again relying significantly on Asian imports

Overview of exports/imports of main PPE categories in the UK in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	UK exports 2019 , selection of medical PPE (non-exhaustive)			**UK imports 2019,** selection of medical PPE (non-exhaustive)		
	Value, $m	**Exporter rank,** globally	**Largest export partners**	**Value,** $m	**Importer rank,** globally	**Largest import partners**
Coveralls, gowns, aprons[1]	56	#10	Belgium: 33% US: 13% HK, China: 11%	52	#9	China: 47% Belgium: 15% Germany: 14%
Masks[2]	14	#11	Germany: 31% Ireland: 11% France: 9%	31	#5	China: 50% Germany: 11% Vietnam: 5%
Gloves[3]	4	#21	Ireland: 42% France: 9% Malaysia: 8%	121	#3	Malaysia: 50% Belgium: 24% Netherlands: 5%

1. The HS code used is 621010 (garments made up of felt or nonwovens) and may not consider exclusively medical coveralls, aprons and gowns
2. The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)
3. The HS code used is 401511 (surgical gloves)

Source: ITC Trademap

1| France's PPE trade balance is negative across all PPE types, and the country also relies significantly on Asian imports

Overview of exports / imports of the main PPE in France in 2019

ONLY MEDICAL PPE CONSIDERED – NON EXHAUSTIVE

	French exports 2019 , selection of medical PPE (non-exhaustive)			**French imports 2019,** selection of medical PPE (non-exhaustive)		
	Value, $m	**Exporter rank,** globally	**Largest export partners**	**Value,** $m	**Importer rank,** globally	**Largest import partners**
Masks[1]	18	#8	Spain: 15% Italy: 10% Romania: 9%	43	#4	China: 41% Tunisia: 13% Germany: 6%
Gloves[2]	11	#13	Switzerland: 26% Spain: 16% Italy: 14%	73	#6	Malaysia: 46% Thailand: 20% Belgium: 12%
Coveralls, gowns, aprons[3]	30	#13	Switzerland: 23% Italy: 16% Spain: 15%	126	#3	China: 51% Cambodia: 17% Tunisia: 9%

1. The HS code used is 630790 (made-up articles of textile materials) to which a % share of masks has been applied based on masks imports/exports figure between US and China (source: USA Today News)
2. The HS code used is 401511 (surgical gloves)
3. The HS code used is 621010 (garments made up of felt or nonwovens) and may not consider exclusively medical coveralls, aprons and gowns

Source: ITC Trademap

2| Europe's PPE production increased significantly in 2020 due to COVID-19, with a 20-fold increase in medical masks

Estimation of production increases on a selection of PPE types during the COVID-19 crisis

NON-EXHAUSTIVE AND DIRECTIONAL – ESTIMATES FROM PRESS AND EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

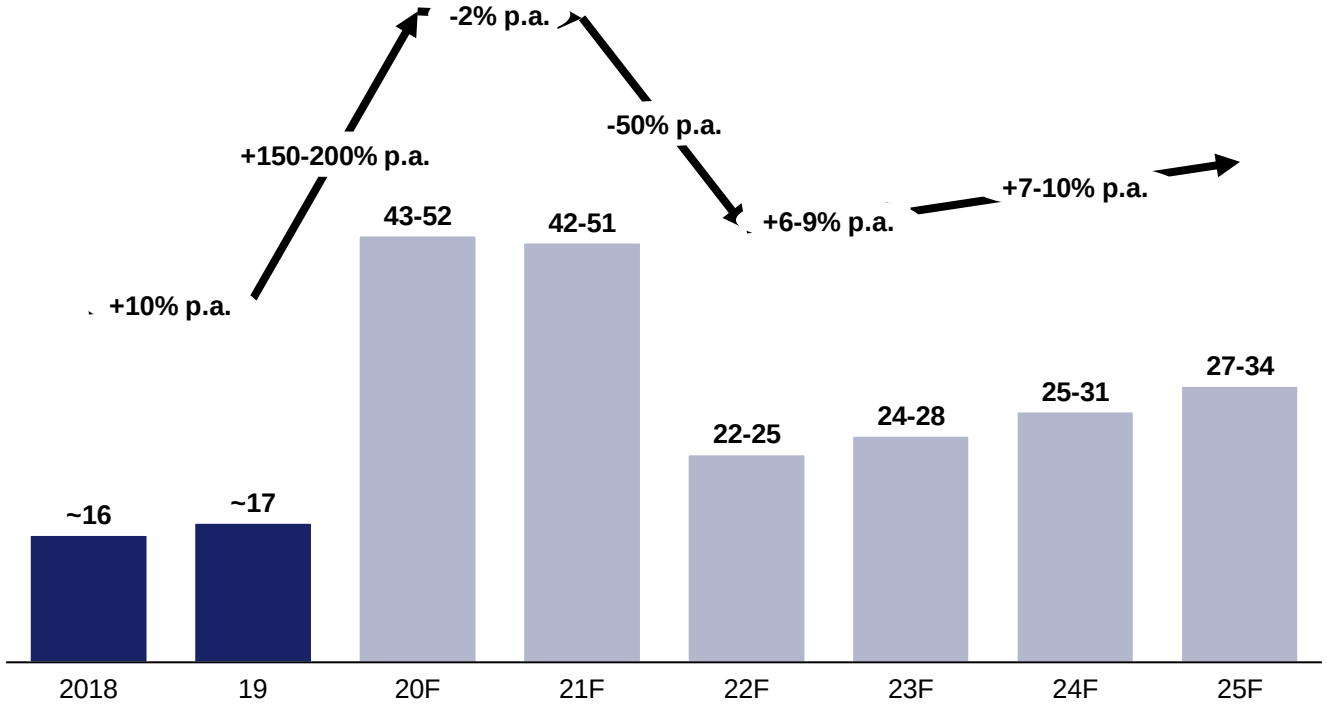
Selection of medical PPE (non-exhaustive)	**Estimated peak production increase,** %	**Market insights from press search (AS OF MID-DECEMBER 2020)**	
Masks	1,500-2,000%	EU production of face masks, essential for tackling the coronavirus crisis, is set to increase 20-fold by November this year compared to pre-crisis times. This means that EU-based producers will be able to make the equivalent of 1.5bn three-layer masks a month **– Press article (Non woven industry), June 2020**	"At the beginning of the crisis, mask demand was 10 times greater than local production. Since then, France has tripled its mask production." **– Vincent Moulin Wright (CEO of France Industrie), April 2020**
Face shields	**INFORMATION NOT AVAILABLE**	Ricoh UK Products Ltd. (RPL), a manufacturing and business development organization based in the UK, began production of face shields using Ricoh's 3D printers. They are currently supplying 40,000 face shields a week to the UK's NHS (National Health Service) and additional personal protective equipment (PPE) around the world. **– Ricoh website, December 2020**	[In Germany] up to 1,500 face shields can now be produced at RWTH Aachen University per day. "This is rapid prototyping in perfection: Using 3D printing and similar processes, a prototype can be produced from a virtual 3D model, tested, and the design directly modified within a few hours," explains RWTH professor Jan Borchers **– Press article (DWIH New Delhi), May 2020**
Hand sanitizer	**INFORMATION NOT AVAILABLE**	Ineos […] is planning to build two hand sanitizer factories in just 10 days as part of the effort to prevent the spread of coronavirus. [Ineos] aims to produce a million bottles of hand sanitizer a month when the plant is in operation. **– Press article (The Guardian), March 2020**	LVMH is to start producing hand sanitizer at three of its perfume and cosmetics factories for distribution to French hospitals fighting the country's coronavirus outbreak. Twelve tonnes will be produced as early as this week. **– Press article (The Guardian), March 2020**

Source: press search, interviews with industry experts (November-December 2020)

2| This 2020 demand peak will be sustained in 2021 but will drop in 2022 and return to historic ~7-10% p.a. growth during 2023-25

ESTIMATES FROM DEMAND MODEL, AS OF MID-DECEMBER 2020

European estimated[1] PPE demand by volume, 2018-19 historic and 2020-25 forecast, units, bn[2]



Market drivers

European demand surge in 2020 was mainly driven by:

- Surgical masks (+2,500-3,000% vs. pre-crisis), which are expected to represent 25-30% of the volumes in 2020 (vs. 2-4% in 2019)
- Gloves (+30-35% vs. pre-crisis), which are expected to represent 60-65% of the volumes in 2020 (vs. 65-70% in 2019)

After a sharp 50% volume drop in 2022, the market is expected to return to its 7-10% p.a. historic growth rate in 2022-25, with a similar product mix vs. pre-crisis:

- Gloves are estimated to represent 65-70% of European demand volumes in 2025
- Gowns, coveralls, and aprons may represent 25-30% of total PPE demand
- Surgical masks may go back to less than 5% of the volumes

1.Range reflects 2 scenarios ("high" vs. "low"): (i) non-COVID baseline demand depends on 2 growth scenarios (historic growth -2% to account for critical size of the market vs. historic growth +1% to account for potential changes in usage habits), (ii) hospital days and vaccination demands depend on vaccination scenario ("pessimistic" vs. "optimistic"), and (iii) non-healthcare worker and consumer demands depend on adoption rate assumptions ("high" vs."low")
2.Unit is per item or per pair in case of gloves, hand sanitizer is per litre, and chlorine is per kg

Source: Mordor Intelligence (updated in November 2020), EPI model, WHO assumptions

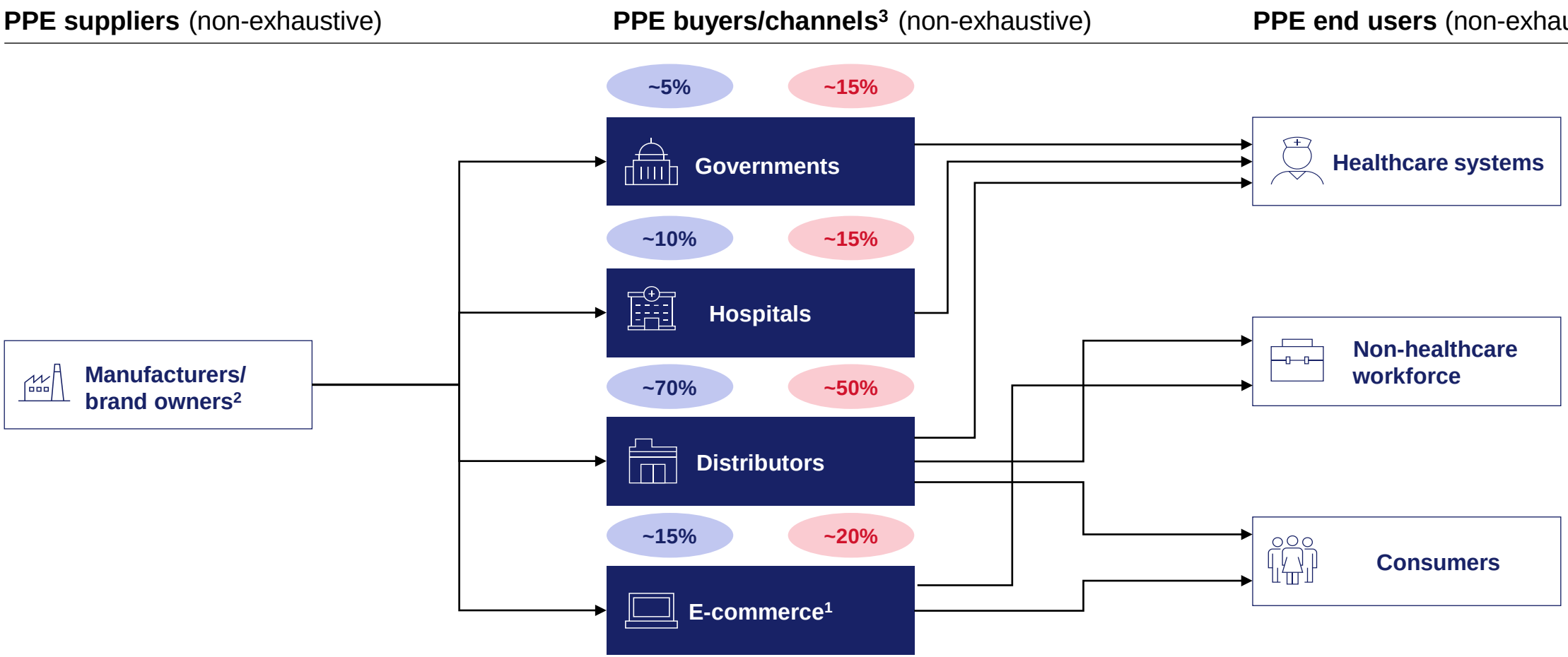
3| Despite a 300% increase in government share of purchased PPE, distributors remain the top PPE buyers in most European countries

