BOSTON CONSULTING GROUP

COVID-19 Respons— Systeem vragen

Internationale inzichten op de medische logistieke keten

08 APRIL 2020

Draft

Summary: clear signals to expand product scope due to supply chain challenges

Current scope of LCH covers products which are needed most urgently, and the scope is continuously evolving

- Main focus on PPE, such as different types of masks, gloves and gowns, test kits and disinfectant
- The product scope has been evolving over the past weeks to include additional products with high demand
- In addition to LCH, the 'Landelijk coördinatiecentrum geneesmiddelen' coordinates the availability of medication

Clear signals to expand product scope with more products becoming scarce due to supply chain challenges

- Due to high demand world wide, more products are potentially becoming scarce, such as infusion pumps, tube feed and body bags
- In addition, disruptions in products and export restrictions put further pressure on product availability, for example for a wide range of drugs (paracetamol, antibiotics) and surgical drapes

Crucial to look further ahead and start the procurement of products that will become scarce in the future

- With more countries starting to suffer from outbreaks, products for COVID-19 treatment are likely to become more scarce, for example needles and catheters
- In addition also non COVID-19 related products, needed regularly in the healthcare system, are more likely to become scarce, such as orthopedic implants and vaccines for influenza/HiB

Clear need for a continuous process to adjust product scope and communicate

- To deal with the rapid changes in demand and supply, a clear process between the Ministry of HWS and the LCH is needed to quickly propose and decide on scope changes; this process has been clarified last week and now needs to be implemented
- In addition, clear communication about product scope changes to the care providers and within LCH is key to ensure clear priorities for all stakeholders

Scope

1. Op hoofdlijnen: Inzichten productenscope en vervolgstappen
2. In detail: de Chinese markt
3. In detail: de Indiase markt
4. Appendix: rationale product schaarste
5. Appendix: product catalogus

1. Op hoofdlijnen: Inzichten productenscope en vervolgstappen

Market for some products more disrupted than for others

COVID-19 causes a steep increase in demand for specific products (e.g., masks, test kits) and disruptions in supply, mainly due to closed or disrupted production facilities

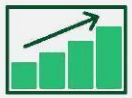
In addition, also supply of non COVID-19 related medical products might be at risk due to disrupted production facilities

Central procurement only needed in disrupted markets to avoid interference in well-functioning markets

What products are in scope for central procurement?

Three criteria for central procurement of scarce products

A product is likely to become scarce when there is...



Steep increase in demand
Demand will go up significantly and exceeds normal supply levels
Note: Requires demand predictions for the coming month

and/or

Disruption in supply chain
Supply is disrupted due to issues in production or distribution

and

High urgency / limited stock
Insufficient quantity in stock to cover demand in the coming months

This can include both COVID-19 related products and other scarce medical products

Overview as of April 8th; continuous refinement needed

- Observed demand increase
- Expected demand inc
- Observed supply disruption
- Expected supply disruption

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Current scope LCH and potential additions

Current scope LCH

PPE
- FFP1
- FFP2
- FFP3
- KN95
- Surgical masks (Type 2/2R)
- Gloves (non-sterile)
- Glasses (vices)
- Gowns
- Aprons

Tests
- Swabs
- Test media

Cleaning
- Disinfectant (hand)

Consumables
- Soda-lime pellets
- IC consumables[1]

Directly with Min VWS

Equipment
- Ventilators/breathing systems
- Perfusor/syringe/infusion pumps

Potentially scarce products[4] - to add to scope?

PPE
- Coveralls[2]
- Surgical mask incl. shield[2]
- Full shield face masks[2]
- N95 Mask[2]

Tests
- Molecular tests
- Serological tests

Equipment
- Feeding pump
- Morphine pumps
- Patient monitors
- CRRT-machines
- Matrasses for prone position

Consumables
- Body bags
- Clinical waste bags
- Wound gauze/bandages
- Surgical drapes

Other
- Oxygen (high concentration)
- Tube feed

Cleaning
- Disinfectant (surface)
- Cleaning (surface)

Products to monitor - to be decided

PBM
- Gloves (sterile)
- Shoe/Boot covers
- (Surgical) Hoods/hair nets
- PAPR (full face respirators)

Equipment
- Defibrillators
- ICU ultrasound machines
- Echocardiogram machines
- CT scanning machines

Cleaning
- Chlorine tablets
- Cleaning wipes
- Microfiber cloths
- Hand lotion

Consumables
- Needles/catheters/cannulae

Other
- Thermometers (rectal)+cover
- Bed frames
- Orthopedic implants

Medication/Vaccines

ICU: intubation and sedation
- Neuromuscular blocker (rocuronium)
- Anesthetics (propofol/midazolam)
- Painkiller (ketamine)
- Painkiller (morphine)
- Painkiller (paracetamol/tylenol)
- Mintelukast/Albuterol (asthma)
- Lopinavir / Ritonavir
- Heparin
- Saline
- Wide range of antibiotics[3]

COVID treatment
- (Hydroxy)chloroquine (plaquenil)
- Antiviral medication (acyclovir)
- Azithromycin
- Antipyretic (acetaminophen)

Other
- Vaccines for influenza/HiB

1. Wide range of consumables, specific SKU's to be determined, potentially includes ventilator consumables (hoses, flow sensors, HME filters, swivles, humidifiers, respiration filters, closed suction system, suction bags and CO2 cuvettes), Non-rebreathing/non-invasive mask, Infusion pump consumables (fluids), Central Venous Line, Intravenous infusions/Drips, Arterial line and Blood gas capillaries 2. Back-up for other PPE, such as gowns and glasses 3. Including Amoxicillin, Ofloxacin, Doxycycline, Penicillin, Azithromycin and Chloramphenicol 4. Scarce as defined in this document

Bron: LCH; Newsletter LCH March 26; Press release Opstart initiatief Landelijk Consortium Hulpmiddelen (Ministry HWS); GlobalData Pharm; Government of India; PIIE; BCG analysis

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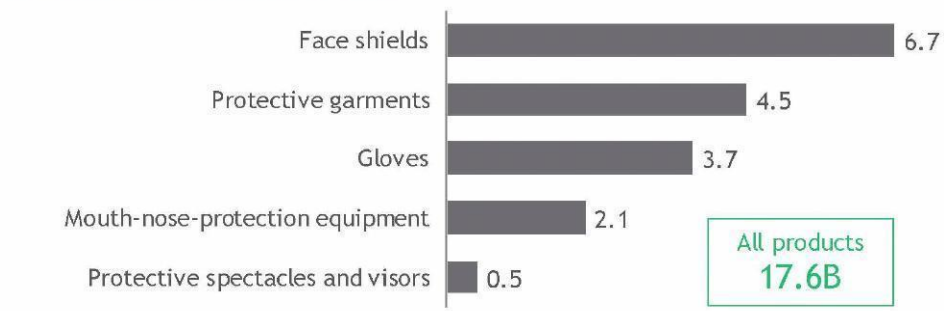
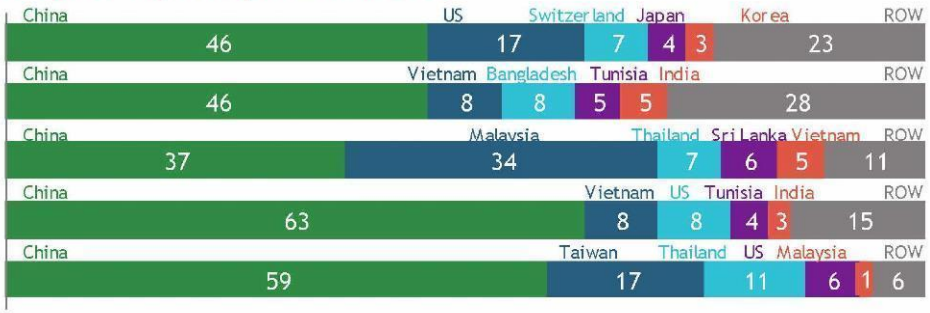
The EU imports a lot of these medical supplies, leaving it vulnerable to other countries' export restrictions or factory closings

