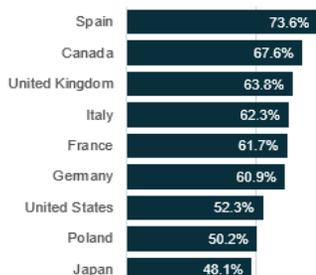


Let's first vaccinate the world against Covid-19 before we move to Single Dose Containers!

HICs have vaccinated the majority of their populations... and seem to consider the introduction of single dose containers

% of population fully vaccinated¹



Potential drivers for single dose:

- + Mass vaccinated nations asking for single dose containers
- + Governments transitioning to "booster" dose strategies
- + Medical personnel prefer single dose for easier shot delivery

Key Constraints

Glass Manufacturing • Fill & Finish Capacity • Cold Chain Distribution

Impact of Single Dose Vials on Vaccine Value Chain



Glass Manufacturing Impact

- Containers for COVID-19 vaccines occupy a significant portion of global glass manufacturing capacity
- Glass manufacturers are fully booked until end of 2022
- Glass manufacturers can produce either multidose or single dose vials; production capacity and raw materials are limiting factors

Glass Quantities for different vaccine delivery

Type	# Doses	Glass per Dose
Vial	10	ca. 1 g
	5	ca. 1.3-1.6 g
	1	ca. 4.2 g
Syringe	1	ca. 3.5-4.5 g



Fill & Finish Capacity Impact

- Single dose containers would multiply the demand for F&F capacity, which is already in critical shortage
- Vaccine release testing capacities will be constrained at Vaccine Manufacturers and Health Authorities as it would result in 5-10 times more batches to be released for the same total number of doses

If HICs start to fill only half their Vx as single-dose, F&F capacity occupation increases from ca. 15% to > 40%



Cold Chain Distribution Impact

- Cold chain space per dose is optimal for multidose vials
- Single dose vials require significantly more space
- Single dose syringes take up the most space due to blister packs

Cold Chain space requirements per dose

Delivery Method	cm ³ /dose
Multidose Vial	1.3-2.2
Single Dose Vial	10.2
Prefilled Syringe	56-107

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¹ Our World in Data, 7 Sept 2021