High-level overview of the main PPE selling channels in Europe

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020
UK AND GERMANY DEEP-DIVES ON NEXT PAGES

x Volume share pre-COVID-19

x Current volume share during COVID-19 crisis



1. Most of the time e-commerce platform is only used as channel, but do not purchase products
2. Large PPE players are called brand owners when they purchase PPE products from manufacturers and put their brand on it
3. Average figures across Europe; could vary from a European country to another

Source: interviews with industry experts (November-December 2020)

3| deep-dive into buyers in Germany

High-level overview of the main PPE selling channels in Germany

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

PPE buyers	Impact of COVID-19	Procurement process (non-exhaustive)
Government	PPE procurement was centralized by the Federal government in response to intense competition in the global PPE market. PPE has been procured via the procurement offices of the Ministries of Health, Interior, Defense, and Finance	The Federal Government procured PPE through the following 2 channels: 1) BMG (Ministry of Health) that initiated a temporary open house procedure 2) Major German companies buying on behalf of the BMG for procurement on the Chinese market
GPOs (groups of hospitals)	Many hospitals and nursing homes are part of GPOs[1] (GPOs cover 80-90% of German healthcare and social care facilities), although during COVID-19 pandemic, PPE procurement was centralized by the Federal government	GPOs follow a regular 4-step procurement process through tenders to lower prices: 1) Start of nonbinding bidding process via an enquiry process 2) Offer collection for the defined contract period 3) Negotiation packages and evaluation of the offers 4) Contracting
Distributors	Distributors are historically the largest buyers of PPE in Germany. Despite the government's intervention in PPE purchasing, distributors remain the top buyers in the country.	Distributors usually have a list of manufacturers/brand owners from whom they buy PPE A review/update of suppliers list is usually carried out annually and the process to become a distributor supplier is strict, requires 2-3 months of work and leads to the signing of a long-term contract (5 years on average)
E-commerce	E-commerce channel emerged during the COVID-19 pandemic as private individual consumption surged (especially for masks)	E-commerce platforms (e.g. Amazon) are only used as a distribution channel by manufacturers/brand owners (e-commerce platforms rarely purchase PPE on their own account)

1. Group Purchasing Organizations

Source: interviews with industry experts (November-December 2020)

3| deep-dive into buyers in the UK

High-level overview of the main PPE selling channels in the UK

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS , AS OF MID-DECEMBER 2020

PPE buyers	Impact of COVID-19	Procurement process (non-exhaustive)
Government	Previously entirely absent from the market, the UK government became the major buyer in 2020 accounting for >90% of the demand The UK government has purchased directly from manufacturers as well as from distributors; and supplies principally the NHS[1]	The government uses the following 2 procurement processes: 1) A single tender: establishes terms of 1 contract for 1 or many services and can be fulfilled by 1 supplier 2) A framework agreement: is specific for a type of PPE and can be fulfilled by 1 or many suppliers; typically lasts for 4 years
Distributors	Previously supplying NHS directly, distributors had to go through the government during the COVID-19 crisis in order to do business	Distributors usually have a list of manufacturers/brand owners from whom they buy their PPE An annual review/update of suppliers list is usually carried out and the process to become a distributor supplier is strict, requires 2-3 months of work and leads to the signing of a long-term contract (5 years on average)
E-commerce	E-commerce channel emerged during the COVID-19 pandemic as private individual consumption surged dramatically (especially for masks)	E-commerce platforms (e.g. Amazon) are only used as a distribution channel by manufacturers/brand owners (e-commerce platforms rarely purchase PPE on their own account)

1. National Health Service

Source: interviews with industry experts (November-December 2020)

3| To secure offtakes by these main buyers, PPE manufacturers need to comply with European standards

NON-EXHAUSTIVE – FROM PRESS SEARCH , AS OF MID-DECEMBER 2020

PPE type	European standard requirements
Surgical masks 	EN 14683 :2019
Respirators 	EN 149 +A1
Surgical gloves 	EN 455
Protective gloves 	EN 374 – Protection from chemical risks and micro-organisms
Protective eyewear and visors 	EN 166
Medical clothing 	EN 13795
Protective clothing 	EN 14126 – protective clothing against infective agents EN 14605 – protective clothing against liquid chemicals

Source: press search

Contents

Overview of the Indian, Sri Lankan, Bangladeshi and Vietnamese PPE markets

1. Limited PPE manufacturing capacity pre-COVID-19

PPE production capacity in India, Sri Lanka, Bangladesh and Vietnam was quite limited before the COVID-19 crisis and focused only on specific PPE

- The four countries manufactured virtually no PPE kits until January 2020
- Sri Lanka accounted for ~5% of the global glove market (including examination, surgical and chemotherapy gloves) due to its privileged access to natural rubber

2. Increase in manufacturing capacity during the COVID-19 crisis

Since the COVID-19 outbreak, India has been the most proactive of the 4 countries in increasing PPE production capacity, driven by booming domestic demand and the global PPE shortage

- The country's PPE manufacturing capacity has surged, with a production increase of 56x in 2-3 months, making India the second largest PPE producer after China; this supply spike has been facilitated by ambitious support from the government
- Production increases in Bangladesh and Vietnam have been lower but are still highly significant (x10 for Bangladesh and x6 for Vietnam)

In these countries, most additional supply has come from textile manufacturers who shifted their production in response to the health emergency and in order to mitigate losses caused by cancelled orders for garments, but they have struggled to meet global standards, resulting in significant quality issues

3. Key success factors and barriers to entry

The 2020 demand peak induced by COVID-19 is expected to persist in 2021, with some potential for new local manufacturers to capture market share

- All four countries have competitive advantages that could attract companies looking for alternatives to China (e.g. reliable partners, low labour costs, reduced geopolitical risk and significant domestic markets)
- To capture market share, new entrants would have to (i) meet international quality standards, (ii) secure large orders for the production of PPE and (iii) enforce best practice manufacturing processes to ensure quality output and price competitiveness

Thorough business plans will need to be constructed for each manufacturing project to prove long-term viability

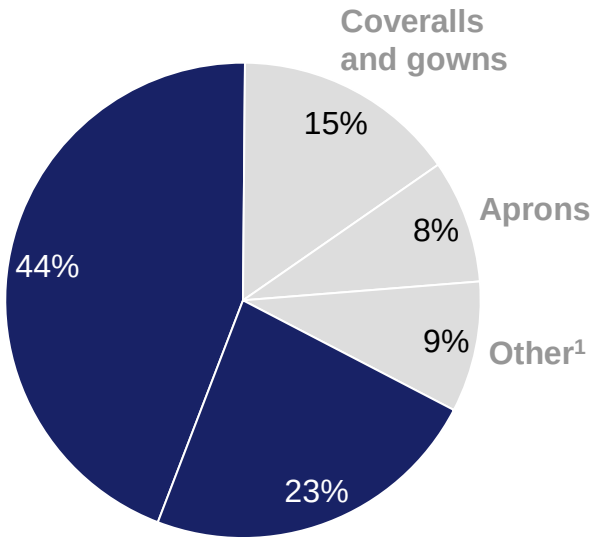
Source: Mordor Intelligence (updated in November 2020), Press search, interviews with industry experts (November-December 2020)

1| In each of these 4 countries, PPE production was limited before the COVID-19 crisis and focused mostly on masks and gloves

ESTIMATES FROM PRESS AND EXPERTS INTERVIEWS – ONLY MEDICAL PPE CONSIDERED

Global medical PPE market by type of PPE,
2019, % of total market

Not addressed in the analysis



Sri Lanka share of production: ~5%

India share of production: <5%[2]

Vietnam share of production: <5%[2]

Market insights from press search and experts interviews (as of mid-December, 2020)

> India had almost no production capacity for PPE kits until January 2020 and was only manufacturing a few products, like medical gowns and surgical gloves
>
> **– PPE industry expert, November 2020**

> In March, when Bangladesh reported its first COVID-19 case, the country was completely relying on imports for PPE.
>
> **– Press article (The Business Standard), August 2020**

> Sri Lanka is a leading manufacturer of protective gloves and medical gloves made with natural rubber latex and nitrile latex. The country's rubber gloves industry caters to nearly 5% of the global demand for household, industrial, and medical gloves
>
> **– Sri Lanka Export Development Board**

1. Shoe covers and eye protection
2. Estimate based on exports value

Source: Mordor Intelligence (updated in November 2020), interviews with industry experts (November-December 2020), Press search

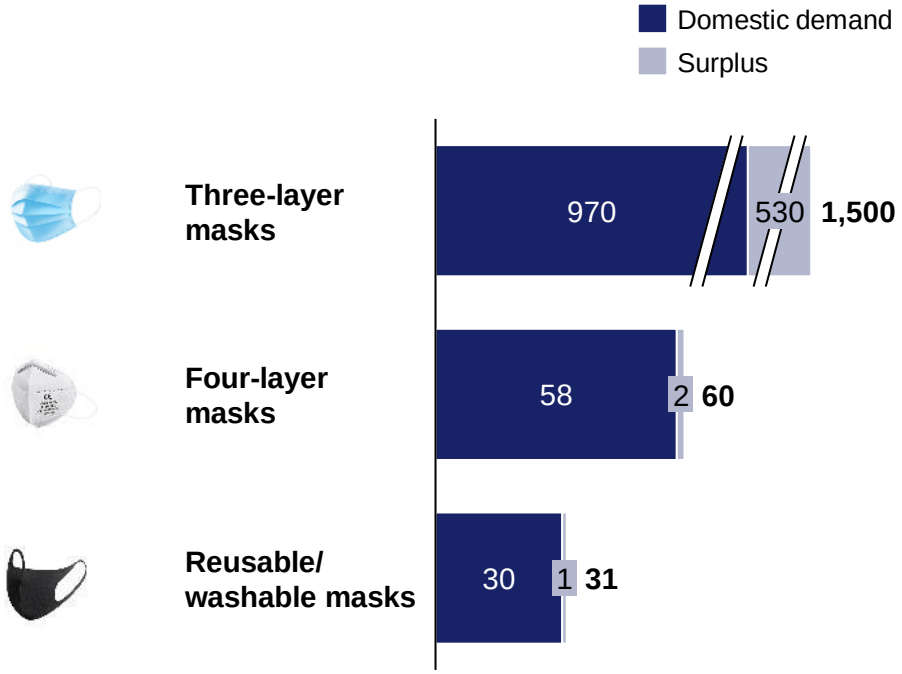
2| Since the COVID-19 outbreak, India has been the most proactive of the 4 countries in increasing its PPE production capacity

NON-EXHAUSTIVE – DIRECTIONAL ESTIMATES FROM PRESS AND EXPERTS INTERVIEWS

India has experienced a dramatic surge in domestic production of PPE, becoming the second largest PPE producer in the world

Selection of medical PPE (non-exhaustive)