EU imports of medical products **subject** to EU export controls

Total value in 2019, billions USD

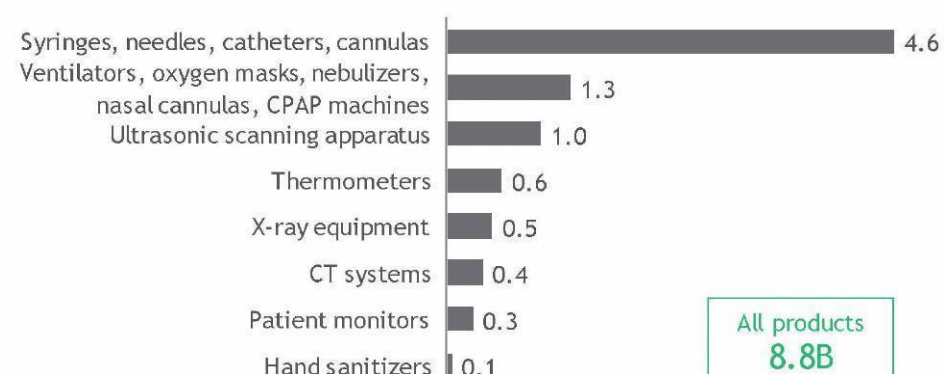


Percent of imports by source in 2019

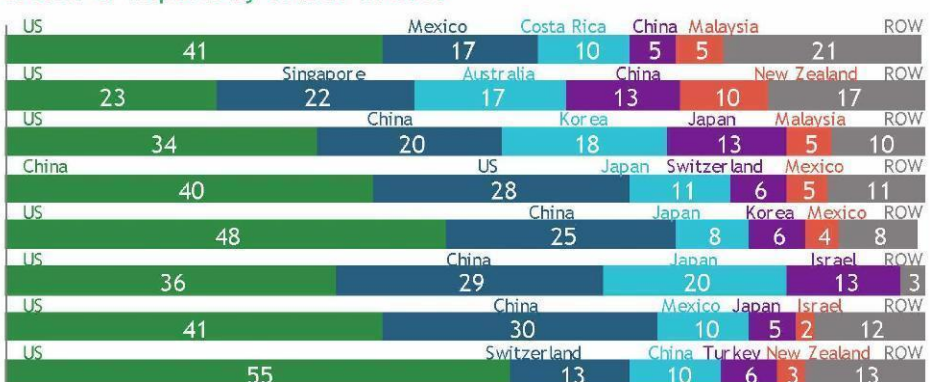


EU imports of medical products **not subject** to EU export controls

Total value in 2019, billions USD



Percent of imports by source in 2019



Source: Peterson Institute for International Economics

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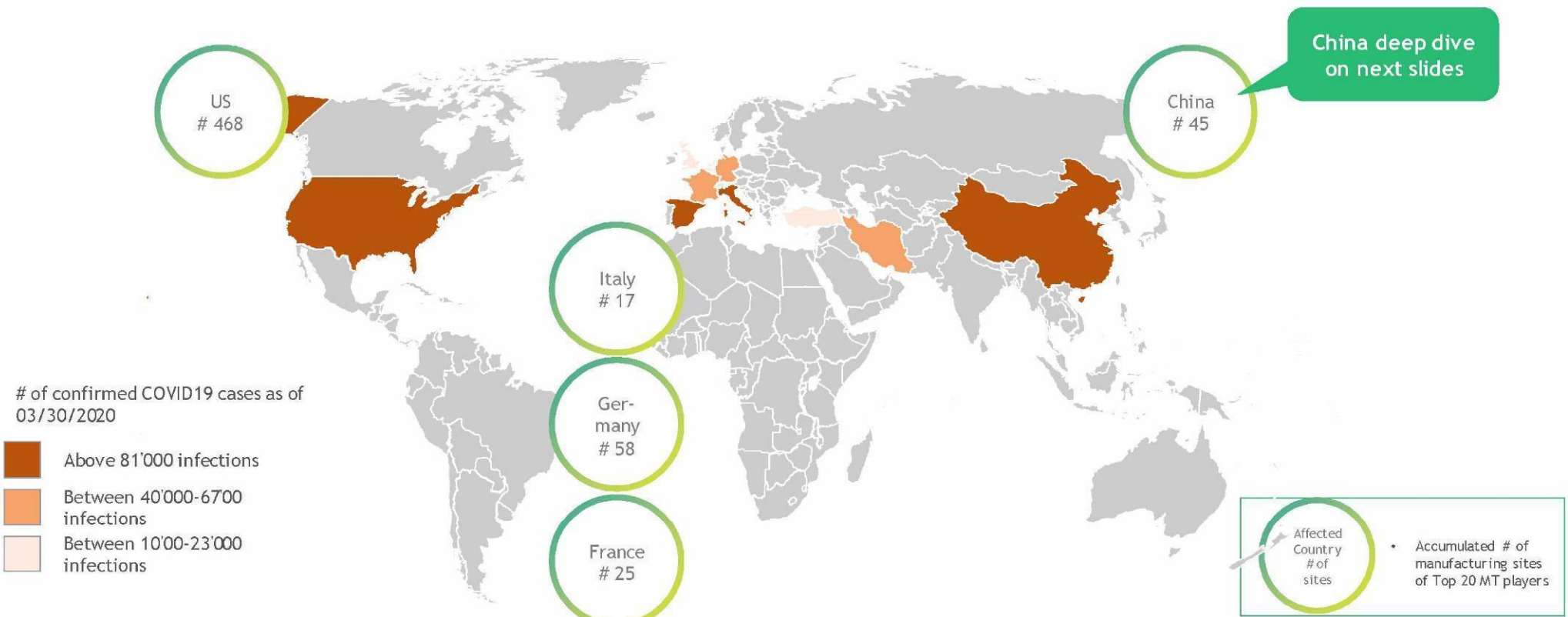
Many manufacturing sites[1] located in countries most affected by COVID-19, (potential) lock-downs put the supply chain even more at risk



1. Manufacturing sites of Top 20 MedTech players
Source: BCG MedTech Manufacturing Database; John Hopkins Coronavirus Resource Center as of 03/30/2020; Natural Earth Country boundaries without large lakes

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Experts indicate additional demand peaks and a high risk of supply disruptions

Demand peak: demand outweighs normal production capacity for critical items currently out of scope

- We are experiencing shortages for several cleaning/hygiene products such as hand alcohol (80%), microfiber cloths, and chlorine tablets - *Purchasing Manager academic hospital*
- The main surgical glove factory in Malaysia has orders for ~2.6B pieces/day, twice their normal capacity. This leads to a 4 month lag in fulfillment - *VP manufacturer/distributor of medical supplies*
- With patients staying on the IC for longer periods, we need a lot more tube feed (~1,5L per patient per day) - *Director health tech*
- We are experiencing urgent shortages in body bags & clinical waste bags due to increased demand - *Group Purchasing Manager UK*
- The main US based producer of ventilators has a production capacity of 250/week; world wide orders are far exceeding this - *VP manufacturer/distributor of medical supplies*
- Scientists expect a second wave of COVID late fall, which could hit together with an influenza/HiB wave and further strain hospital resources. Governments might consider mandatory vaccination, but vaccines have a long lead time to be produced and are scarce - *Health Policy expert*

Supply disruptions: longer leg times due to export restrictions and production disruption

- Many factories are maintaining or even increasing production capacity, however export restrictions and disruptions in logistics are the real problems - *Group Purchasing Manager*
- The surgical glove market is dominated by Malaysia. So far, the government has given exceptions for the large factories of gloves to continue with their production, but it is unclear how this will continue - *VP manufacturer/distributor of medical supplies*
- Export restrictions from India put a lot of pressure on availability of generics, like Paracetamol/infections medication. We have already seen prices for Paracetamol tripling - *Group Purchasing Manager*
- Producers of melt blown fabrics (gowns, drapes, masks) mainly source bulk materials in Saudi Arabia. We are seeing minor fulfilment lags, and this can increase with the recent outbreak in the Middle East - *VP manufacturer/distributor of medical supplies*
- Even though cleaning products (hand alcohol) might be still available in hospitals, for the general public those products are very hard to find. This is critical to prevent further outbreaks - *VP manufacturer/distributor of medical supplies*

Source: Expert interviews; BCG analysis

Supply chain disruptions are severe, and it is unclear how long it will last

Export restrictions

- Export restrictions are difficult to predict, however, thee are no clear signals for other major export restrictions than current situation in India
- China has introduced regulations for export of medical products, incl. the need for a letter of intent from buyer and quality documentation from the supplier

Reduced production capacity

- Production capacity in China seems to be recovering, after a dip in January and February. However, potential new outbreak waves might impact this
- More countries, e.g., US, Asian and Middle Eastern countries, start to implement lock-down type of measures, which potentially impacts the medical supply chain

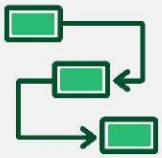
Logistical limitations

- Shipping lanes from Asia are still disrupted, leading to Air Cargo often being the only feasible option
- Due to increased demand for Air Cargo, we are seeing 3-4 day delays compared to normal business levels
- With increasing decline in passenger flights, capacity continues to decide and lead times for Air Cargo will become longer

Source: Seabury Capacity Tracking database; expert interviews; BCG analysis

Vervolgstappen VWS: implementeren en opvolgen van het scopeaanpassingsproces

Note: scopeaanpassing kan ook betekenen dat een product weer uit scope gaat omdat de markt voldoende is hersteld



Implementeren scopeaanpassingsproces en aanwijzen van verantwoordelijkheden, met eerste cyclus deze week

Uitzetten input verzoeken waar nodig, bijvoorbeeld bij brancheorganisaties en industrie experts en dit delen met LCH

Opvolgen acties, zoals het aanpassen van het (financieel) mandaat van LCH en externe communicatie

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Vervolgstappen LCH | Vervolgstappen algemeen en per team bij scope aanpassing

Continue

Bij aanpassing scope

Algemeen

- Bepalen proces-verantwoordelijken en proces implementeren/ uitvoeren
- Opzetten/uitvoeren meeting cadans met het Ministerie om tijdig beslissingen te kunnen nemen
- Opvragen juiste inputs[1] om scope continue te kunnen evalueren en tot een voorstel te kunnen komen (voor op- of afschalen)

Team S&D (incl. vraagvoorspelling)

- Aanpassen S&D model
- Aanpassen inputsheet supply
- Aanpassen vraagvoorspelling

Instroom teams

- Mobiliseren nieuw team
- Huidige teams briefen

Team Inbox

- Aanpassen folderstructuur
- Aanpassen procesflows
- Briefen studenten

Communicatie

- Communiceren scope uitbreiding (nieuwsbrief, leveranciers, koepelorganisaties etc.)

Finance / Legal

- Aanpassen convenant
- Aanpassen finance proces gerelateerde zaken (artikelnummers, etc.)

Team Distributie

- Inregelen distributie eisen
- Aanpassen aanvraagformulier portal/ROAZ app
- Aanpassen allocatiemodel

Kwaliteit

- Aanpassen product catalogus, incl. productspecificaties
- Opstellen kwaliteitschecks (fabriek/Vianen)
- Betrekken benodigde Rijkstoezichthouders

PMO

- Aanpassen productscope lijst (Teams/ communicatiebord)

1. Onder andere zorgaanbieders, bracheorganisaties, Ministerie van VWS, ROAZen, LCPS, Europese instanties, industrie experts, etc.

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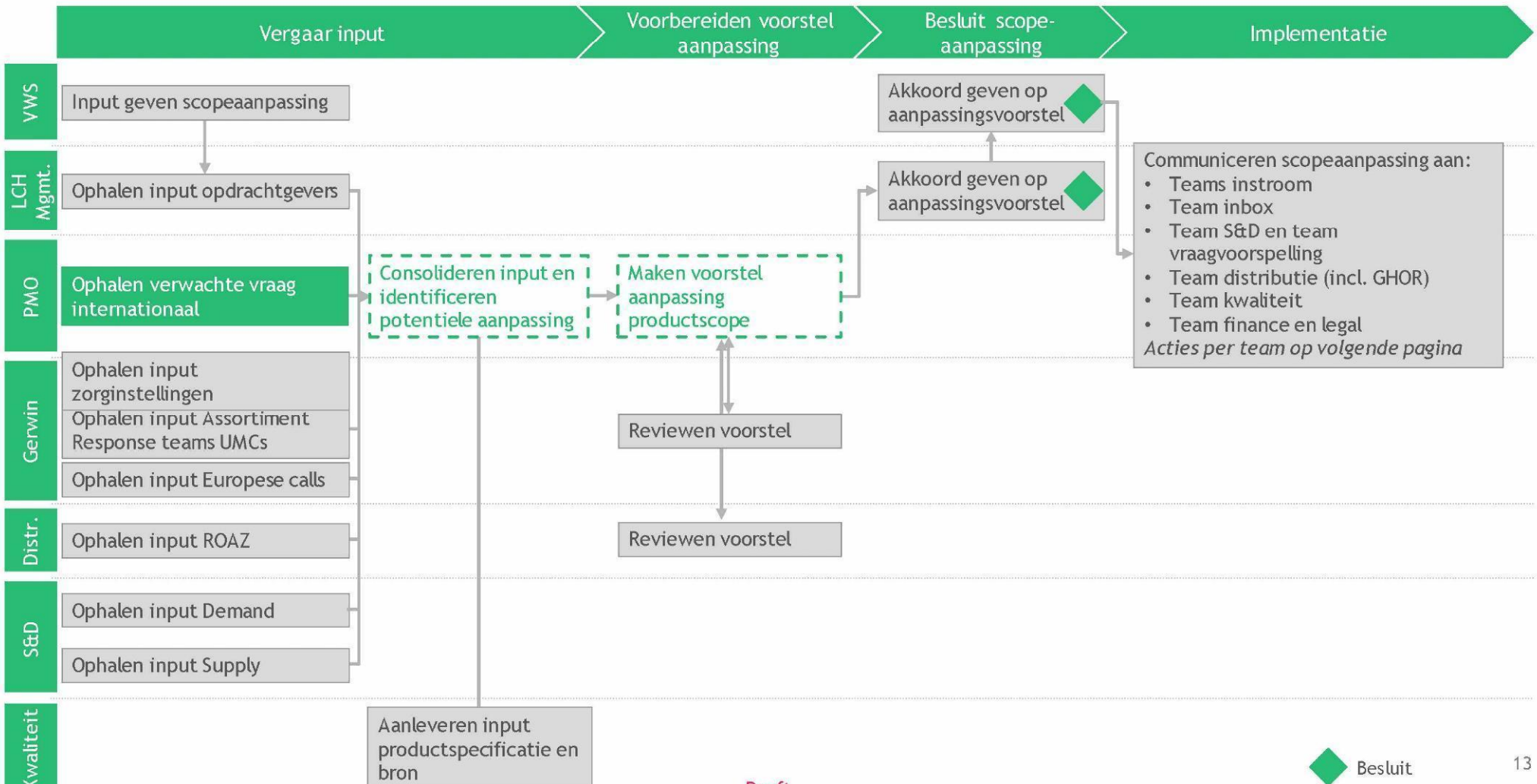
Back-up| Proces voor uitbreiding van productscope LCH