Estimated production capacity, Units. m

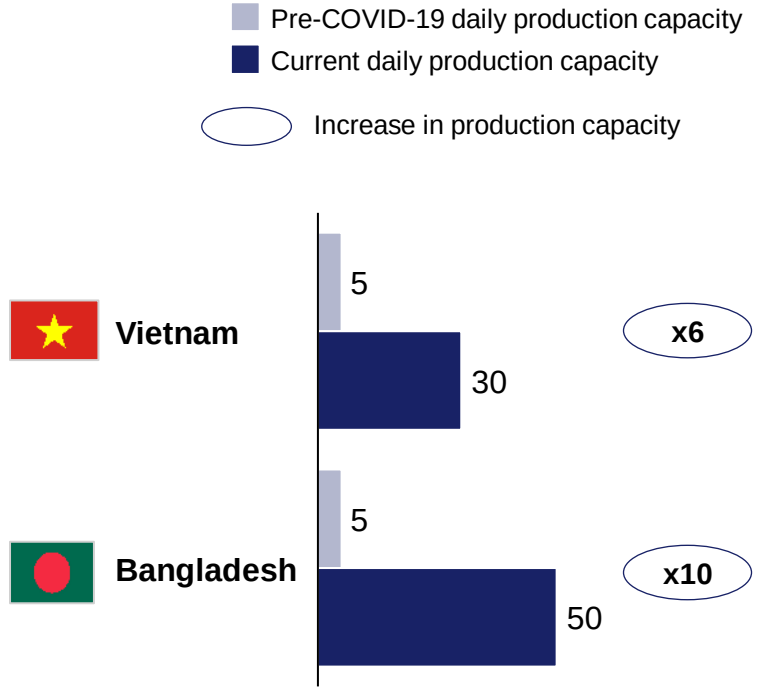


> Beating all odds, India developed a domestic network of PPE fabric and garment manufacturers; in just 60 days, the PPE industry in India has witnessed a 56 times growth.
> **– PPE industry expert, December 2020**

> Now, we have numerous local manufacturers and PPE production capacity has increased so much that it has become a massive industry.
> **– Himanshu Baid, Chairman, Confederation of Indian Industry**

Bangladesh and Vietnam have also increased their production[1]

Pre-COVID-19 vs. current daily production capacity, K units/day



1. No reliable data found for Sri Lankan's production capacity

Source: press search, interviews with industry experts (November-December 2020), Governments official statements

2| Most of this supply increase came from the textile industry, which shifted to PPE production to mitigate losses caused by cancelled orders

PRESS AND EXPERTS INTERVIEWS – AS OF MID-DECEMBER 2020

Country	Textile and clothing exports 2019, $m (% of local exports)	Shift to PPE manufacturing	Market insights from press search and experts interviews (as of mid-December, 2020)
India	 34 ~10%	**+600 Indian companies are now lab-certified for PPE**, including top garment and textile exporters Alok Industries, JCT Phagwara, Gokaldas Exports and Aditya Birla	Garment demand had plummeted in past months […]. We chose to switch to PPE kits as it was doable with the experienced hands we had and infrastructure. This helped us give employment to our workers. **– Amit Jain, a garment manufacturer**
Bangladesh	 35 ~80%	According to the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), there are **33 companies who are making and preparing to export PPE to meet global demand**.	Beximco has proudly joined the fight against the global pandemic by moving swiftly to add manufacturing capabilities in PPE items such as gowns, masks, and coveralls **– Syed Naved Husai, Beximco CEO**
Sri Lanka	 6 ~50%	According to the Board of Investments (BOI), Sri Lanka's apparel industry has **attracted +$500m worth of PPE orders**, and **33 factories are currently manufacturing these products**	Partnering with governments, doctors, healthcare authorities and internal teams, MAS+ is creating a collection of functional and comfortable PPE which includes masks and scrubs. […] MAS+ hopes to bring new innovations to the medical apparel space **– MAS official website**
Vietnam	 40 ~15%	According to the Ministry of Trade, **~50 companies are producing surgical masks** (e.g. TNG, supplier of Levi's, Tesco and Décathlon, exported millions of masks)	We at DONY have long recognized the need to adapt to the pandemic […] we're proud to have supported many countries' healthcare systems with our high-quality protective face masks and medical clothing. **– Mr. Henry Pham, CEO of DONY Garment Company**

Source: WTO, press search, interviews with industry experts (November-December 2020)

2| The 4 countries have benefited from 3 main types of support from governments, yet with different scale

NON-EXHAUSTIVE – PRESS AND EXPERTS INTERVIEWS – AS OF MID-DECEMBER 2020

Type of support	Examples of interventions from governments and international institutions (non-exhaustive)
Financial support and fiscal incentives	In April 2020, government announced a specialized incentive package to promote manufacture of PPE, including (i) a **30% capital subsidy**, up to INR 20 crore (~$3m) per individual entity for textiles and related products and (ii) a **2% interest subvention for loans** for registered MSMEs
	In June, the government **exempted PPE from VAT** at the production and supplier level
International norms enforcement	In July, Salman Rahman, adviser to the prime minister, pledged the government's **support for the development of testing facilities** so that local manufacturers could exploit the full export potential of PPE and masks
	The Ministry of Health, in collaboration with the Ministry of Science and Technology, will **develop and promulgate standards and technical regulations for medical equipment**, with the support of **UNDP**
	In June, USAID committed to initiate new activities to **improve case management and strengthen regulatory and quality standards for local production of PPE**
Technical assistance	In July, USAID funded the organization of two webinars to support Sri Lankan apparel producers to export PPE to the US, including training on **how to comply with the FDA regulations and access the US market** (e.g. federal application, distribution chains, acquisition regulations)
	USAID LinkSME, in coordination with the Vietnamese government, is supporting the Vietnamese private sector to **address gaps in the PPE supply chain**, connecting Vietnam's PPE suppliers to distributors in the US

Among all 4 countries, India has benefited from the most **ambitious and proactive government's support** regarding PPE local production. The Indian government's plan has aimed at:

- Identifying 14 textile and latex companies which could rapidly scale up their production of PPE
- Providing them with an significant financial support, unequalled in any other country in the sub-region

Source: press search, interviews with industry experts (November-December 2020)

3| Three main advantages could enable new local manufacturers to enter the PPE market

NON-EXHAUSTIVE – AS OF MID-DECEMBER 2020

Drivers	Description
Market opportunity	• Although PPE demand is expected to drop in 2022, it is expected to **resume its historic growth rate of ~6-9% p.a.** from 2023 onwards, resulting in a market of 185-235m units in 2025
Geographic diversification	• Many US, European, Japanese and South Korean companies are considering a significant restructuring of their global supply chains away from China in order to **mitigate supply-side risk**
Competitive advantages	• India, Bangladesh, Sri Lanka and Vietnam are well-known, reliable partners with **reduced geopolitical risk** compared to China • The four countries are **cost competitive,** especially in terms of **labour costs** (e.g. monthly minimum wage in the garment industry of ~$70 in Bangladesh, ~$130 in India and ~$140 in Vietnam vs. $150-200 in China) • **Corporate tax rates** for new manufacturing companies are among the lowest in the world • These countries benefit form **growing domestic markets** that may provide additional demand

1. Bureau of Indian Standards

Source: press search, interviews with industry experts (November-December 2020), ILO

> Major PPE producers, such as DuPont, have chosen Vietnamese garment enterprises to produce protective items due to their textile know-how and value for money
>
> **– PPE industry expert, November 2020**

> We are aiming to diversify supply base and find alternatives to Chinese manufacturers […] However, finding suitable manufacturers is challenging due to quality issues and export bans (especially in India)
>
> **– International donor, December 2020**

> In July 2020, the Japanese government announced that it would support the Japanese apparel maker Matsuoka Corp. to produce PPE in Vietnam, primarily to diversify supplies and reduce its dependence on China amid the novel coronavirus pandemic.
>
> **– Mordor Intelligence, November 2020**

Contents

Overview of the melt-blown industry

Main messages

1. Overview of the melt-blown industry pre-COVID-19

The melt-blown industry grew by ~9% p.a. during 2014-2019, reaching ~$1bn in 2019. The largest part - at ~45% - was produced by Asia-Pacific with ~20% by the US and ~15% by Europe. The market is split into 4 types of players

- Large integrated players producing both melt-blown and end-products (e.g. 3M, Dupont, Honeywell), accounting for 35-50% of the market
- Small scale integrated players producing both melt-blown and end-products, accounting for 10-15% of the market
- Large non-integrated manufacturers (e.g. Toray, Mitsui), accounting for 20-30% of the market
- Small scale non-integrated manufacturers, accounting for 20-30% of the market

Most of the melt-blown players also produce spunbound and diversify their production by targeting different end uses in order to achieve scale (as of 2019, medical products only accounted for 10-20% of melt-blown consumption). It is also important to note that integrated players achieve a higher profit margin compared with non-integrated players (15-20% of EBITDA margin vs 10-15%)

2. Perspectives on the COVID-19 impact

Global melt-blown production has significantly increased during the COVID-19 pandemic (up to +100% increases in production in Asia-Pacific) driving the market up ~40% in 2020 (to ~$1.4bn) ; this capacity surge came from 3 sources

- 30-50% from existing melt-blown players (e.g. Toray, Pegas, Mitsui, Kimberly-Clark)
- 35-45% from players in adjacent industries expanding into the melt-blown market (e.g. Winnebago, BYD, Sinopec)
- 10-30% from new players entering the market (~50% of whom were from Asia-Pacific); these are usually non-integrated players who may well disappear once the pandemic slows down

3. Overview of the industry key success factors

The melt-blown industry is expected to continue to grow at ~8% p.a. during 2020-2023, driven by (i) demographic growth, (ii) changes in mask usage habits and (iii) consumption growth in other end-usage segments, such as hygiene products

This growth may be captured either by new entrants, which could be positioned as cost leaders (focusing on high volume and low costs) or premium players (focusing on high quality and margin)**,** or **by large end-product manufacturers willing to integrate the upstream part of the value chain**

Brand new players will need to overcome some major barriers to entry, including (i) achieving scale and volume in order to be cost-competitive, (ii) securing necessary raw materials and machinery and (iii) building solid brands

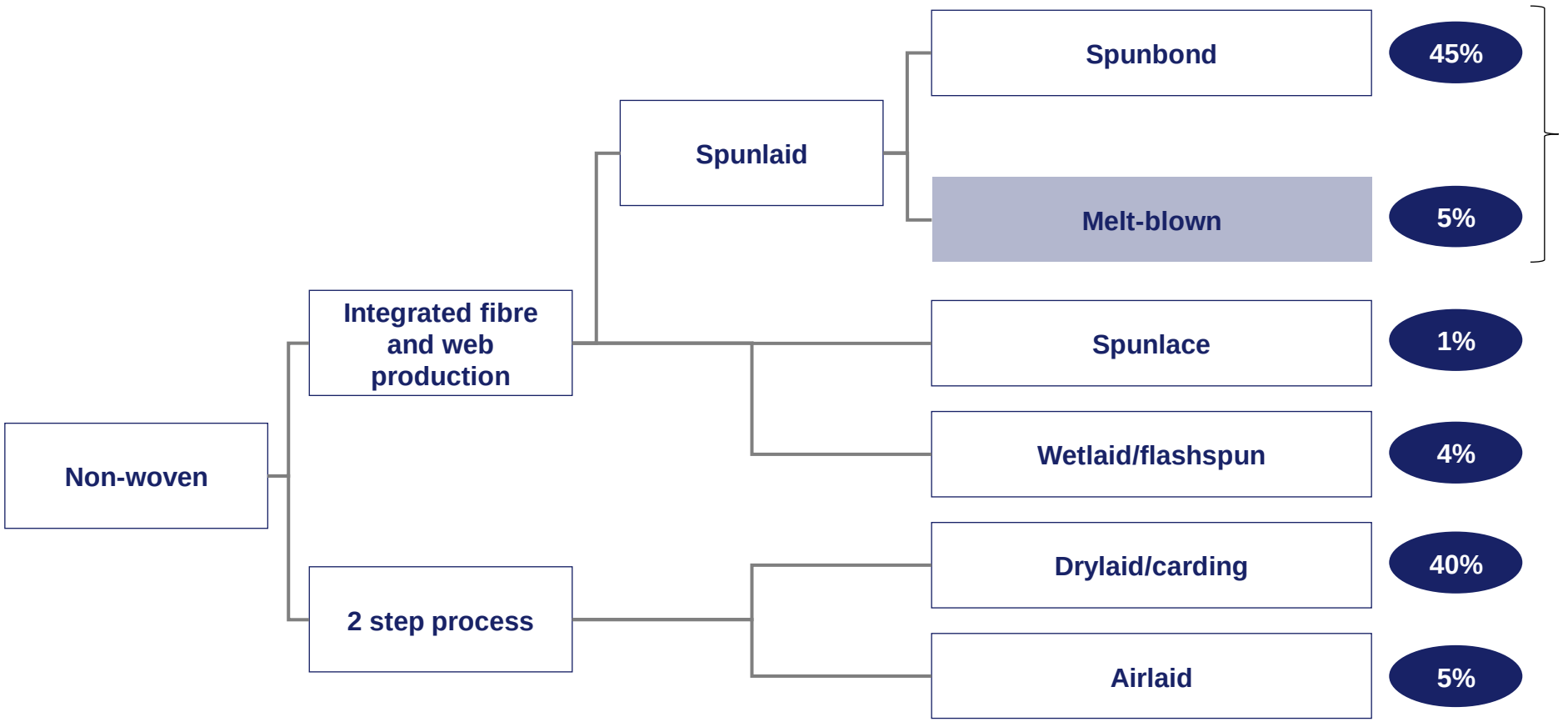
Source: interviews with industry experts (November-December 2020), Press search, OECD, Smithers Apex

1| Melt-blown non-woven accounted for only ~5% of the total non-woven fabric market in 2019

x Share of total non-woven volume, 2019

Focus of this section

Different technologies used for non-woven production



~90% of melt-blown manufacturers also produce spunbond non-woven as a result of (i) high synergies due to similar process and machines and (ii) criticality of scale

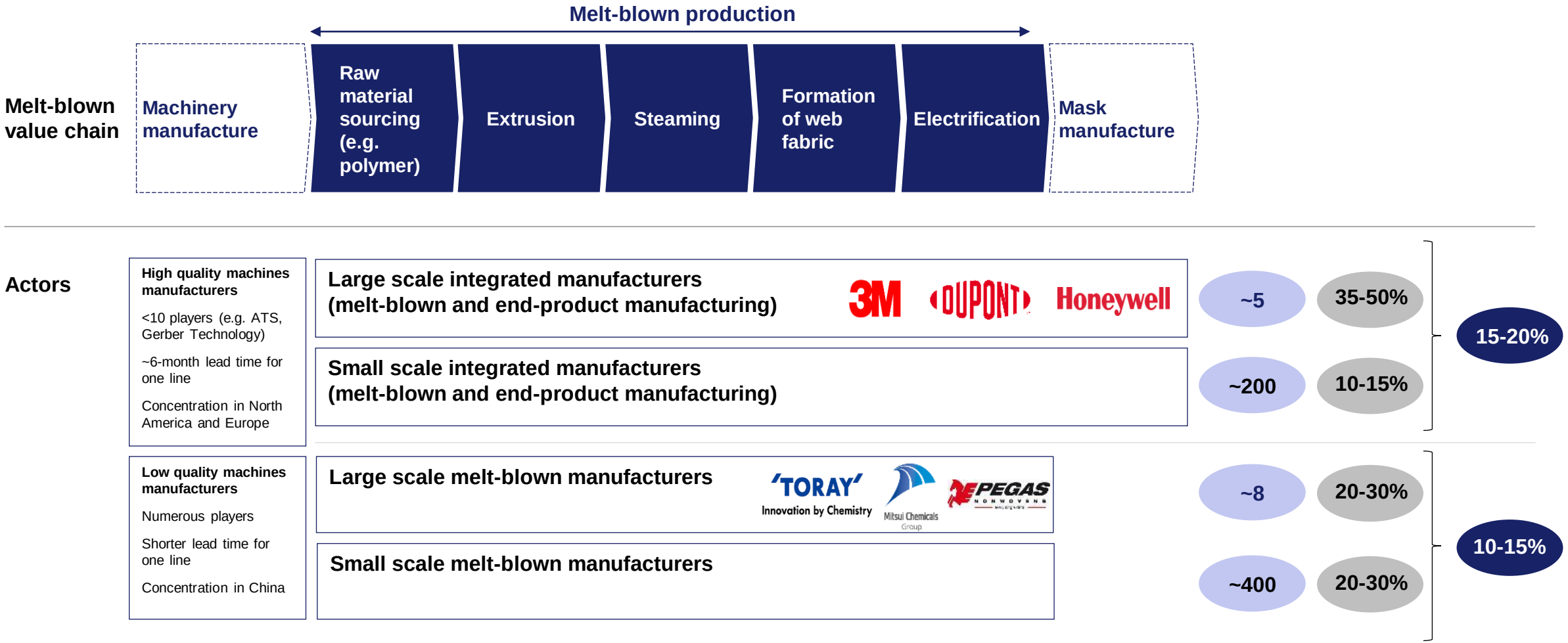
> Customers who purchase melt-blown usually also need spunbond. Producing both allows you to be a one-stop shop for both types of non-woven.
>
> **- PPE expert, December 2020**

Source: Smithers Apex, interviews with industry experts (November-December 2020)

1| ~50% of the melt-blown market is provided by integrated players who also manufacture end-products

ESTIMATES – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

xx Number of players | xx Market share | xx EBITDA margin[1]



1. Pre-COVID-19 margins (EBITDA margins have increased during the pandemic as a result of price surge)

Source: interviews with industry experts (November-December 2020)

1| Historically, medical end-use only accounted for 10-20% of total melt-blown consumption compared with 50-70% used in hygiene products

ESTIMATES – NON-EXHAUSTIVE, AS OF MID-DECEMBER 2020

x% Share of consumption, 2019 | Durable | Disposable

Major spunlaid non-woven (including both melt-blown and spunbond) end uses[1]

Hygiene

Baby diapers

Adult incontinence

Feminine hygiene

50-70%

Medical

Surgical gowns

Face masks

Wound care

10-20%

Technical

Civil construction

Roofing

Filtration

20-30%

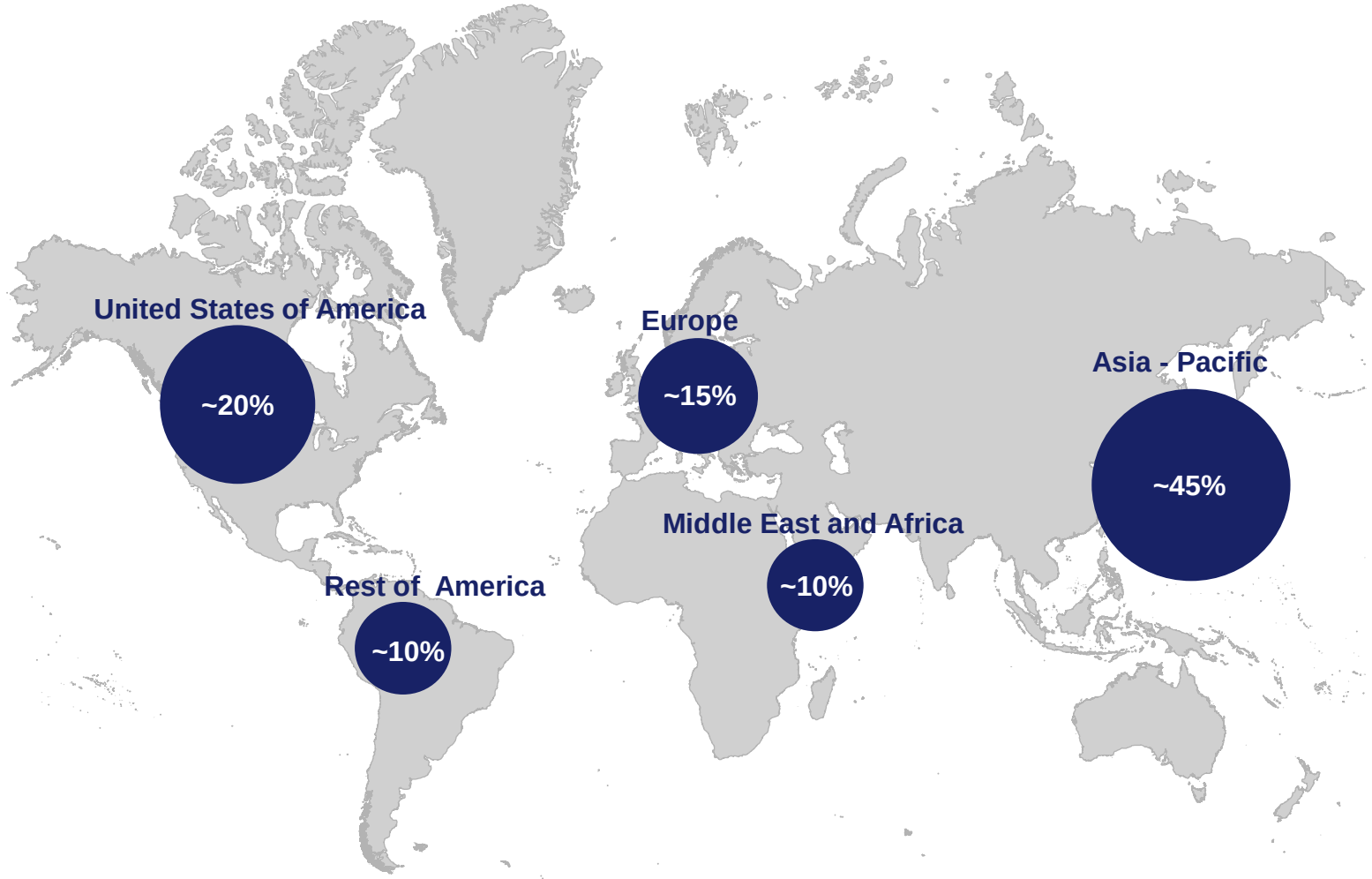
1. Other end uses exist (e.g. automotive, wipes, electronics)

Source: interviews with industry experts (November-December 2020), Smithers Apex

1| Asia-Pacific accounted for ~45% of melt-blown production in 2019, with differences in volumes, quality and delivery time versus Europe and the US

ESTIMATES – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

Melt-blown share of production by region, 2019, %



Key insights

Asian production is characterized by higher volumes, lower quality and quicker delivery times compared to the US and Europe's manufacturers

The NA market is more consolidated than the European market (top 3 players hold ~50% of the NA market vs. ~20% in Europe)

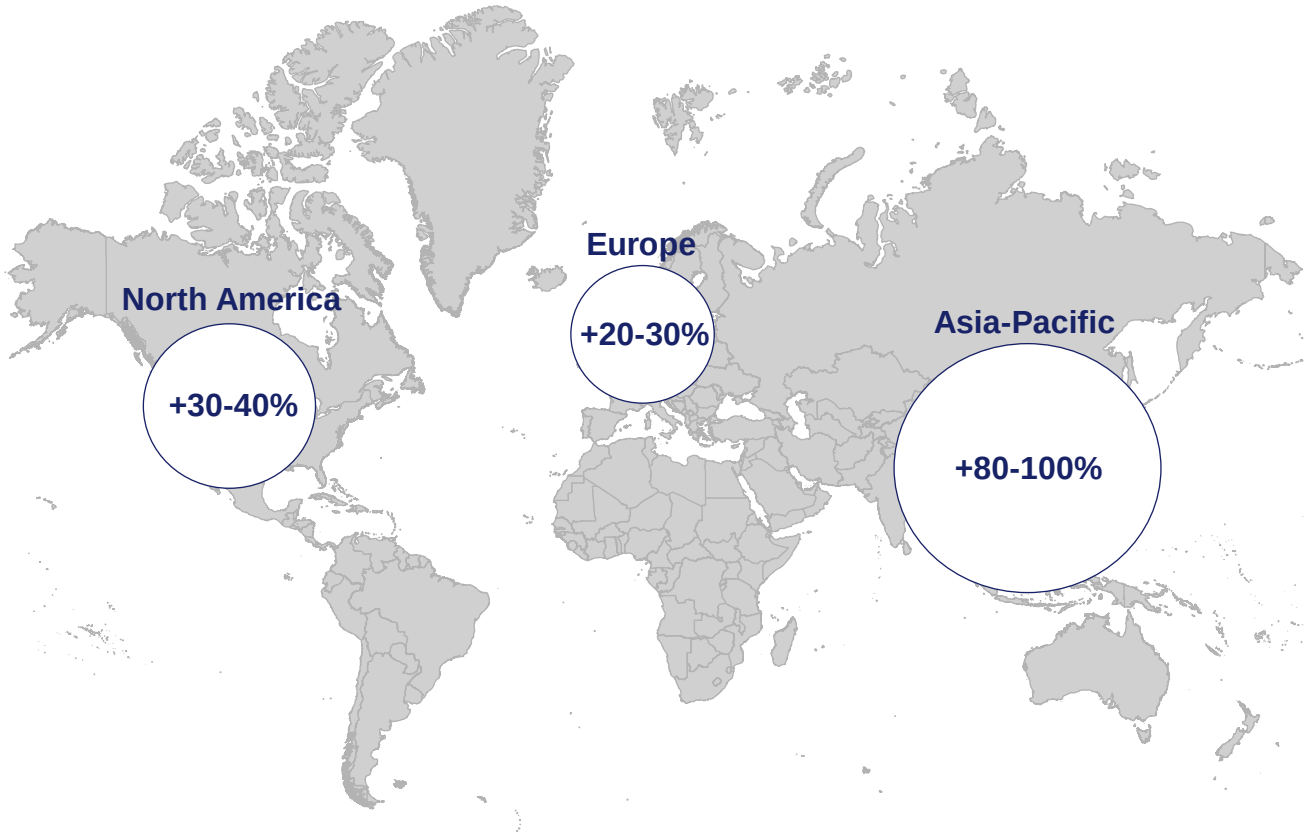
> Asia production is dominated by China, India, Indonesia, Japan, South Korea and Taiwan. This region benefits from the lowest production costs worldwide and focuses on volumes.
>
> **- Melt-blown expert, December 2020**