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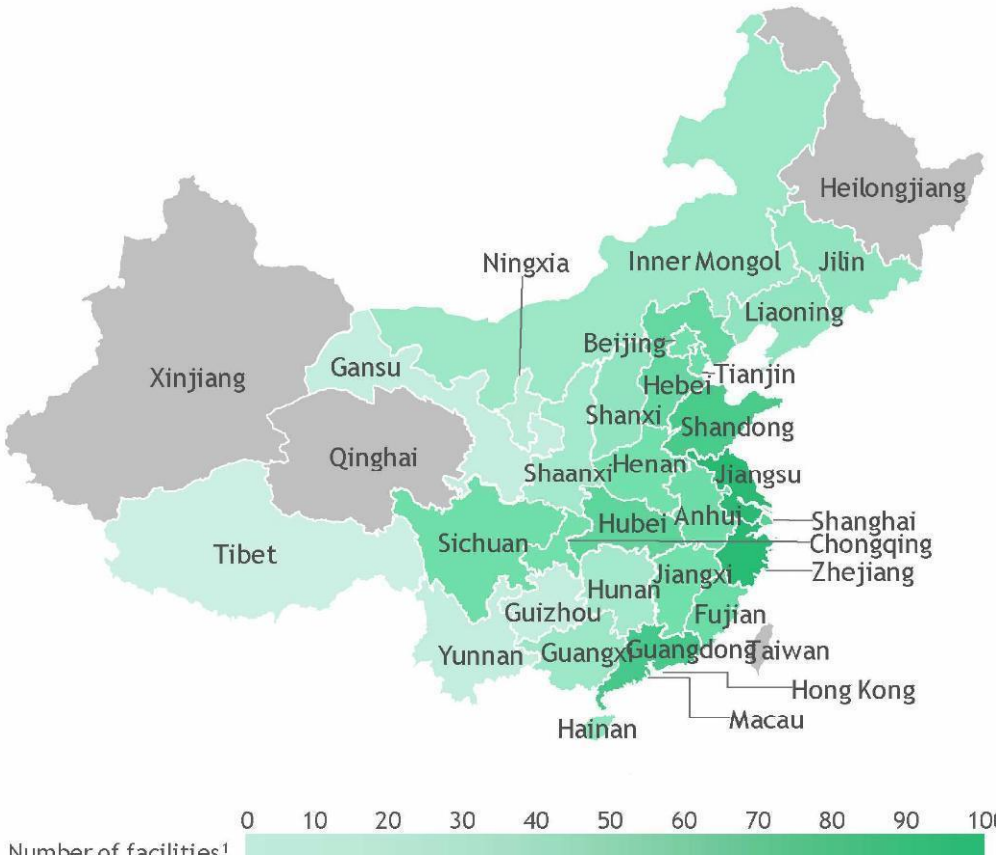
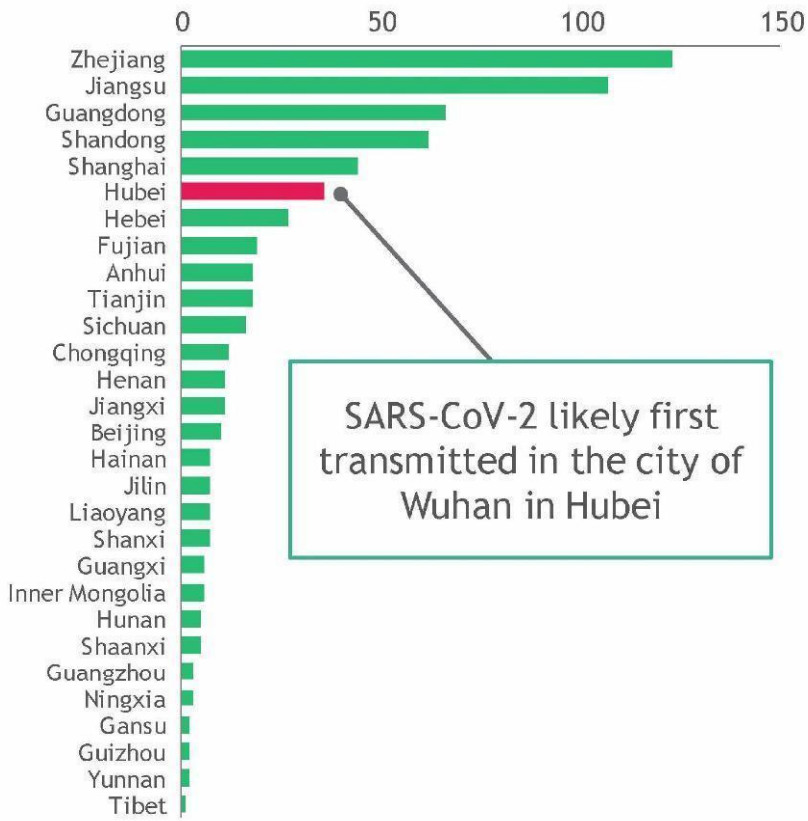
2. In detail: de Chinese markt

China is one of the largest manufacturers of healthcare products with 600+ FDA-registered facilities





1. Number of FDA approved facilities that perform API manufacture, formulation, packaging, labeling, and/or analysis
Source: FDA website, CDC website

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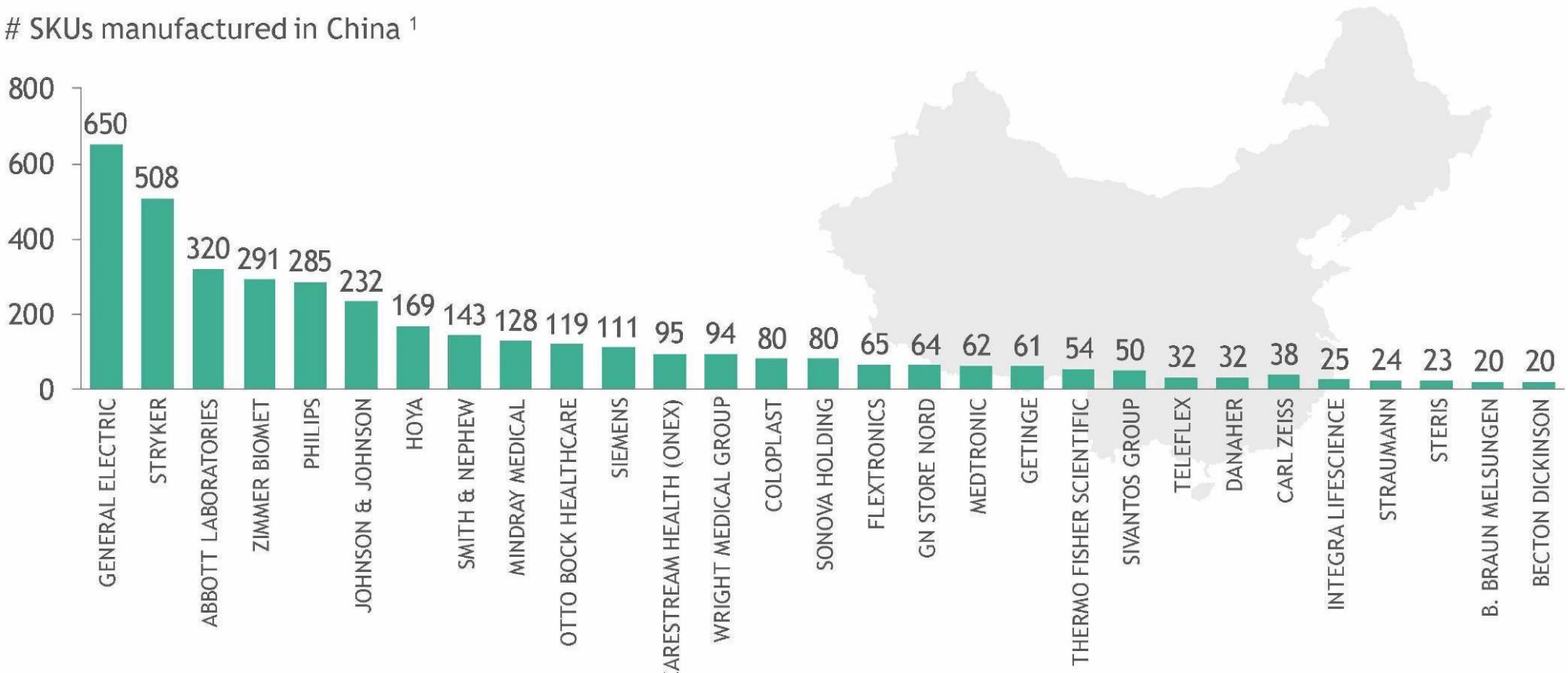
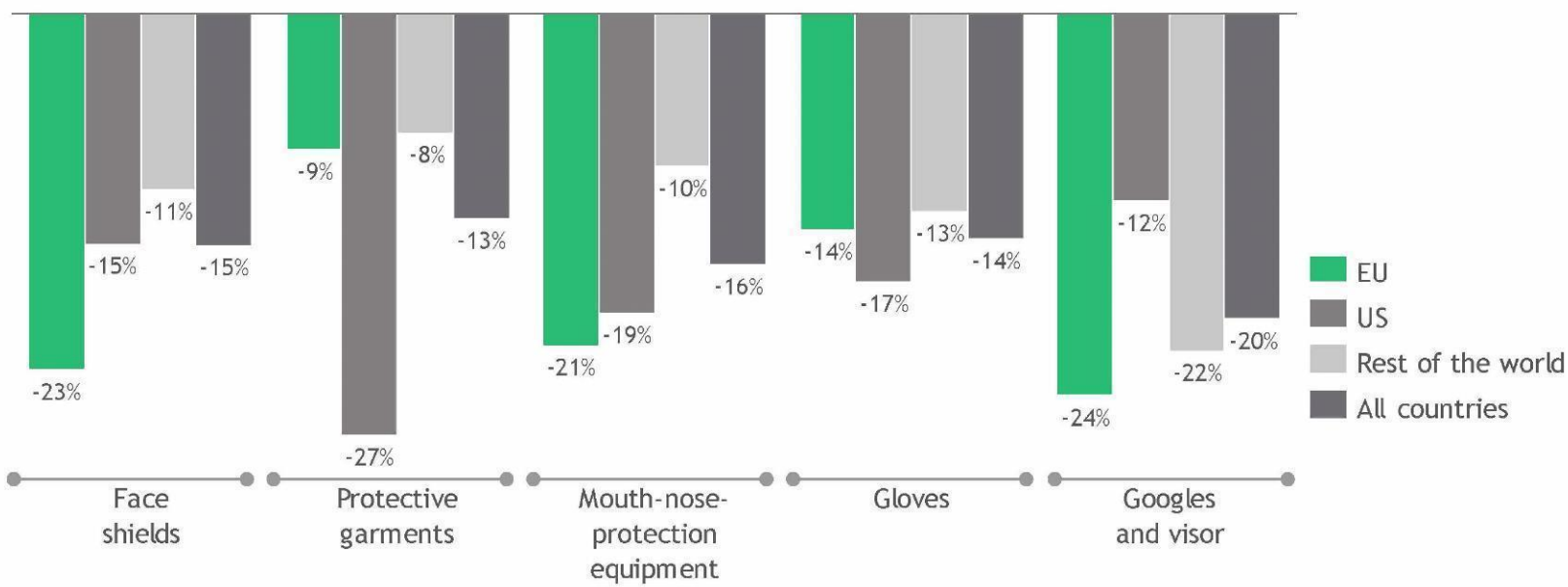
And many SKUs of large MedTech providers are manufactured in China



Note: Natural Earth Country boundaries without boundary lakes; Natural Earth Country breakaway and disputed areas
Source: FDA data, BCG analysis

China's exports of personal protective equipment has decreased in the past months

Export growth (%) in January and February 2020 relative to January and February 2019 for personal protective equipment (PPE) by product



Note: All other products are exports of all products, not only other medical products
Source: Peterson Institute for International Economics

In addition to PPE, a wide range of other products can be affected by reduced capacity of Chinese manufacturers

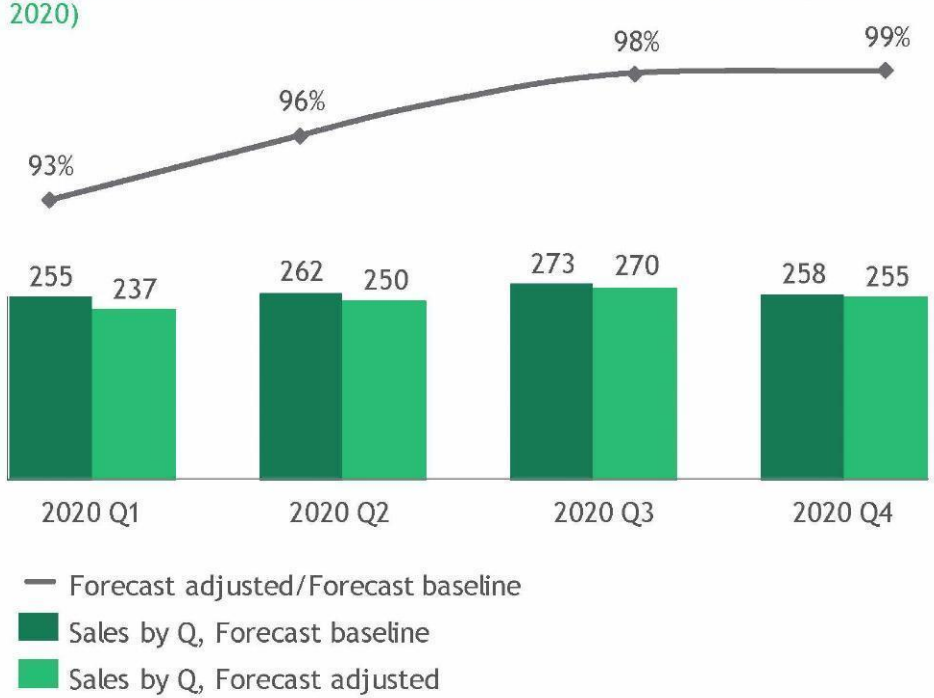
Area	Selected Devices / Technologies
IVD, Life Science Tools	Certain test assays, reagents, microscopes and components
Orthopedics	Screws, pins, prostheses
Surgical Instruments	Forceps, clamps, retractors, saws
Radiology equipment	X-ray systems and components
Wound, Ostomy, Continence	Staples and sutures, bandages, advanced wound care, ostomy bags, catheters
Eyewear and Lens	Lens, frames
Patient Monitoring, Anesthesia equipment	EKG machines, oximeters, ventilators
Dental	Dentures, Toothbrushes, Imaging systems

Note: Not comprehensive, analysis only refers to finished goods that are shipped from China and not component parts that may impact many additional products
FDA data, BCG analysis

China is also a key player in the pharmaceutical market; Chinese market expected to start recovering from Q3 onwards

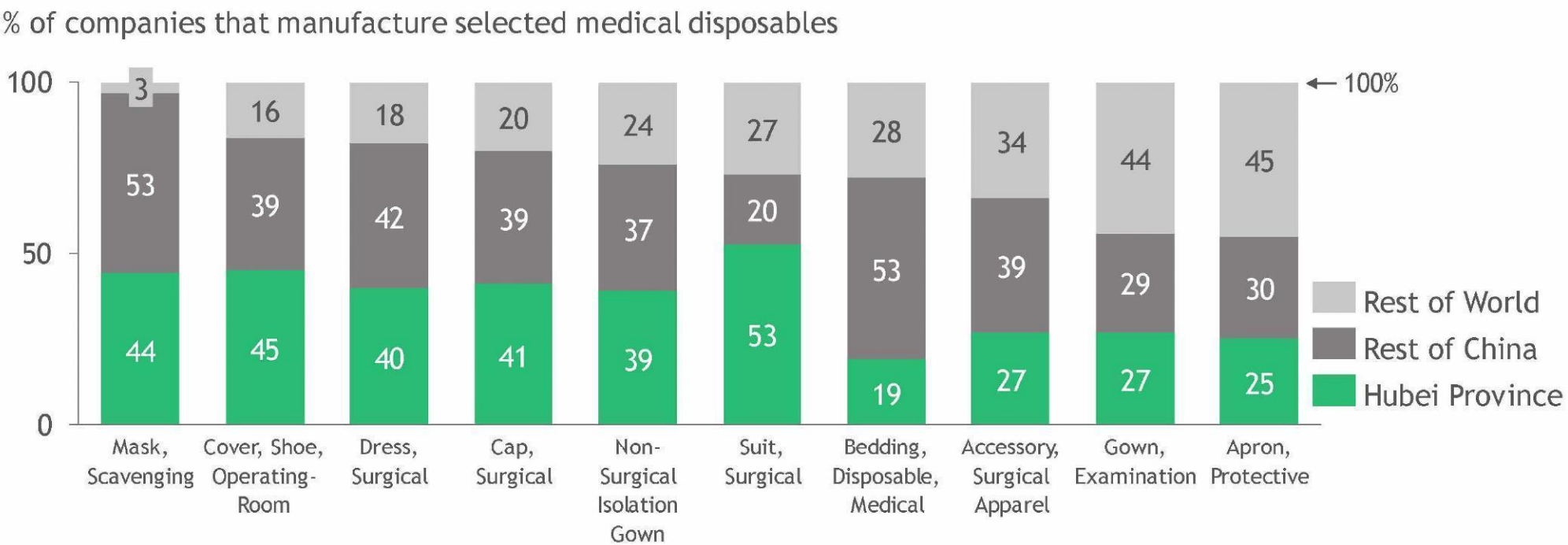
- China is one the largest pharmaceuticals producer in the world responsible for 32.2% of all pharmaceuticals produced globally in 2018
- Production disruptions due to the Chinese lock-down in early 2020 and supply chain challenges will mainly affect the US, India, Germany, Netherlands and Brazil, as they are the largest export destinations of drugs from China
- The FDA already reports potential shortages of ~150 prescription drugs, ranging from antibiotics to generic medicines
- Chinese supply chain disruptions are likely to impact worldwide availability of drugs, as 70% of all APIs used in Indian drug production come from China, and India is responsible for 20% of pharmaceuticals production in volume terms globally
- Recovery of the Chinese market expected from Q3 onwards, depending on potential new COVID-19 outbreaks and logistical disruptions

China pharmaceutical market prognosis, Bn RMB (sales value, by quarter, 2020)



Note: All projections are based on the constant inflation rate
Source: Euromonitor; IQVIA; BCG analysis

Hubei—Large share of companies that produce medical disposables are located in China's Hubei province, where disruptions are most severe

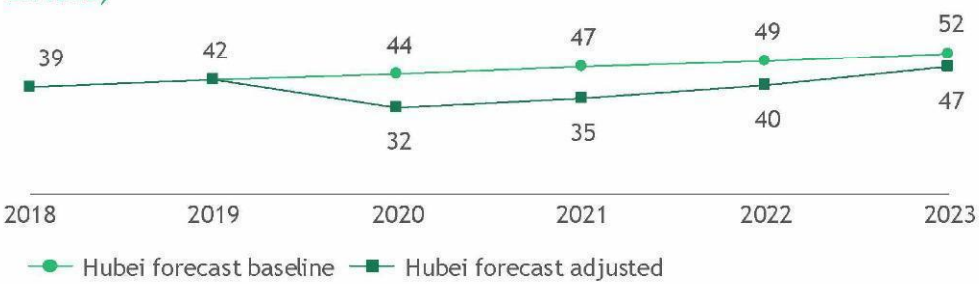


Note: Analysis only refers to number of companies manufacturing specific products; does not include output or capacity; Only refers to finished goods that are shipped to United States or Europe, not for the domestic Chinese market
Source: FDA manufacturing database, BCG analysis

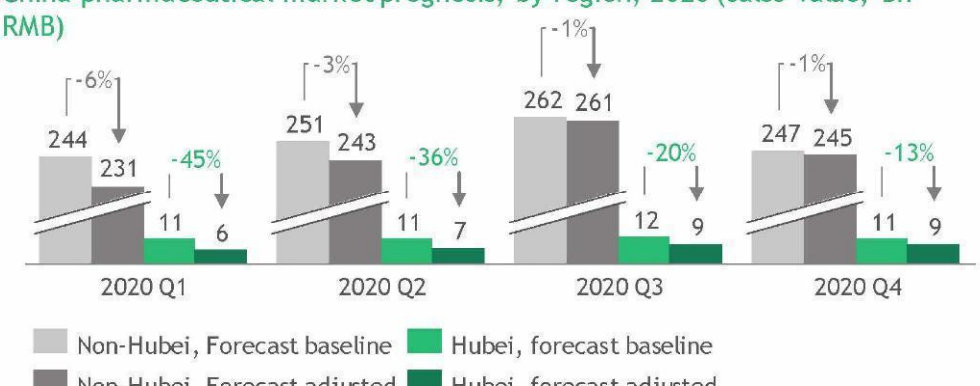
Hubei—Large part of Chinese pharma companies located in Wuhan (Hubei) where recovery is only expected from 2021 onwards