Source: interviews with industry experts (November-December 2020)

2| Global melt-blown production increased significantly in 2020 due to COVID-19, with increases of +100% in Asia-Pacific

ESTIMATES – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

Estimated increase in melt-blown production during the COVID-19 crisis, 2019-2020 change in production capacity, %



Key insights

The global melt-blown capacity increase in 2020 has been driven by:

- Existing melt-blown players increasing their production capacity: 30%-50% of the capacity increase
- Existing adjacent industries players (e.g. Sinopec, BYD, Winnebago) expanding into the melt-blown market: 35-45% of the capacity increase
- Entirely new players entering the market, representing 10-30% of the capacity increase

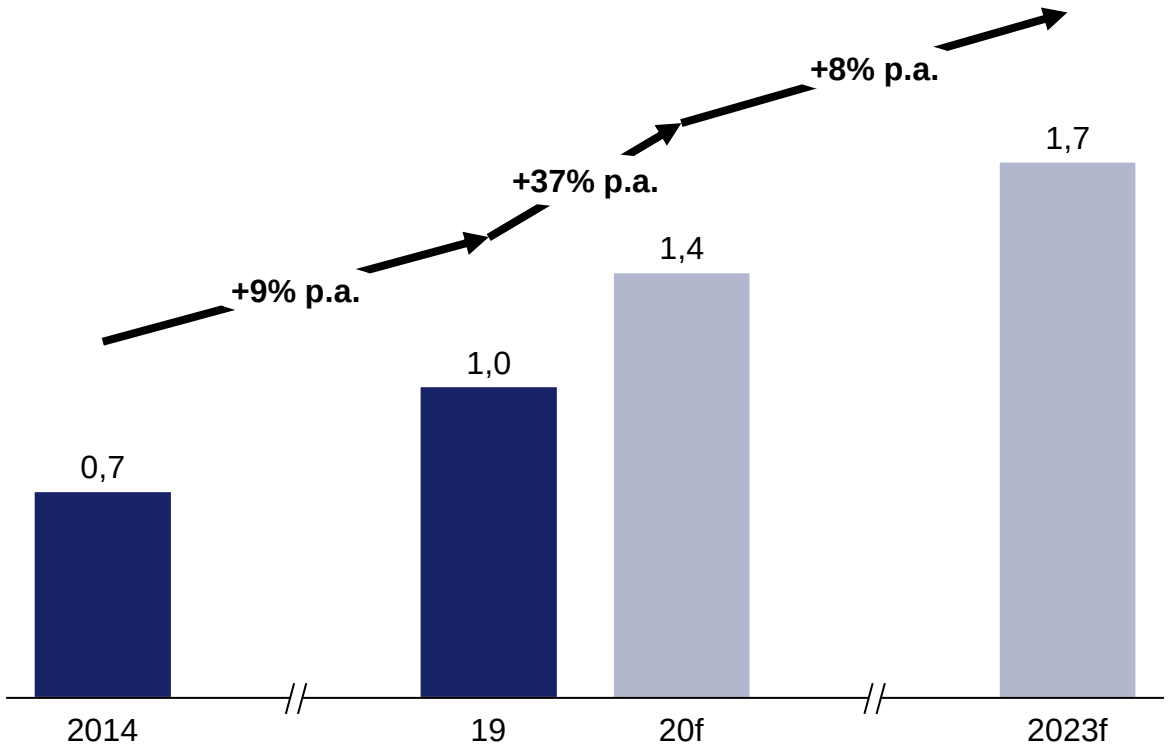
> New small-scale players entering the market are usually non-integrated players as mask production would require higher capital, specific machines and a high number of workers; but those are likely to disappear once the pandemic slows down as a consequence of their full focus on supplying mask producers
>
> **- Melt-blown expert, December 2020**

Source: interviews with industry experts (November-December 2020)

3| The melt-blown market is expected to continue to grow after the 2020 demand peak, maintaining a ~8% p.a. growth rate during 2020-2023

ESTIMATES – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

Melt-blown market size[1],
2014-2019 historic & 2020-2023 forecast,$bn



Key insights

The market is expected to continue to grow until 2023 driven by:

- Demographic growth, which is expected to increase by 1-1.5%[2] p.a. in 2020-2030
- Changes in consumer habits in wearing more masks after the crisis for environmental and sanitary purposes
- Growth in hygiene product consumption, especially in developing countries

After a price surge in melt-blown at the beginning of the crisis, prices are now progressively decreasing, as a result of supply increase

> Melt-blown prices surged by 150% at the beginning of the crisis
>
> **- PPE expert, Dec 2020**

1. All melt-blown end uses have been considered in the market sizing
2. According to the United Nations

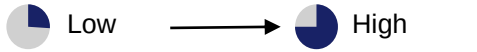
Source: interviews with industry experts (November-December 2020), Smithers Apex

3| Given this context, cost-advantaged new entrants and large end-product producers wanting to integrate vertically may have an opportunity

PROPOSITION - NON-EXHAUSTIVE

THOROUGH BUSINESS PLANNING REQUIRED TO FURTHER ASSESS THE STRATEGIC POSITIONING

Feasibility



Type of player	Strategic positioning	Description	Key success factors	Feasibility
For a brand new player	Cost leader	**Enter the melt-blown industry with a high volume and low cost strategy** by using low cost raw materials and low quality machinery	• Achieve economies of scale (would require producing spunbond as well as melt-blown and targeting multiple industries as customers) • Locate near to raw material supply • Locate in a low labour and utilities cost country • Target small/medium and local players as customers	
	Premium manufacturer	**Enter the melt-blown industry with a high margin strategy** by using high quality raw materials and machinery	• Secure high quality raw materials and machinery (in short supply during the COVID-19 crisis) • Target large players as customers (would involve inspections and quality control) • Build solid brand and reputation (would require several years)	
For an existing end-product manufacturer	Value chain integrator[1]	**Build in-house melt-blown production capabilities** for own usage (only makes sense for large end-product manufacturers)	• Sufficient internal demand to break-even; it would be hard for a small company to integrate upward due to capital intensity and technical barriers • Secure high quality machinery and raw materials for premium products manufacturers/locate in low labour costs country with proximity to raw materials for lower quality products manufacture.	

1. Some examples of hygiene end-product manufacturers with integrated melt-blown manufacturing: Cardinal Health, Kimberly-Clark, Halyard Health

Source: interviews with industry experts (November-December 2020)

3| New entrants to the melt-blown market must overcome 4 major entry barriers

NON-EXHAUSTIVE – FROM EXPERTS INTERVIEWS, AS OF MID-DECEMBER 2020

FOCUS ON REQUIREMENTS FOR BRAND NEW PLAYERS

Strength of barrier

Limited → Significant

Barrier	Description	Relevance/ strength	Expert quotes
Competitive industry with large players dominating the market	The melt-blown competitive landscape is consolidated: • ~10-15 large players account for ~60% of the market, incl. ~5 large integrated players who manufacture finished PPE (e.g. 3M, Dupont) • In addition, + 500 smaller players are competing in this industry		The melt-blown market is dominated by large integrated and non-integrated manufacturers; in addition, hundreds of small players are producing melt-blown **- PPE expert, November 2020**
Changing regulations and importance of brand	• Regulations have changed rapidly during the pandemic, with quality standards requirements becoming more stringent • Building brand identity, trust and loyalty is key in this industry		The COVID-19 pandemic has led some governments to change regulations to limit low quality PPE on the market **- Melt-blown expert, November 2020**
Scale and volume	Economies of scale and volume are critical to achieve competitiveness, suggesting manufacturers would have to expand beyond melt-blown for medical end use only: • Produce spunbond non-woven on top of melt-blown (spunbond market is 9x larger[1] than the melt-blown market) • Target different types of customers (e.g. hygiene customers on top of medical ones)		A successful player would need quickly to scale and secure long-term contracts. The production of spunbond non-woven on top of melt-blown could be necessary to achieve scale. **- PPE expert, November 2020**
Limited availability of machinery and raw materials	• Fewer than 10 companies manufacture high-quality machine lines which can produce high quality melt-blown and it takes ~6 months to produce a single line • Polymer, the main raw material used to manufacture melt-blown, has been in short supply during the pandemic		A new entrant would need to secure its polymer inputs early to avoid another potential shortage in the future **- Melt-blown expert, November 2020**

1. In volume

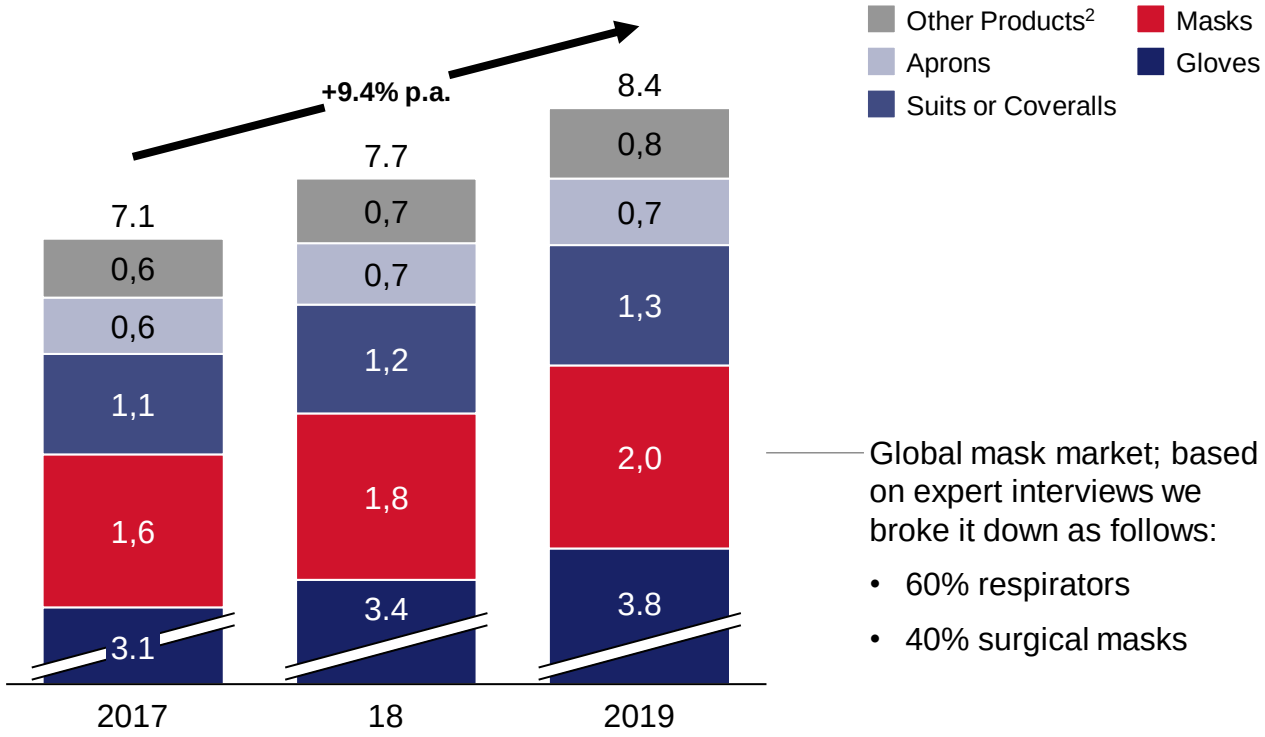
Source: interviews with industry experts (November-December 2020)