- Most Chinese pharma companies are located in the country's southeast and the Hubei province has the largest number of pharma manufacturing facilities (36%)
- Hubei's pharma manufacturing facilities are particularly concentrated in the provincial capital, Wuhan, and in Huanggang
- International pharma companies and CMOs such as Puracap Pharmaceutical LLC (Piscataway, NJ, US), Fresenius Kabi AG (Hessen, Germany), and Granules India Ltd (Hyderabad, Telangana) have manufacturing facilities in Hubei
- Production in the Hubei province is expected to take longer to go back to normal than other Chinese factories, causing longer disruptions in the pharma supply chain; recovery only expected from 2021 onwards

China pharmaceutical market prognosis Hubei region, 2018–2023 (sales value, Bn RMB)



China pharmaceutical market prognosis, by region, 2020 (sales value, Bn RMB)



Source: GlobalData Healthcare; Euromonitorl IQVIA; BCG analysis

3. In detail: de Indiase markt

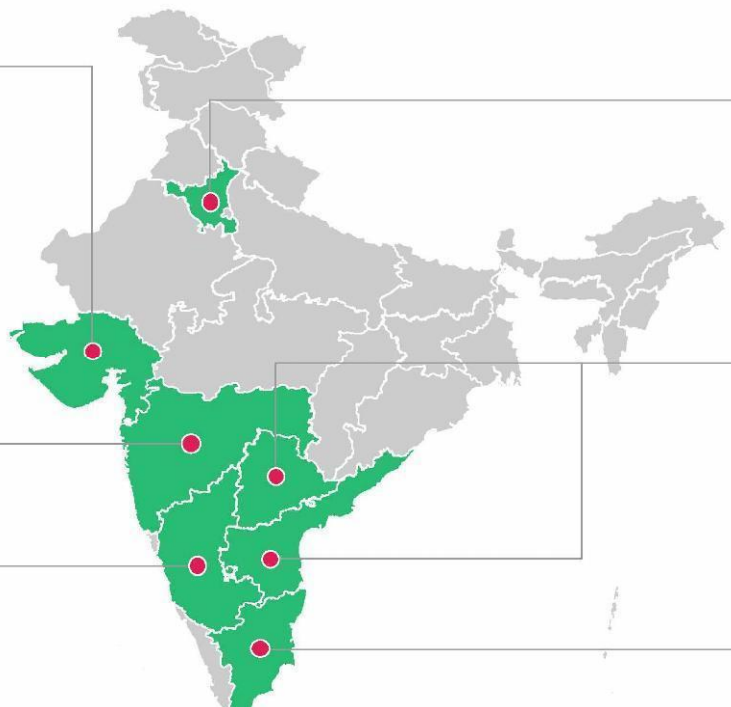
India has some large production clusters for medical devices and pharmaceuticals

Manufacturing clusters for medical devices

Gujarat
Pharmaceuticals
Ahmedabad, Vapi industrial corridors

Maharashtra
Pharmaceuticals
Mumbai, Pune, Nagpur

Karnataka
Insulin pens, stents and implant, Medical electronics
Bengaluru, Mangalore



Haryana
Low-end medical consumables
Chandigarh, Ballabhgarh, Faridabad, Manesar

Andhra Pradesh, Telangana
Medical electronics
Hyderabad, AMTZ Medtech Park in Visakhapatnam; Sultanpur (upcoming in Telengana)

Tamli Nadu
Medical electronics
HLL Medipark, Chennai

Source: National Investment Promotion and Facilitation Agency

Export restrictions will negatively affect global pharmaceutical supply chains for key APIs and medication

- India is a vital location of pharmaceutical manufacturing for drugs: Indian formulations control almost 26% of the European market in the generic space
- Early March, the Indian government has restricted the export of 27 active pharmaceutical ingredients (APIs) and finished dose drugs made with those APIs in response to COVID-19 "till further orders."
- The Indian Pharmaceutical Alliance (IPA) and the Indian Drugs' Manufacturer's Association (IDMA) claim they have enough stock to meet demand. Widely used Tylenol (acetaminophen/paracetamol) is among the drugs whose supply chain will be affected
- Early April, the Government of India started exploring possibilities for lifting the some of the restrictions and putting APIs and drugs in a 'licenced exporting regime'. The situation is expected to change frequently in the coming months

India restricted APIs and dose forms

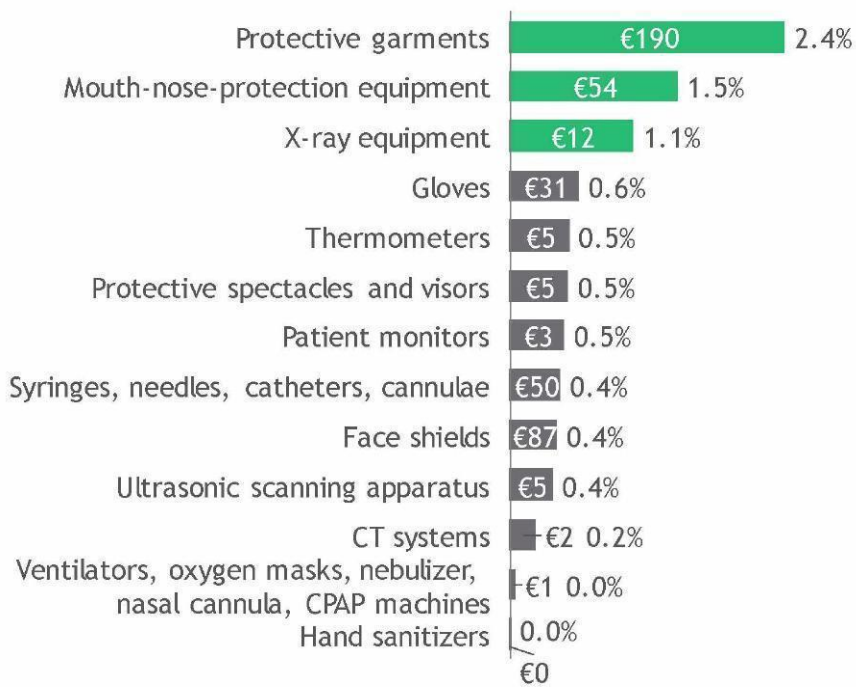
Active Pharmaceutical ingredient or Vitamin	Formulations using API also restricted
Acetaminophen/Paracetomol	Yes
Acyclovir	Yes
Chloramphenicol	Yes
Clindamycin salts	Yes
Erythromycin	No
Erythromycin salts	Yes
Metronidazole	Yes
Neomycin	Yes
Ornidazole	Yes
Progesterone	No
Tinidazole	Yes
Vitamin B1	Yes
Vitamin B12	Yes
Vitamin B6	Yes

Source: Global Data; GlobalData PharmSource, Government of India; NY times

India also responsible for a substantial part of the EU import of other medical products, but less dominant compared to its position in pharma

- India is also responsible for a substantial part of the EU import of other medical products.
- India's main export to EU in protective garments, such as gowns, mouth-nose-protection, such as masks, and X-ray equipment. All essential products in the COVID-19 crisis
- The government if India is likely to restrict export of certain of these products, such as protective garments and mouth-nose-protection
- However, position of India is less dominant compared to India's position in pharma; India counts for maximum 2.4% of the European import per product. Impact on the supply chain will be less disruptive

EU import of medical products from India in 2019 (€million)



Source: Peterson Institute for International Economics

4. Appendix: rationale product schaarste

Eerste inzichten - nog te verfijnen

- Observed demand increase
- Expected demand inc
- Observed supply disruption
- Expected supply disruption

In detail: supply chain challenges per product (I/V)

Current scope LCH	Rationale	BCG analysis based on the following sources
PBM		
FFP1 FFP2 FFP3 KN95 Surgical masks (Type 2/2R)	COVID-19 has caused a large increase in demand from care providers, other segments and citizens for masks. In January/February 2020 import from China, from which the EU imports most masks, has decreased by 21%. Shipping lanes are disrupted, air cargo currently only option.	Expert interviews; Peterson Institute for International Economics; Reuters; World Customs Organization
Gloves (non-sterile)	COVID-19 has caused a large increase in demand from care providers for gloves. Import mainly comes for China and Malaysia. The main surgical glove factory in Malaysia has orders for ~2.6B pieces/day, twice their normal capacity.	Expert interviews; World Customs Organization
Glasses (vices)	COVID-19 has caused a large increase in demand from care providers for protective glasses. Mainly vices have become scarce. In January/February 2020 import from China, from which the EU imports most masks, has decreased by 24%. Shipping lanes are disrupted, air cargo currently only option.	Expert interviews; Peterson Institute for International Economics; World Customs Organization
Gowns Aprons	COVID-19 has caused a large increase in demand from care providers for protective gowns and aprons. Aprons are usually of insufficient protection quality, but currently are sometimes used in combination with low quality gowns as protection. In January/February 2020 import from China, from which the EU imports most masks, has decreased by 9%. Potentially more disruption expected due to outbreak in the Middle East (producing raw materials). Shipping lanes are disrupted, air cargo currently only option.	Expert interviews; Peterson Institute for International Economics; World Customs Organization
Tests		
Swabs Test media	Demand for COVID-19 test kits has increased, mainly based on government policy in countries such as China, South Korea, etc. to test on large scale. Many different test kits are being developed and produced, however, not all tests are approved. China restricted export of tests due to low quality.	Expert interviews; WHO; NMPA; World Customs Organization
Cleaning		
Disinfectant (hand)	COVID-19 has caused a large increase in demand from care providers, other segments and citizens for disinfectants. Particularly hand sanitizers and disinfectants containing high percentages of alcohol are scarce. EU depends on import from the U.S. So far, there have not been any supply issues, but it is uncertain how this develops	Expert interviews; Peterson Institute for International Economics; World Customs Organization

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Eerste inzichten - nog te verfijnen

- Observed demand increase
- Expected demand inc
- Observed supply disruption
- Expected supply disruption

In detail: supply chain challenges per product (II/V)

Current scope LCH	Rationale	BCG analysis based on the following sources
Consumables		
Soda-lime pellets	Given the increase in the number of patients with respiratory needs, demand for soda-lime pellets is expected to increase. It is unclear if and to what extent demand exceeds supply.	Expert interviews
IC consumables	Given the increase in the number of patients with respiratory needs at the IC, IC consumables are in high demand. The specific SKU's have to be determined, but can include ventilator consumables (hoses, flow sensors, HME filters, swivles, humidifiers, respiration filters, closed suction system, suction bags and CO2 cuvettes), Non-rebreathing/non-invasive mask, Infusion pump consumables (fluids), Central Venous Line, Intravenous infusions/Drips, Arterial line and Blood gas capillaries	
Directly with Min VWS		
Equipment		
Ventilators/breathing systems	COVID-19 has caused a large increase in the number of ICUs needed, including ventilators/breathing systems. Demand is currently exceeding supply. Large manufacturers, like Philips and Medtronic, are trying to increase capacity. A large share of the ventilators in the EU is imported from the U.S. The increased demand in the U.S. itself, and dependencies on China for subassembly, might lead to supply chain disruptions in the future	Expert interviews; Peterson Institute for International Economics; Philips
Perfusor/syringe/infusion pumps	COVID-19 has caused a large increase in the number of ICUs needed, including perfusor/syringe/infusion pumps. It is unclear if and to what extent demand exceeds supply	Expert interviews
Potentially scarce products - to add to scope?		
PBM		
Coveralls	Coveralls can be used in stead of gowns as protective gear. Several countries, such as India, are procuring coveralls in large quantities.	Expert interviews; The Economic Times
Surgical mask incl. shield	Surgical masks incl. shield/full shield face masks can be used when there is no other eye protections available. Several countries, such as India, are procuring coveralls in large quantities.	Expert interviews; The Economic Times
Full shield face masks		
N95 Mask	N95 Mask is comparable to the FFP2 or the KN95 masks. The U.S. is procuring N95 masks in large quantities. Masks are mainly being produced in China, where the supply chain is disrupted	Expert interviews; Peterson Institute for International Economics
Testkits		
Molecular tests	Demand for COVID-19 test kits has increased, mainly based on government policy in countries such as China, South Korea, etc. to test on large scale. Many different test kits are being developed and produced, however, not all tests are approved. China restricted export of tests due to low quality.	Expert interviews; WHO; NMPA
Serological tests		

Draft

- Observed demand increase
- Expected demand inc
- Observed supply disruption
- Expected supply disruption

In detail: supply chain challenges per product (III/V)

Potentially scarce products - to add to scope?	Rationale	BCG analysis based on the following sources
Equipment		
Feeding pump	COVID-19 has caused a large increase in the number of ICUs needed. For each ICU a lot of equipment is required, including a patient monitor, morphine pump, infusion pump and feeding pump. Given the world wide increase in number of ICUs, demand of all items is expected to increase, while those products are mainly imported from China and the U.S. It is unclear if and to what extent demand exceeds supply.	Expert interviews; Peterson Institute for International Economics
Morphine pumps		
Patient monitors		
CRRT-machines	For some patients, COVID-19 causes dysfunctions in the kidneys. It is unclear to what extent demand exceeds supply for those machines.	Expert interviews
Matrasses for prone position	COVID-19 has caused a large increase in the number of ICUs needed, including matrasses needed for patients in prone position. This is especially relevant since patients stay longer than average on the ICU, so better quality matrasses are needed to avoid bed sores. So far, we have not seen any signals that demand exceeds supply.	Expert interviews
Consumables		
Body bags	With more deceased patients than usual, we expect an increase in demand for body bags. The UK is already experiencing shortages. It is unclear if and to what extent demand exceeds supply.	Expert interviews
Clinical waste bags	With more patients hospitalized than usual, we expect an increase in demand for clinical waste bags. The UK is already experiencing shortages. It is unclear if and to what extent demand exceeds supply.	Expert interviews
Wound gauze/bandages	Wound gaze and drapes are mainly produced in Saudi Arabia (raw materials) and Asia (processing). Given the recent outbreak in the Middle East, some production disruption is possible.	Expert interviews
Surgical drapes		
Overig		
Oxygen (high concentration)	Given the increase in the number of patients with respiratory needs, demand for medical oxygen has increased between three and five-fold. In the UK, one major hospital almost ran out of oxygen. Supply seems to be sufficient, but logistics are currently the main issue	Expert interviews; The Guardian; Gasworld
Tube feed	Given the increased amount of patients at the IC, and the longer stay than usual, we expect an increase in the demand for tube feed. It is unclear if and to what extent demand exceeds supply.	Expert interviews
Cleaning		
Disinfectant (surface)	COVID-19 has caused a large increase in demand from care providers, other segments and citizens for disinfectants. EU depends on import from the U.S. So far, there have not been any supply issues, but it is uncertain how this develops	Expert interviews; Peterson Institute for International Economics; World Customs Organization
Cleaning (surface)		

Eerste inzichten - nog te verfijnen

- Observed demand increase
- Expected demand inc773856
- Observed supply disruption
- Expected supply disruption

In detail: supply chain challenges per product (IV/V)

Products to monitor - to be decided	Rationale	BCG analysis based on the following sources
PPE		
Gloves (sterile)	COVID-19 might also increase demand for other PPE, such as sterile gloves, boot covers, hoods and PAPR masks. However, no clear signals for an increase in demand have been received yet.	Expert interviews
Shoe/Boot covers		
(Surgical) Hoods/hair nets		
PAPR (full face respirators)		
Equipment		
Defibrillators	COVID-19 has caused a large increase in the number of ICUs needed, which might lead to an increase in demand for defibrillators. However, no clear signals for an increase in demand have been received yet.	Expert interviews
ICU ultrasound machines	Main suppliers of ultrasound, echocardiogram and CT scanning machines, like Siemens and GE, indicate an increase in demand from hospitals for such machines. The machines are mainly imported from China and the U.S. It is unclear if and to what extend demand exceeds supply.	Expert interviews; Peterson Institute for International Economics
Echocardiogram machines		
CT scanning machines		
Cleaning		
Chlorine tablets	COVID-19 can potentially cause an increase in demand for Chlorine tablets, cleaning wipes, microfiber cloths and hand lotion, since all are used for cleaning/hygiene procedures. However, no clear signals for an steep increase in demand have been received yet.	Expert interviews
Cleaning wipes		
Microfiber cloths		
Hand lotion		
Consumables		
Needles/catheters/cannulae	COVID-19 can potentially cause an increase in demand for Needles/catheters/cannulae. Those products are mainly imported from the U.S. However, no clear signals for a supply disruption have been received yet.	Expert interviews; Peterson Institute for International Economics
Overig		
Thermometers (rectal)+cover	COVID-19 has caused an increase in the demand for thermometers and covers, which are mainly imported from China. It is unclear if and to what extent demand exceeds supply.	Expert interviews; Peterson Institute for International Economics
Bed frames	COVID-19 has caused a large increase in the number of ICUs needed, incl. bed frames. It is unclear if and to what extent demand exceeds supply.	Expert interviews
Orthopedic implants	While currently many regular care operations, such as hip replacements are postponed, a peak can be expected once regular care goes back to normal. Implants are often produced in India, where some production disruptions can be expected due to the lock-down.	Expert interviews

Draft

Eerste inzichten - nog te verfijnen

- Observed demand increase
- Expected demand inc773856
- Observed supply disruption
- Expected supply disruption

In detail: supply chain challenges per product (V/V)

Medicatie/Vaccinaties	Rationale	BCG analysis based on the following sources
ICU: intubation and sedation		
Neuromuscular blocker (rocuronium)	Both China and India are large pharmaceutical producers (APIs and drugs), and the EU depends on import for several essential drugs, such as painkillers and antibiotics. Several are critical for COVID-19 treatment, for example anesthetics, and others are critical for the health system in general (antibiotics). We see supply disruptions both in China and India due to export restrictions and production disruptions due to lock-down measures. Prices are already increasing, for example for Paracetamol. In addition, medication used for COVID-19 treatment is in high demand.	Global Data; FDA; Euromonitor; Expert interviews
Anesthetics (propofol/midazolam)		
Painkiller (ketamine)		
Painkiller (morphine)		
Painkiller (paracetamol/tylenol)		
Mintelukast/Albuterol (asthma)		
Lopinavir / Ritonavir		
Heparin		
Saline		
Wide range of antibiotics[3]		
COVID treatment		
(Hydroxy)chloroquine (plaquenil)		
Antiviral medication (acyclovir)		
Azithromycin		
Antipyretic (acetaminophen)		
Other		
Vaccines for influenza/HiB	Scientists expect a second wave of COVID-19 late fall, which could hit together with an influenza/HiB wave. Vaccines are scarce and have a long lead time to produce. Governments might consider more extensive/obligatory vaccination, leading to an increase in demand	Expert interviews

Draft

5. Appendix: product catalogus

PBM (I/II)

FFP1

FFP1 refers to the least filtering of the three masks with an aerosol filtration of at least 80% and leakage to the inside of maximum 22%. This mask is mainly used as a dust mask (home renovations and various types of work).

FFP2

FFP2 masks have a minimum of 94% filtration percentage and maximum 8% leakage to the inside. They are mainly used in construction, agriculture, and by healthcare professionals against influenza viruses. They are currently used for protection against the coronavirus.

FFP3

FFP3 masks are the most filtering mask of the FFPs. With a minimum filtration percentage of 99% and maximum 2% leakage to the inside, they protect against very fine particles such as asbestos.

KN95

KN95 masks represent a type of mask that can filter non-oily particles in the air to more than 95%.

Surgical masks (Type 2/2R)

Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection

Source: http://emag.medicalexpo.com/which-masks-actually-protect-against-coronavirus/; https://www.masksheets.com/kn95-respirator-face-mask.html; https://www.cdc.gov/niosh/npptl/pdfs/UnderstandDifferenceInfographic-508.pdf

PBM (II/II)

Gloves (non-sterile)

"Non-sterile gloves are single use and should be applied:

- Before an aseptic procedure
- When anticipating contact with blood or body fluid, non-intact skin, secretions, excretions, mucous membranes, or equipment/environmental surfaces contaminated with the above blood or body fluids
- When in contact with a patient or patient equipment/ environment during additional precautions"

Glasses (vices)

Safety-type spectacles with side shields necessary for the dental team and patients to prevent ocular injuries and infections during procedures.

Gowns

Gowns are examples of personal protective equipment used in health care settings. They are used to protect the wearer from the spread of infection or illness if the wearer comes in contact with potentially infectious liquid and solid material. They may also be used to help prevent the gown wearer from transferring microorganisms that could harm vulnerable patients, such as those with weakened immune systems. Gowns are one part of an overall infection-control strategy.

Aprons

An outer garment covering the front of the body for protection of clothing during surgery or certain nursing procedures.

Source: https://www.cdc.gov/niosh/npptl/pdfs/UnderstandDifferenceInfographic-508.pdf; https://opentextbc.ca/clinicalskills/chapter/1-6-hand-hygiene; https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/medical-gowns; https://medical-dictionary.thefreedictionary.com/apron

Tests

Swabs

A wad of absorbent material usually wound around one end of a small stick and used especially for applying medication or for removing material from an area

Test media

A collection and transport system suitable for collection, transport, maintenance and long-term freeze storage of clinical specimens containing viruses

Source: https://www.merriam-webster.com/dictionary/swab; https://www.copanusa.com/sample-collection-transport-processing/utm-viral-transport/

Cleaning

Disinfectant (hand)

An alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to inactivate microorganisms and/or temporarily suppress their growth. Such preparations may contain one or more types of alcohol, other active ingredients with excipients, and humectants.