Contents

A: Baseline modelled using historic annual market in value and average prices per PPE item by category post-COVID-19

ASSUMPTIONS

Historic annual market in value, $bn



Global mask market; based on expert interviews we broke it down as follows:

- 60% respirators
- 40% surgical masks

Average prices per item in 2019, $/unit[1]

For the purpose of this exercise, we used UK prices[3] as an estimate of global prices but price variations can be observed at a country-level

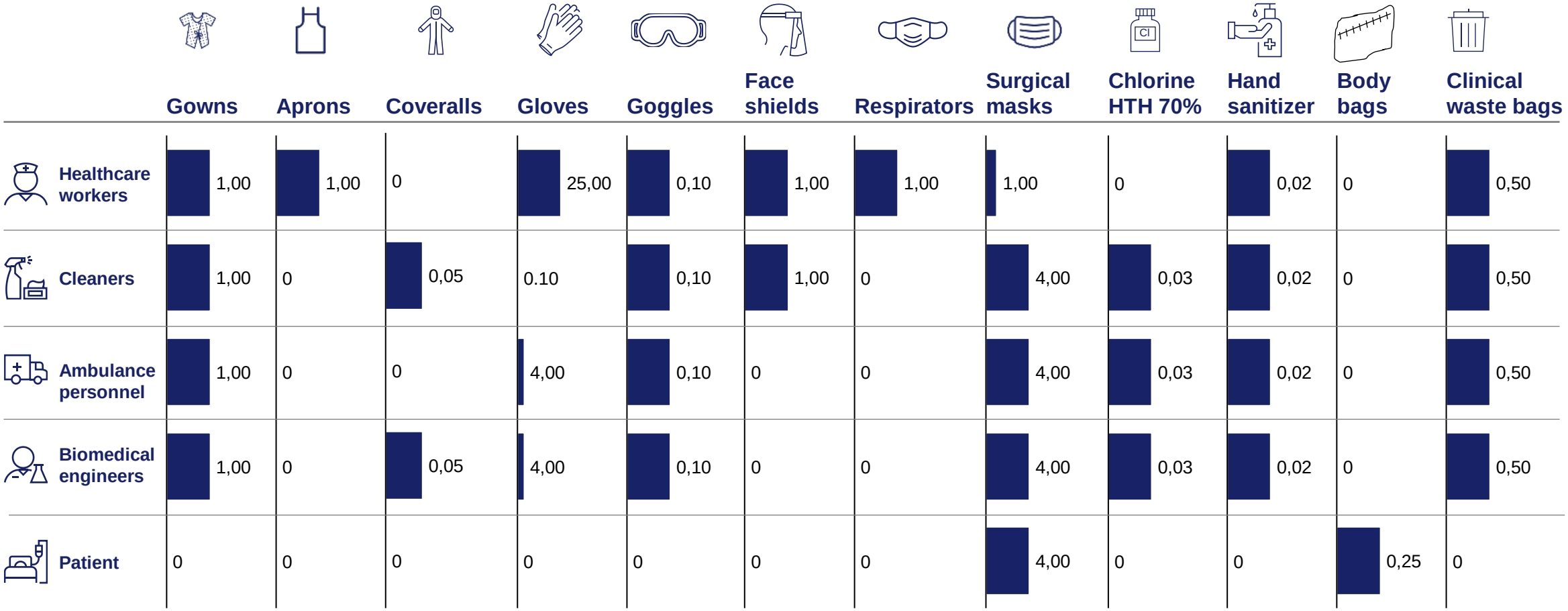
1.Unit is per item or per pair in case of gloves
2.Shoe cover and eye protection
3.UK Department of Health & Social Care data on prices in 2019

Source: Mordor Intelligence (updated in November 2020), National Audit Office analysis of Department of Health & Social Care data

B: Usage rate for each type of PPE estimated using WHO standards

Daily usage rate per item by healthcare workers and other staff

ASSUMPTIONS



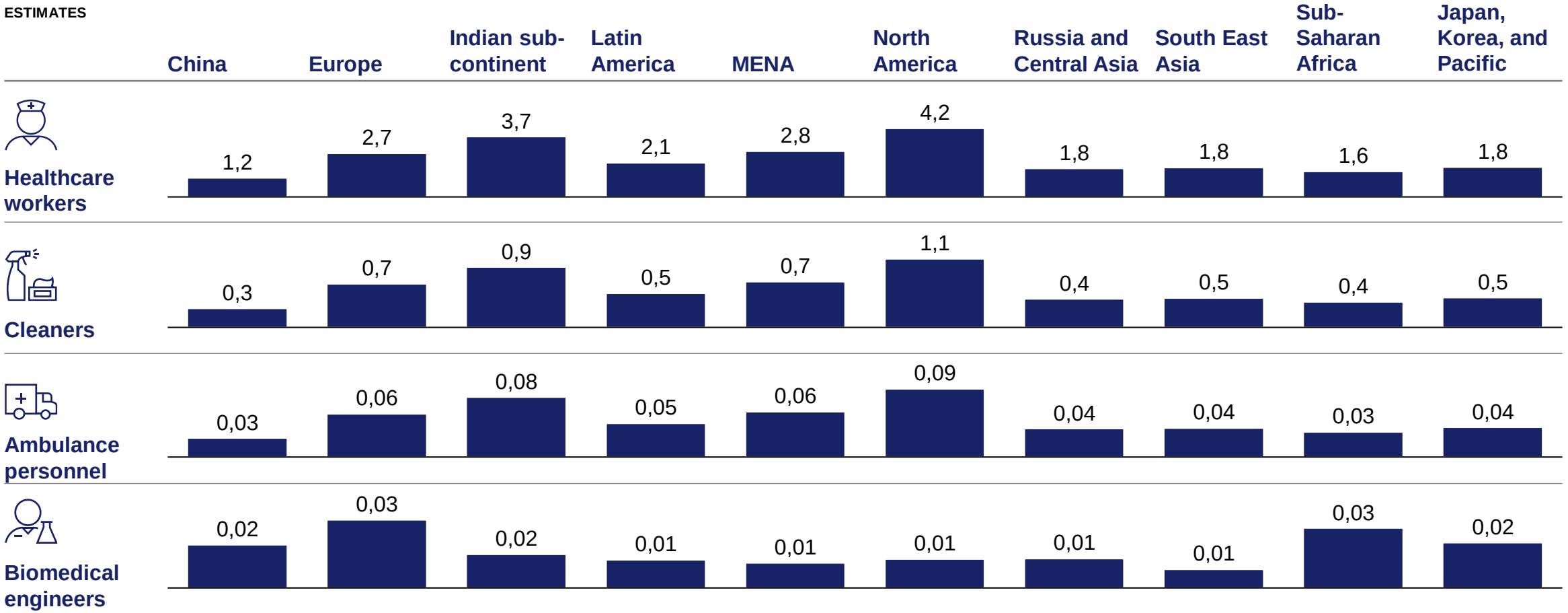
For the purpose of this exercise, we used global WHO standards but at a country-level exercise, these norms could be adjusted via local clinical data/local observations

Source: WHO

B: Healthcare workers and other staff by bed and day reflect regional profiles

#Healthcare workers and other staff/bed/day

ESTIMATES



Methodology

- hospitalisation days are converted to number of healthcare workers using World Bank data on hospital beds and healthcare workers (HCW)by country
- Number of other workers is estimated based on WHO standards adjusted by a regional ratio $\frac{\text{WHO standards on \#HCW by bed}}{\text{Regional WB data on \#HCW by bed}}$

Source: WHO norms, World Bank database (# HCWs per 1,000 people by country by year, and # hospital beds per 1,000 people by country by year)

D: To model non-healthcare worker demand, different sources (each with limitations) have been used for each independent variable

High degree of uncertainty

	Elements	Overall methodology	Main limitations	Sources
	# workers by archetype	**Segmentation of each region's workforce** by type of job (physicality and level of social interaction)	Segmentation is based on overall economic activity but this data could be refined using country employment statistics	International Labour Organization
1	**% back to work**	Projection of **return-to-work timeline** indexed to the epidemiological curve	For the purpose of this exercise, we used a global percentage of workers physically back at work (across both geography and archetype)	Interviews with experts[1] Survey of working professionals[2]
2	**Adoption rate by PPE by archetype** (i.e., sections of the workforce that will use PPE)	Use of **current US adoption rate** to get an adoption rate baseline Conversion by region using a **regional adjustment factor** indexed to current surgical mask adoption rate Scale-down of adoption rate **indexed to the epidemiological curve**	For the purpose of this exercise, we used a regional assumption for the adoption rates but country-level adoption rates should be refined to fit local situation	
3	**Usage rate by PPE** (i.e., number of units per day)	Assumptions about **usage rate by type of job**	Usage rates are assumed to be standard for all regions but some discrepancies may exist between countries depending on usage habits	WHO recommendation Interviews with experts[1] Survey of working professionals[2]

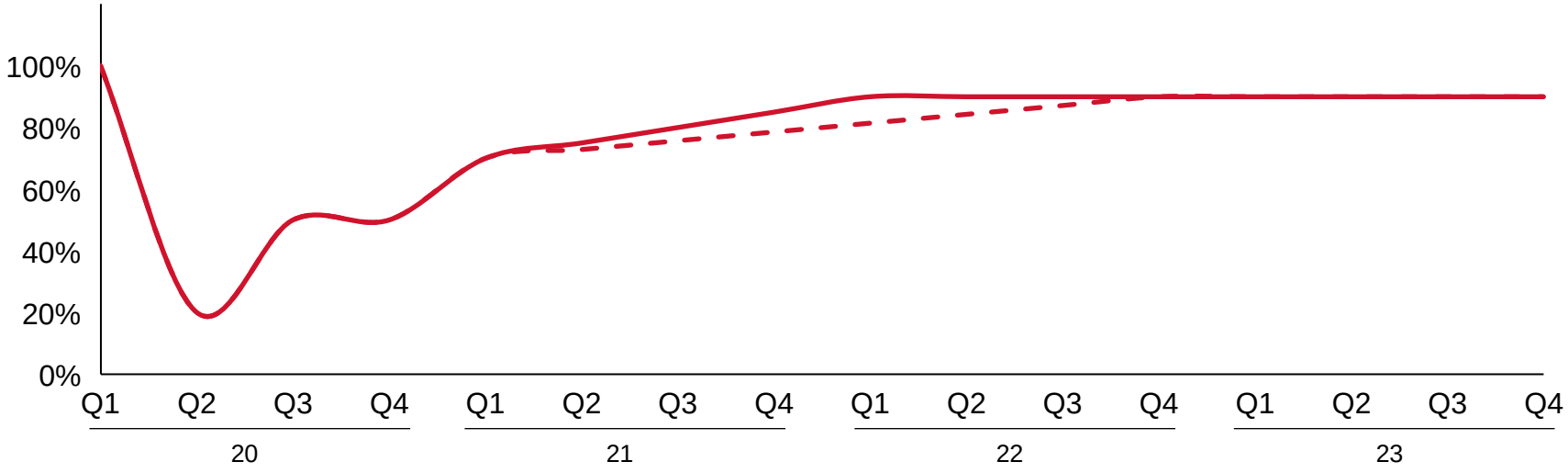
1.November-December 2020
2.Survey carried out in the US, 28 May – 3 June 2020; n=1,021