Source: https://www.ncbi.nlm.nih.gov/books/NBK144046/

Consumables (I/III)

Soda Lime Pellets

Soda lime is used in breathing systems to absorb expired CO2 during anaesthesia. It can be incorporated in a Mapleson C system or a circle system

The size of the soda lime granules is 4-8 mesh (i.e. will pass through a mesh of 4-8 strands per inch in each axis or 2.36-4.75 mm).

Non-heated ventilation tubing

Non-heated breathing tubes are used during mechanical ventilation, with or without active passive humidification

Heated ventilation tubing

Heated ventilation tubing prevents condensation of water on the wall of the breathing circuit, while maintaining the temperature of the air delivered to patients' airways

Flow sensors

Expiratory flow sensor used on intensive care ventilators to measure a patient's exhaled gas flow from the expiratory limb. Data is then used to calculate exhaled tidal and minute volumes

HME filters

Heat and moisture exchangers and breathing system filters are intended to replace the normal warming, humidifying and filtering functions of the upper airways.

To humidify gases and protect the breathing system from expired infective droplets, the device is placed between the patient and the breathing system [4]. In this position, it adds to the dead space, thus increasing rebreathing (necessitating an increase in ventilation or allowing permissible hypercapnia), and it also adds to the resistance to gas flow, thus increasing the work of breathing.

Source: https://www.frca.co.uk/article.aspx?articleid=247; ://www.plastiflex.com/solutions/healthcare/respiratory-care/; https://www.intersurgical.com/products/critical-care/flow-sensors; https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2044.2010.06564.x

Consumables (II/III)

Swivels

Use:
- allow ventilation without gas leak during invasive bronchial procedures (e.g. fibreoptic bronchoscopy, suctioning with a catheter)
- provide improved flexibility, stability and comfort to the ventilation circuit

Description:
- disposable plastic
- right angled design
- "Double swivel" capacity at attachments to circuit component (22 mm outer diameter over a 15 mm universal connector of an endotracheal/tracheostomy tube and into an airway connector via a 15 mm outer diameter connector attached to ventilator tubing)
- airway access port (self sealing or with removable/replaceable cap)

Humidifiers

Humidifiers are devices that add molecules of water to gas. They are classified as active or passive based on the presence of external sources of heat and water (active humidifiers), or the utilization of patients' own temperature and hydration to achieve humidification in successive breaths (passive humidifiers)

Respiration filters

Filters used in pulmonary function laboratories are consumable items used for trapping bacteria and viruses, ensuring prevention of any cross-contamination. The filters generally consist of a flat wad of electrostatically charged fibres or pleats formed from a wad of fibres. These filters may/should have hydrophobic properties

Closed suction system

To help protect patients, a closed ventilator circuit is recognized as a best practice in the prevention of VAP2 to maintain ventilation and oxygen therapy throughout suctioning, preventing approximately 50% of the lung volume fall observed when suctioning after disconnection from the ventilator. Closed suctioning is a best practice that protects patients and caregivers

Suction bags

This product is used for collecting biohazardous fluids which produced in ICU, operation rooms, gynecology and other clinical practices

Source: https://litfl.com/swivel-connector; https://www.hindawi.com/journals/bmri/2014/715434/; http://www.wales.nhs.uk/sitesplus/documents/861/bacterial%20viral%20filter%20info.pdf; https://avanosmedicaldevices.com/respiratory-health/closed-suction-systems/; https://medplus.en.alibaba.com/product/558354423-211891442/medical_disposable_receptal_EVA_suction_bag.html

Draft

Consumables (I/III)

CO2 cuvettes

CO2 sensor

Source: https://www.draeger.com/Products/Content/co2_cuvette_pi_9051010_en.pdf

Equipment

Ventilators/ breathing systems

Mechanical ventilation is a life-support system used to maintain adequate lung function in patients who are critically ill or undergoing general anesthesia.

Perfusion Pump

Perfusionists employ artificial blood pumps to propel open-heart surgery patients' blood through their body tissue, replacing the function of the heart while the cardiac surgeon operates.

Infusion Pump

An infusion pump draws fluid from a standard bag of intravenous fluid and controls the rate of flow. It provides accurate and continuous therapy. Because it can use any size bag of intravenous fluid, an infusion pump can be used to deliver fluids at either a very slow or very fast infusion rate. Some pumps are able to control a single intravenous line, whereas, other infusion pumps have 3 pumps built into one device. These "triple pumps" are used to save space

Syringe Pump

A syringe pump is a different type of infusion delivery device. Instead of drawing fluid from an infusion bag, intravenous medications are drawn into a syringe and installed into the device. Because syringe pumps contain a maximum volume of 50 ml, syringe pumps are used to administer medications that have very small hourly volumes (for example, usually less than 5 ml/hr). If the hourly volume requirements increase, an infusion pump is generally used to deliver the medication. Syringe pumps are more compact and take up less space than infusion pumps. This becomes important when the patient is on many different infusions

1Source: https://www.perfusion.com/education/what-is-perfusion; https://www.lhsc.on.ca/critical-care-trauma-centre/critical-care-trauma-centre-283#1

Draft

PPE (I/II)

PBM Coveralls

Disposable coveralls are an item of personal protective equipment (PPE) designed to cover the whole body and other clothing to protect against dirt or other outside contaminants. Coveralls are one piece and loose fitting for ease of movement, with sleeves, full leggings and often a hood to cover the head. These can also include overshoe pieces to cover footwear and protect against contamination.

Face Shields

Face shields are personal protective equipment devices that are used by many workers (e.g., medical, dental, veterinary) for protection of the facial area and associated mucous membranes (eyes, nose, mouth) from splashes, sprays, and spatter of body fluids. Face shields are generally not used alone, but in conjunction with other protective equipment and are therefore classified as adjunctive personal protective equipment. Although there are millions of potential users of face shields, guidelines for their use vary between governmental agencies and professional societies and little research is available regarding their efficacy.

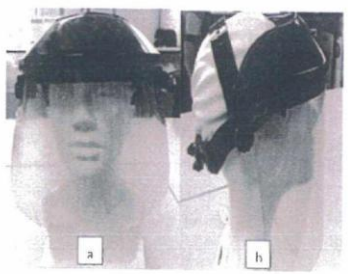
Visors

Visor. Visors, also referred to as lenses or windows, are manufactured from any of several types of materials that include polycarbonate, propionate, acetate, polyvinyl chloride, and polyethylene terephthalate glycol (PETG) and come in disposable, reusable, and replaceable models

Frames

Face shield frames used in healthcare are generally made of lightweight plastic. There are a variety of frame styles, including adjustable and nonadjustable frames that fully or partially encircle the circumference of the skull or those with eyeglass-type temple bars that are worn like standard eyewear. There are also metal clip-on frames available that are designed to attach face shield visors to prescription eyewear, and some frames allow for the visor to be flipped up when not in use. A number of manufacturers offer detachable frames for easy change-out of the face shield visor. Some models also incorporate a brow cap into the frame that affords additional splash protection in the forehead region, as well as allowing for more visor distance from the face that better accommodates the wearing of additional PPE (e.g., goggles, loupes, prescription eyewear, respirators). Disposable visor-only face shields are also available that have a forehead foam cushion that provides a comfortable seal to the forehead

Suspension Systems



There are a variety of face shield suspension systems on the market that offer either fully or partially circumferential attachment features. Fully circumferential suspension systems include plastic headbands that are adjustable for comfort by a ratchet mechanism, pin-lock systems, or Velcro®; nonadjustable systems employ elastic straps. Some models utilize eyeglass-type temple bars for suspension with or without eyewear-like nose pads and bridge assemblies to assist in maintaining face shield position and stability on the face. A top band that is adjusted for depth is found on some models

Source: https://www.safeopedia.com/definition/863/disposable-coveralls; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5015006/

PPE (II/II)

N95

Filters out at least 95% of airborne particles including large and small particles. Reduces wearer's exposure to particles including small particle aerosols and large droplets (only non-oil aerosols).

Source: https://www.cdc.gov/niosh/npptl/pdfs/UnderstandDifferenceInfographic-508.pdf

Tests

Molecular Tests

A laboratory test that checks for certain genes, proteins, or other molecules in a sample of tissue, blood, or other body fluid. Molecular tests also check for certain changes in a gene or chromosome that may cause or affect the chance of developing a specific disease or disorder, such as cancer. A molecular test may be done with other procedures, such as biopsies, to help diagnose some types of cancer. It may also be used to help plan treatment, find out how well treatment is working, or make a prognosis.

Serological Tests

Serologic tests are blood tests that look for antibodies in your blood. They can involve a number of laboratory techniques. Different types of serologic tests are used to diagnose various disease conditions.

Serologic tests have one thing in common. They all focus on proteins made by your immune system. This vital body system helps keep you healthy by destroying foreign invaders that can make you ill. The process for having the test is the same regardless of which technique the laboratory uses during serologic testing.

Source: https://www.cancer.gov/publications/dictionaries/cancer-terms/search?contains=false&q=serological+tests; https://www.healthline.com/health/serology;

Equipment

Feeding Pumps

Enteral feeding pumps use feeding tubes to deliver nutrition to patients who cannot obtain such by swallowing. The specific feeding tube used most with feeding pumps is the nasogastric tube. These tubes are inserted into a nostril, into the throat, down the esophagus, and into the stomach. By using a feeding pump, these tubes are able to deliver more than nutrients. They're used to deliver medications, antibiotics, and to keep the patient sufficiently hydrated

However, there is a variety of other tubes used with feeding pumps. Another common gastric tube used with feeding pumps is known as the PEG tube, or Percutaneous Endoscopic Gastrostomy tube. This tube is typically placed endoscopically but it's also common to place the PEG tube surgically through the abdomen. The PEG tube lasts approximately 6 months, making it suitable for long-term use. They are typically used for patients with neurological or anatomic disorders resulting from a stroke, esophageal atresia, tracheoesophageal fistula, and to avoid the risk of aspiration pneumonia. They are also used when patients are malnourished and unable to take food by the mouth in order to maintain their weight

Morphine Pumps

Intrathecal pumps are used to administer medication straight into the spinal fluid of patients. Only a small amount of medication is needed since it is delivered directly to the pain receptors. As you may have guessed, an implantable morphine pump is an intrathecal pump which delivers morphine to the patient's spinal fluid.

The entire arrangement consists only of a pump and a catheter. The pump is the small, battery-powered device which holds and administers the morphine. The catheter is a thin tube which is connected to the pump and inserted into the patient's spine. Both devices are implanted just beneath the skin.

Using a small needle, the doctor will fill the pump with morphine. The pump will send the morphine through the catheter and into the spinal fluid

Patient Monitors

Patient monitors measure, record, distribute and display combinations of biometric values such as heart rate, SPO2, blood pressure, temperature and more. High-capability, multi-function monitors are typically used in hospitals and clinics to ensure a high-level of quality patient care. Portable patient monitors are designed to be compact and power-efficient. This allows them to be used in remote areas or by paramedics to aid diagnosis in the field, enable monitoring and transmitting data to health care providers in other locations

CCRT machine

Continuous renal replacement therapy (CRRT) units are used to treat patients suffering from acute kidney injury (AKI), a critical condition characterized by sudden temporary loss of normal kidney function. They are also used for the treatment of other critical diseases, such as refractory pulmonary edema, pericarditis, hypothermia, or poisonings with a dialyzable toxin.

Mattresses for prone position

A mattress used to facilitate prone positioning during sleep

Source: https://www.medical-supplies-equipment-company.com/homehealth/feeding-pumps-220.htm; https://www.microchip.com/design-centers/medical/applications/patient-monitor; https://austinpaindoctor.com/pain-treatment/implantable-morphine-pumps; https://www.who.int/medical_devices/innovation/hospt_equip_14.pdf; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4389730/#R14

Consumables

Body bags

The common description of body bags is that it has a full-length U-or J-shaped zipper; runner large metal loops on the zip-runner. It is leak-proof, during handling and transportation corpse and has an integrated transparent label pocket for identification tag. It is highly tear-proof and puncture resistant, seams heat-sealed. Types of linears enforced are PE, EVA or PEVA. They usually do not contain chlorides (suitable for cremation), are either non-degradable or biodegradable with handles and a shelf life

Clinical waste bags

Clinical waste bags are leak-proof, impervious to moisture and strong enough to prevent tearing or bursting under normal handling. Such containers should be of one-trip type and should not be reused. They should be capable of being sealed in a manner that can prevent spillage of the contents during transportation

Wound gauze/ bandages

Wound gauze is a woven fabric of absorbent cotton and is available in a number of formats and materials, including cotton or synthetic, non-impregnated, and impregnated with water, saline, or other substances. Gauze is a light material intended for post-surgicalwound applications or deep wound healing. (upper image)

Bandages are a piece of material to support a medical apparatus, such as wound dressings, or on its own to administer support to the body. Bandages, additionally, can be used to inhibit bodily fluids from flowing, such as blood, lymph fluid, and more. Available in a variety of types, from padding to compression, and different sizes. (lower image)

Surgical drapes

Surgical drapes and sterile instrument fields are used to limit contamination of the surgical wound, the surgical instruments, and the surgeon's hands.
There are three types of draping materials: cloth reusable drapes, paper disposable drapes, and disposable plastic adhesive drapes

Source: https://www.unicef.org/supply/files/Supplies_for_EVD_outbreak_response_Body_bags_UNICEF.pdf; https://www.epd.gov.hk/epd/clinicalwaste/en/mobile_psubsubpage.html, https://www.incontinencechoice.co.uk/personal-care-and-cleaning/disposal-bags-bins/clinical-waste-bags.html; https://www.surgeryencyclopedia.com/A-Ce/Bandages-and-Dressings.html, https://www.vitalitymedical.com/wound-care.html; https://www.sciencedirect.com/topics/medicine-and-dentistry/surgical-drape, https://deltamed.pro/en/products/o-r-division/surgical-drapes

Other

High concentration oxygen masks

High concentration oxygen masks, also known as 'partial and non rebreathing masks'. These masks can provide concentrations of oxygen up to 80% at flows of 10-15 l/min (these values are approximate and depend on the patients breathing pattern).

Tube feed

It is a polyurethane feeding tube is designed for nasogastric and nasoduodenal feeding with a slimmer lighter weighted tip for easier insertion

Source: https://musculoskeletalkey.com/basic-equipment-and-supplies-for-intravenous-therapy/; https://emedicine.medscape.com/article/1999586-periprocedure; https://www.intersurgical.com/products/oxygen-and-aerosol-therapy/high-concentration-oxygen-masks; https://medicina.co.uk/enfit-nasogastric-short-term-feeding-tubes; https://www.cardinalhealth.com/en/product-solutions/medical/enteral-feeding/adult-nasogastric-feeding-tubes/kangaroo-feeding-tubes-with-standard-tip.html

Cleaning

Disinfectant/cleaning (surface)

Chemical that destroys or inactivates microorganisms. Disinfectants are classified as low-, intermediate-or high-level depending on their ability to kill or immobilize some (low-or intermediate-level) or all (high-level) microorganisms (but not all spores). Phenols, chlorine or chlorine-containing compounds and QUATs are classes of disinfectants frequently used to clean noncritical surfaces such as floors, walls and furniture.

Source: https://www.henryschein.com/us-en/medical/resource-center/surface-disinfectants/surface-cleaning-terms.aspx

PBM

Gloves (sterile)

Sterile gloves are defined as sterile when they meet the FDA standards for sterilization techniques. Non-sterile gloves are not usually sterilized by the manufacturer of the gloves, but still must be tested by the FDA after sterilization to ensure that they meet the FDA's standard assurance level (SAL) for sterilization techniques

It is important to note that non-sterile gloves are typically used for non-surgical medical procedures and examinations. Sterile gloves are used to carry out surgical procedures

Shoe/Boot covers

These products are packaged and manufactured inside of a clean room to make them safe for your controlled environment. Sterile foot coverings come individually wrapped and clean-processed for use in ISO5 Class 100 environments. There are both aseptic boot covers and shoe covers. Materials: sterile tyvek, microporous and other materials depending on your facility environment

PAPR (full face respirators)

PAPR is an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering

Source: https://glovenation.com/blogs/default-blog/sterile-vs-non-sterile-gloves; https://www.cleanroomsupplies.com/product-category/cleanroom-apparel/shoe-covers/sterile-shoe-covers/; https://www.ncbi.nlm.nih.gov/books/NBK294223/

Equipment

Defibrillator

Defibrillators are devices that restore a normal heartbeat by sending an electric pulse or shock to the heart. They are used to prevent or correct an arrhythmia, a heartbeat that is uneven or that is too slow or too fast. Defibrillators can also restore the heart's beating if the heart suddenly stops.

Different types of defibrillators work in different ways. Automated external defibrillators (AEDs), which are in many public spaces, were developed to save the lives of people experiencing sudden cardiac arrest. Even untrained bystanders can use these devices in an emergency.

Other defibrillators can prevent sudden death among people who have a high risk of a life-threatening arrhythmia. They include implantable cardioverter defibrillators (ICDs), which are surgically placed inside your body, and wearable cardioverter defibrillators (WCDs), which rest on the body. It can take time and effort to get used to living with a defibrillator, and it is important to be aware of possible risks and complications.

Ultrasound machine

Ultrasound uses high-frequency sound waves to make images of organs and structures inside the body. An ultrasound machine makes images so that organs inside the body can be examined. The machine sends out high-frequency sound waves, which reflect off body structures. A computer receives the waves and uses them to create a picture. Unlike with an x-ray or CT scan, this test does not use ionizing radiation.

Echocardiogram

An echocardiogram uses sound waves to produce images of your heart. This common test allows your doctor to see your heart beating and pumping blood. Your doctor can use the images from an echocardiogram to identify heart disease.

Depending on what information you need you would use different types: transthorathic echocardiogram, transesophageal, doppler, stress.

CT Scanner

A computerized tomography (CT) scan combines a series of X-ray images taken from different angles around your body and uses computer processing to create cross-sectional images (slices) of the bones, blood vessels and soft tissues inside your body. CT scan images provide more-detailed information than plain X-rays do.

A CT scan has many uses, but it's particularly well-suited to quickly examine people who may have internal injuries from car accidents or other types of trauma. A CT scan can be used to visualize nearly all parts of the body and is used to diagnose disease or injury as well as to plan medical, surgical or radiation treatment.

Source: https://medlineplus.gov/ency/article/003336.htm; https://www.nhlbi.nih.gov/health-topics/defibrillators; https://www.mayoclinic.org/tests-procedures/echocardiogram/about/pac-20393856; https://www.mayoclinic.org/tests-procedures/ct-scan/about/pac-20393675

Cleaning

Chlorine tablets

Chlorine is a widely used water disinfectant which kills most viruses and bacteria in water. As well as for treating drinking water.

Cleaning Wipes

"Disposable wipes For cleaning of surfaces that tolerate water at/in e.g. hospitals, nursing homes, sanitary facilities, day care institutions, dentist clinics, aircrafts, trains, ferries, cars and offices."

Microfiber cloths

Microfiber cloth is used for the car, office, book bag, purse and more. Absorbent micro fiber make this cleaning cloth Ideal for eyeglass lenses, camera lenses, binoculars, microscopes and other delicate surfaces. Reusable cloth is machine washable hundreds of times

Hand lotion

Hand lotion is a product that is intended to moisturize and soften the hands. They are often semi-solid emulsions of oil and water. Hand Creams/Lotions contain special ingredients that help to replace the oils contained in the skin or to protect against the loss of moisture from the skin.

Source: https://www.lifesystems.co.uk/products/water-purification/chlorine-tablets; https://plum.eu/products/hygiene/wipeclean-wipes/wipeclean-universal-cleaning-wipes/download/894/211/27; https://www.amazon.com/Microfiber-Cleaning-Apex-Healthcare-Products/dp/B00HEQDTHO; https://cosmeticsinfo.org/product/skin-care-products-creams-lotions-powders-and-sprays; https://www.amazon.com/Professional-Healthcare-Ecolab-Revitalize-Protects/dp/B01B25813E

Consumables

Needles/catheters/ cannulae

A catheter is a thin tube often made of soft plastic material that can be inserted into the body. Catheters are referred to as medical device, and are prescribed by doctors (upper image)

Vascular cannulas for ECMO have a thin wall, commonly made of polyurethane, and are often reinforced with wire to prevent kinking or collapse. Venous cannulas have side holes close to the tip or along the last 15 to 20 cm (multistage cannulas) to facilitate drainage of blood from the venous system. Modern cannulas have heparin-coated surfaces to increase biocompatibility and reduce activation of the clotting cascade (bottom image)

Source: https://www.wellspect.com/bladder/about-cic/choosing-the-right-catheter/different-types-of-catheters; https://www.sciencedirect.com/topics/medicine-and-dentistry/cannula; https://www.vitaneedle.com/cannula/;

Other

Thermometers (rectal) + cover

Rectal temperature is measured with a lubricated blunt-tipped glass thermometer inserted 4 to 5 cm into the anal canal at an angle 20° from the horizontal with the patient lying prone. Three minutes dwell time is required

Bed frames

Bed Frames usually have tubular steel design which provides sturdier structure for the resident's safety, with a grid surface offering improved air flow and ultimate support for the sleep surface and several sections forming the sleep surface offering a full range of positions, which may reduce skin shear

Orthopedic implants

Orthopedic implants are the devices that are surgically inserted into the body and are intended to reinstate function by restoring or strengthening a damaged structure. They are usually made out of stainless steel or titanium

Source: https://www.ncbi.nlm.nih.gov/books/NBK331; https://www.alibaba.com/product-detail/medical-mercury-glass-rectal-thermometer_60253338314.html; https://www.joerns.com/product/8/2468/Care100.aspx?categoryID=8; https://orthopedicimplantsindia.wordpress.com, https://orthopedicimplants.wordpress.com

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