Source: ILO, WHO, YouGov, interviews with public health experts (November-December 2020), survey carried out in the US, 28 May-3 June 2020; n=1,021

D1: The return-to-work timeline has been indexed to the epidemiological curve

ESTIMATES

Percentage of workers physically back at work



~20% of workers (i.e,., essential workers) physically at work during Q2 2020 due to restrictive measures	Ramp-up of percentage of workers physically at work as COVID-19 immunity increases and hospitalisations decrease	Return to normal (90% of workers back at work) should vary depending by geographies driven by their vaccination timeline

Points to note

Percentage of workers physically back at work is assumed to be **consistent across all type of workers and geographies**

Return-to-work timeline is expected to vary **depending on the epidemiological curve**; 90% of workers should be physically back at work once herd immunity is achieved

Source: interviews with public health experts (November 2020), Survey held in the US, 28 May-3 June 2020; n=100, interviews made in the US in April and May 2020, Press search

D2: Adoption rate by archetype, PPE, and region (1/2)

Russia and Asia

ESTIMATES

		China			Indian subcontinent			Japan, Korea, and Pacific			Rest of South East Asia			Russia and Central Asia		
	PPE category	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal
Archetype 1 High social interaction and high physicality	Respirators	4-6%	15-20%	~2%	4-5%	15-20%	0%	4-5%	14-19%	~1%	4-6%	15-20%	~2%	3-4%	13-18%	0%
	Surgical masks	14-17%	49-59%	5-6%	12-15%	50-60%	~1%	12-14%	48-57%	~3%	14-17%	50-60%	5-6%	11-13%	45-54%	~1%
	Gloves	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Hand sanitizer	14-17%	49-59%	5-6%	12-15%	50-60%	~1%	12-14%	48-57%	~3%	14-17%	50-60%	5-6%	11-13%	45-54%	~1%
	Face shields	26-28%	89-99%	9-10%	22-25%	90-100%	~2%	21-24%	86-95%	~5%	26-29%	91-101%	9-10%	20-22%	81-90%	~1%
Archetype 2 High social interaction and low physicality	Respirators	3-4%	10-15%	1-2%	2-4%	10-15%	0%	2-4%	10-14%	~1%	3-4%	10-15%	1-2%	2-3%	9-13%	0%
	Surgical masks	0-1%	0-5%	0-1%	0-1%	0-5%	0%	0-1%	0-5%	0%	0-1%	0-5%	0-1%	0-1%	0-4%	0%
	Gloves	14-17%	49-59%	5-6%	12-15%	50-60%	~1%	12-14%	48-57%	~3%	14-17%	50-60%	5-6%	11-13%	45-54%	~1%
	Hand sanitizer	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Face shields	14-17%	49-59%	5-6%	12-15%	50-60%	~1%	12-14%	48-57%	~3%	14-17%	50-60%	5-6%	11-13%	45-54%	~1%
Archetype 3 Low social interaction and low physicality	Respirators	26-28%	89-99%	9-10%	22-25%	90-100%	~2%	21-24%	86-95%	~5%	26-29%	91-101%	9-10%	20-22%	81-90%	~1%
	Surgical masks	1-3%	5-10%	~1%	1-2%	5-10%	0%	1-2%	5-10%	0-1%	1-3%	5-10%	~1%	1-2%	4-9%	0%
	Gloves	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Hand sanitizer	11-14%	39-49%	4-5%	10-12%	40-50%	~1%	10-12%	38-48%	2-3%	12-14%	40-50%	4-5%	9-11%	36-45%	0-1%
	Face shields	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: interviews with public health experts (November 2020), Survey conducted in the US, 28 May-3 June 2020; n=100, Press search

D2: Adoption rate by archetype, PPE, and region (2/2)

Europe, America, Africa, and Middle East

ESTIMATES

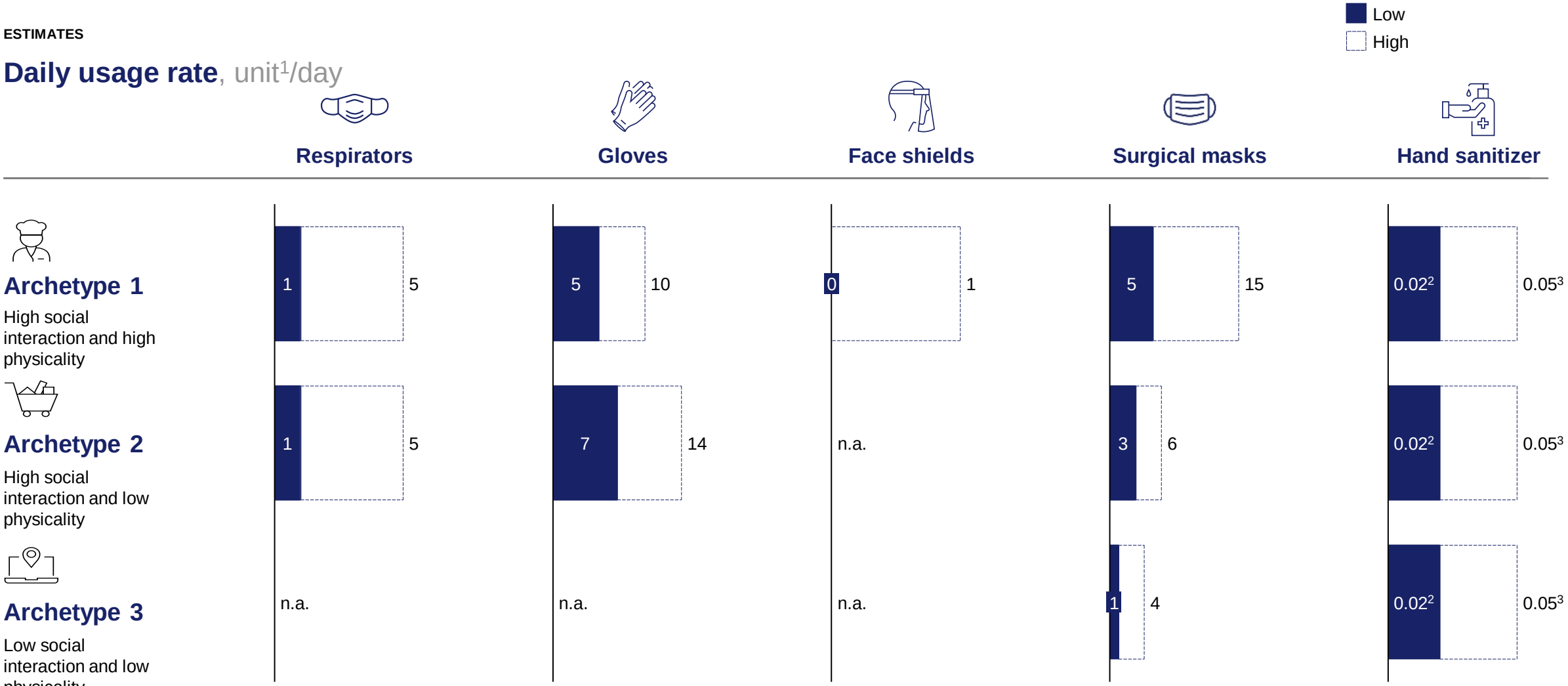
		Europe			North America			Latin America			Sub-Saharan Africa			Middle East and North Africa		
	PPE category	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal
 **Archetype 1** High social interaction and high physicality	Respirators	3-4%	13-18%	0%	4-5%	15-20%	0%	3-4%	12-16%	0%	~1%	3-4%	0%	3-4%	13-17%	0%
	Surgical masks	11-13%	45-54%	~1%	13-15%	50-60%	~1%	10-12%	39-47%	~1%	~3%	10-12%	0%	11-13%	43-51%	~1%
	Gloves	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Hand sanitizer	11-13%	45-54%	~1%	13-15%	50-60%	~1%	10-12%	39-47%	~1%	~3%	10-12%	0%	11-13%	43-51%	~1%
	Face shields	20-22%	81-90%	~2%	23-25%	90-100%	~2%	18-20%	71-79%	~1%	~5%	18-20%	0%	19-21%	77-85%	~1%
 **Archetype 2** High social interaction and low physicality	Respirators	2-3%	9-13%	0%	3-4%	10-15%	0%	2-3%	8-12%	0%	~1%	2-3%	0%	2-3%	9-13%	0%
	Surgical masks	0-1%	0-4%	0%	0-1%	0-5%	0%	0-1%	0-4%	0%	0%	0-1%	0%	0-1%	0-4%	0%
	Gloves	11-13%	45-54%	~1%	13-15%	50-60%	~1%	10-12%	39-47%	~1%	~3%	10-12%	0%	11-13%	43-51%	~1%
	Hand sanitizer	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Face shields	11-13%	45-54%	~1%	13-15%	50-60%	~1%	10-12%	39-47%	~1%	~3%	10-12%	0%	11-13%	43-51%	~1%
 **Archetype 3** Low social interaction and low physicality	Respirators	20-22%	81-90%	~2%	23-25%	90-100%	~2%	18-20%	71-79%	~1%	~5%	18-20%	0%	19-21%	77-85%	~1%
	Surgical masks	1-2%	4-9%	0%	1-3%	5-10%	0%	1-2%	4-8%	0%	0-1%	1-2%	0%	1-2%	4-9%	0%
	Gloves	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Hand sanitizer	9-11%	36-45%	~1%	10-13%	40-50%	~1%	8-10%	31-39%	0-1%	2-3%	8-10%	0%	9-11%	34-43%	0-1%
	Face shields	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: interviews with public health experts (November 2020), Survey held in the US, 28 May-3 June 2020; n=100, Press search

D3: Usage rates by archetype and PPE category are assumed to be consistent across regions

ESTIMATES

Daily usage rate, unit[1]/day



1.Unit is per item or per pair in case of gloves, and is per litter for hand sanitizer
2.Corresponds to 2 frictions per day
3.Corresponds to 4 frictions per day

Source: WHO, interviews with public health experts (November 2020), Survey conducted in the US, 28 May-3 June 2020; n=100, Press search

E: To model consumer demand, different sources (some with limitations) have been used for each independent variable

High degree of uncertainty

	Elements	Overall methodology	Main limitations	Sources
1	**# population by age range**	**Segmentation of each region's population** by age group	n.a.	UN Population Division
2	**Adoption rate of PPE by age range** (i.e., proportion of the population that will use PPE)	Use of **current US adoption rate** to get an adoption rate baseline Conversion by region using a **regional adjustment factor** indexed on current surgical mask adoption rate Scale-down of adoption rate **indexed on the epidemiological curve**	For the purpose of this exercise, we used a regional assumption for the adoption rates but country-level adoption rates should be refined to fit local situation	YouGov Interviews with experts[1] Survey of general public[2]
3	**Usage rate by PPE** (i.e., number of units per day)	Assumption on **usage rate by age group**	Usage rate is assumed to be standard for all regions but some discrepancies may exist between countries depending on usage habits	WHO recommendation Interviews with experts[1] Survey of general public[2]

1.November-December 2020
2.Survey held in the US, 28 May-3 June 2020; n=1,021

Source: UN Population Division, WHO, YouGov, interviews with public health experts (November-December 2020), Survey conducted in the US, 28 May-3 June 2020; n=1,021

E1: Adoption rate by age range, PPE and region (1/2)

Russia and Asia

ESTIMATES

		China			Indian subcontinent			Japan, Korea, and Pacific			Rest of South East Asia			Russia and Central Asia		
	PPE category	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal
 **15-19**	Respirators	0-1%	0-5%	0-1%	0-1%	0-5%	0%	0-1%	0-5%	0%	0-1%	0-5%	0-1%	0-1%	0-4%	0%
	Surgical masks	11-14%	39-49%	4-5%	10-12%	40-50%	~1%	10-12%	38-48%	2-3%	12-14%	40-50%	4-5%	9-11%	36-45%	0-1%
	Cloth masks	11-14%	39-49%	4-5%	10-12%	40-50%	~1%	10-12%	38-48%	2-3%	12-14%	40-50%	4-5%	9-11%	36-45%	0-1%
	Gloves	0-1%	0-5%	0-1%	0-1%	0-5%	0%	0-1%	0-5%	0%	0-1%	0-5%	0-1%	0-1%	0-4%	0%
	Hand sanitizer	17-23%	59-79%	6-8%	15-20%	60-80%	1-2%	14-19%	57-76%	3-4%	17-23%	60-81%	6-8%	13-18%	54-72%	~1%
 **20-65**	Respirators	1-3%	5-10%	~1%	1-2%	5-10%	0%	1-2%	5-10%	0-1%	1-3%	5-10%	~1%	1-2%	4-9%	0%
	Surgical masks	9-11%	30-39%	3-4%	7-10%	30-40%	~1%	7-10%	29-38%	~2%	9-12%	30-40%	3-4%	7-9%	27-36%	0%
	Cloth masks	9-11%	30-39%	3-4%	7-10%	30-40%	~1%	7-10%	29-38%	~2%	9-12%	30-40%	3-4%	7-9%	27-36%	0%
	Gloves	0-3%	0-10%	0-1%	0-2%	0-10%	0%	0-2%	0-10%	0-1%	0-3%	0-10%	0-1%	0-2%	0-9%	0%
	Hand sanitizer	10-14%	35-49%	4-5%	9-12%	35-50%	~1%	8-12%	33-48%	2-3%	10-14%	35-50%	4-5%	8-11%	31-45%	0-1%
 **Over 65**	Respirators	0-1%	0-5%	0-1%	0-1%	0-5%	0%	0-1%	0-5%	0%	0-1%	0-5%	0-1%	0-1%	0-4%	0%
	Surgical masks	7-11%	25-39%	3-4%	6-10%	25-40%	~1%	6-10%	24-38%	1-2%	7-12%	25-40%	3-4%	6-9%	22-36%	0%
	Cloth masks	7-11%	25-39%	3-4%	6-10%	25-40%	~1%	6-10%	24-38%	1-2%	7-12%	25-40%	3-4%	6-9%	22-36%	0%
	Gloves	0-3%	0-10%	0-1%	0-2%	0-10%	0%	0-2%	0-10%	0-1%	0-3%	0-10%	0-1%	0-2%	0-9%	0%
	Hand sanitizer	14-20%	49-69%	5-7%	12-17%	50-70%	~1%	12-17%	48-67%	3-4%	14-20%	50-71%	5-7%	11-16%	45-63%	~1%

Source: WHO, YouGov, interviews with public health experts (November-December 2020), Survey conducted in the US, 28 May-3 June 2020; n=1,021

E1: Adoption rate by age range, PPE and region (2/2)

Europe, America, Africa, and Middle East

ESTIMATES

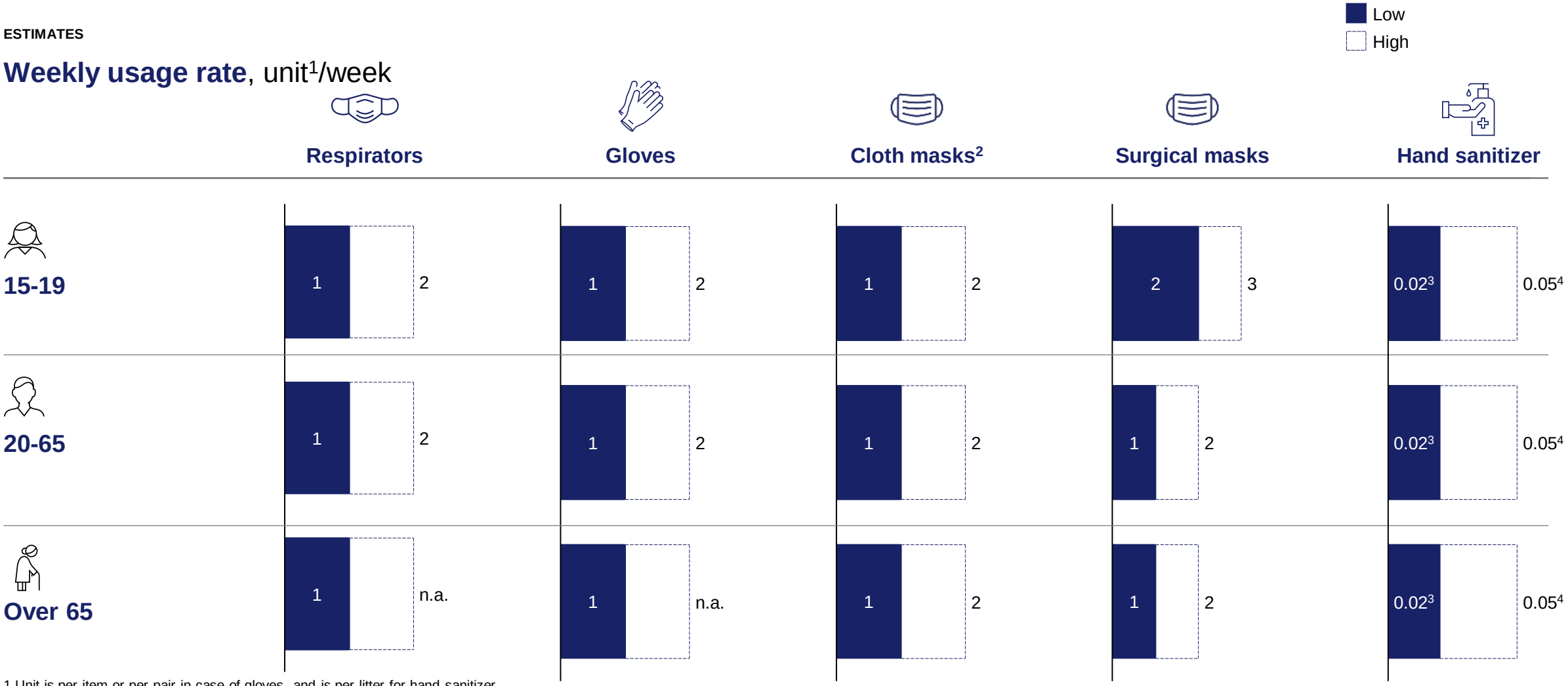
		Europe			North America			Latin America			Sub-Saharan Africa			Middle East and North Africa		
	PPE category	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal	Q2 2020	Current situation	New normal
15-19	Respirators	0-1%	0-4%	0%	0-1%	0-5%	0%	0-1%	0-4%	0%	0-0%	0-1%	0%	0-1%	0-4%	0%
	Surgical masks	9-11%	36-45%	~1%	10-13%	40-50%	~1%	8-10%	31-39%	0-1%	2-3%	8-10%	0%	9-11%	34-43%	0-1%
	Cloth masks	9-11%	36-45%	~1%	10-13%	40-50%	~1%	8-10%	31-39%	0-1%	2-3%	8-10%	0%	9-11%	34-43%	0-1%
	Gloves	0-1%	0-4%	0%	0-1%	0-5%	0%	0-1%	0-4%	0%	0-0%	0-1%	0%	0-1%	0-4%	0%
	Hand sanitizer	13-18%	54-72%	1-2%	15-20%	60-80%	1-2%	12-16%	47-63%	~1%	3-4%	12-16%	0%	13-17%	51-68%	~1%
20-65	Respirators	1-2%	4-9%	0%	1-3%	5-10%	0%	1-2%	4-8%	0%	0-1%	1-2%	0%	1-2%	4-9%	0%
	Surgical masks	7-9%	27-36%	~1%	8-10%	30-40%	~1%	6-8%	24-31%	0%	~2%	6-8%	0%	6-9%	26-34%	0%
	Cloth masks	7-9%	27-36%	~1%	8-10%	30-40%	~1%	6-8%	24-31%	0%	~2%	6-8%	0%	6-9%	26-34%	0%
	Gloves	0-2%	0-9%	0%	0-3%	0-10%	0%	0-2%	0-8%	0%	0-1%	0-2%	0%	0-2%	0-9%	0%
	Hand sanitizer	8-11%	31-45%	~1%	9-13%	35-50%	~1%	7-10%	28-39%	0-1%	2-3%	7-10%	0%	7-11%	30-43%	0-1%
Over 65	Respirators	0-1%	0-4%	0%	0-1%	0-5%	0%	0-1%	0-4%	0%	0-0%	0-1%	0%	0-1%	0-4%	0%
	Surgical masks	6-9%	22-36%	~1%	6-10%	25-40%	~1%	5-8%	20-31%	0%	1-2%	5-8%	0%	5-9%	21-34%	0%
	Cloth masks	6-9%	22-36%	~1%	6-10%	25-40%	~1%	5-8%	20-31%	0%	1-2%	5-8%	0%	5-9%	21-34%	0%
	Gloves	0-2%	0-9%	0%	0-3%	0-10%	0%	0-2%	0-8%	0%	0-1%	0-2%	0%	0-2%	0-9%	0%
	Hand sanitizer	11-16%	45-63%	~1%	13-18%	50-70%	~1%	10-14%	39-55%	~1%	3-4%	10-14%	0%	11-15%	43-60%	~1%

Source: WHO, YouGov, interviews with public health experts (November-December 2020), survey conducted in the US, 28 May-3 June 2020; n=1,021

E2: Usage rates by age group and PPE category are assumed to be consistent across regions

ESTIMATES

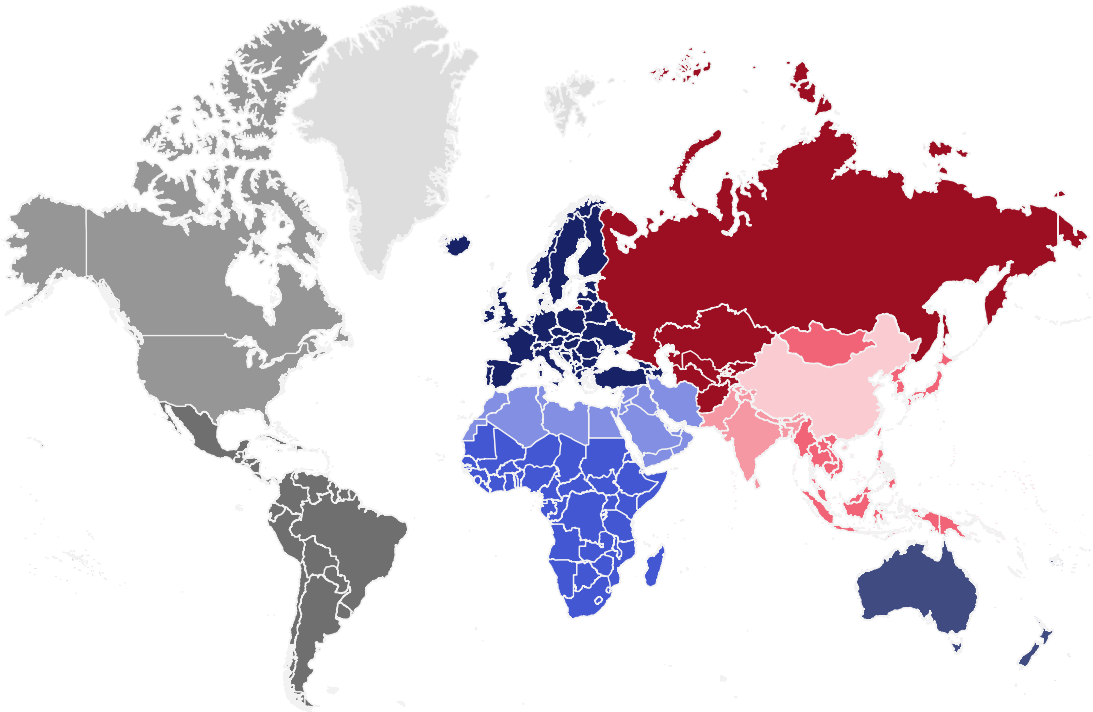
Weekly usage rate, unit[1]/week



1. Unit is per item or per pair in case of gloves, and is per litter for hand sanitizer
2. Usage rate per month
3. Corresponds to 2 frictions per day
4. Corresponds to 4 frictions per day

Source: WHO, interviews with public health experts (November 2020), Survey conducted in the US, 28 May-3 June 2020; n=100, Press search

Geographical scope



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