Covid-19 vaccine supply chain

PhD research Albert Mandemakers

- **PhD Research on Covid-19 vaccine supply chains:**
  - **Supply chain coordination, resilience and visibility**
  - **Emphasis on behavioral aspects in ramp ups and decision-making**
  - **Focus on the role of LSPs**
  - **Promotor: Prof. dr. H.Akkermans**
  - **Connection to LCB-theme:**
    - **Healthcare logistics**
    - **But also: Event Logistics**

Activities 2021

- Field research: 20 interviewees/ 24 interviews (22-24 interviewees required) and analysis
- Collection and use of secondary data
- First steps on writing a paper based on the interviews and writing a Literature Review Paper
- Research Proposal (at this moment: includes app. 50 papers)
- Student products:
  - 3 finished master thesis reports TiU-students
  - In progress: 3 master thesis reports TiU-students
  - In progress: 1 supply chain minor product BUas bachelor
  - In progress: 1 master Learning Community product BUas master (white paper)

Planned Activities 2022 (1/2)

- Field research: 2-4 interviewees required to complete app. 24 interviewees plus analysis
- Collection, use and analysis of secondary data
- Focus group meeting with some of the interviewees
- Finalizing a conference paper, a first paper for publication (based on the interviews, secondary data and focus group meeting) to be reviewed and continuation with literature review paper
- Finalizing Research Proposal
- External exposure:
  - LCB-symposium (Spring 2022)
  - possibly attending international conference (Summer 2022)

Planned Activities 2022 (2/2)

- **Student products:**
  - **3 finished master thesis reports TiU-students**
  - **1 finished supply chain minor product BUas bachelor**
  - **1 finished master Learning Community product BUas master (white paper)**
  - **2 or 3 new master thesis reports TiU-students**
  - **+ ……. to be decided**

LCB-Presentatie 31 May 2021

Topics:

- **Schets context vanuit de media aandacht:**
  - **Collectieve verontwaardiging en beleving in de samenleving**
  - **Relativering en de scherpere blik**
- **Het afgebakende supply chain systeem**
- **De deelonderzoeken van Tim Coolen, Jojan Heijnen en Alexander Rus**

COVID-19 vaccin supply chains; voorjaar 2021, colectieve beleving en commentaren

“Weer minder geprikt dan gepland”

“Lege hallen”

“Aanhouden van onnodige voorraden”

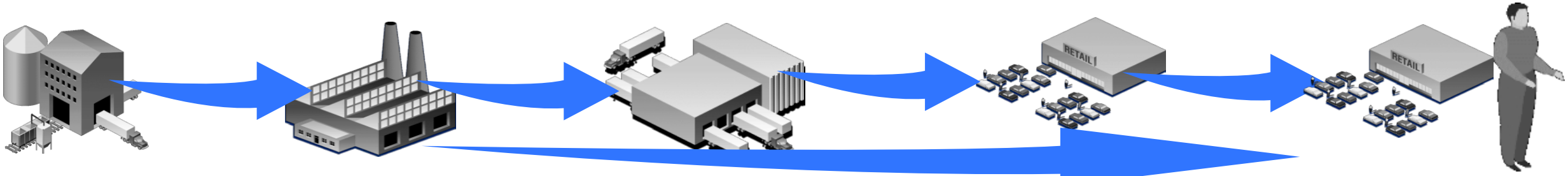
Vantill.nl

“Je zou de slachtoffers kunnen uitrekenen onder de kwetsbare groepen”

Relativering: “voorraden van 500.000 doseringen werden in de periode mei-juni 2021 in enkele dagen weggeprikt”

Scherpere blik: “overcapaciteit liet zien dat we klaar waren voor de opschaling”

Supply chain system of vaccines (simplified)



Supplier:

Supply 1

Manufacturer:

Supply 2

Central hub/:

Supply 3

Regional warehouse:

Supply 4 (e.g.: Oss)

Local facility at destination:

Supply 5 & actual demand

1. Agreement by EC about vaccine shares per member state
2. Contracts between EC and Pharma companies
3. Contracts between Pharma companies and LSPs (forwarders, integrators,..)
4. Contracts between LSPs and subcontractors

1. RIVM rolls out vaccination programme on behalf of Ministry of VWS
2. RIVM designates GGDs, GPs, hosppitals, nursery homes to execute the vaccination programme
3. Contracts with LSPs for central storage and last mile

1. **Tim S1 → S2 en S5; focussing on matching supply and demand of vaccines through time; impact of production failures**
2. **Jojan S2 → S5; focussing on waste (risks) strategy and management**
3. **Alexander S4 → S5; focus on last mile and vaccine organisation**

Last mile focus: Dutch situation compared to other EU member states, but also outside EU

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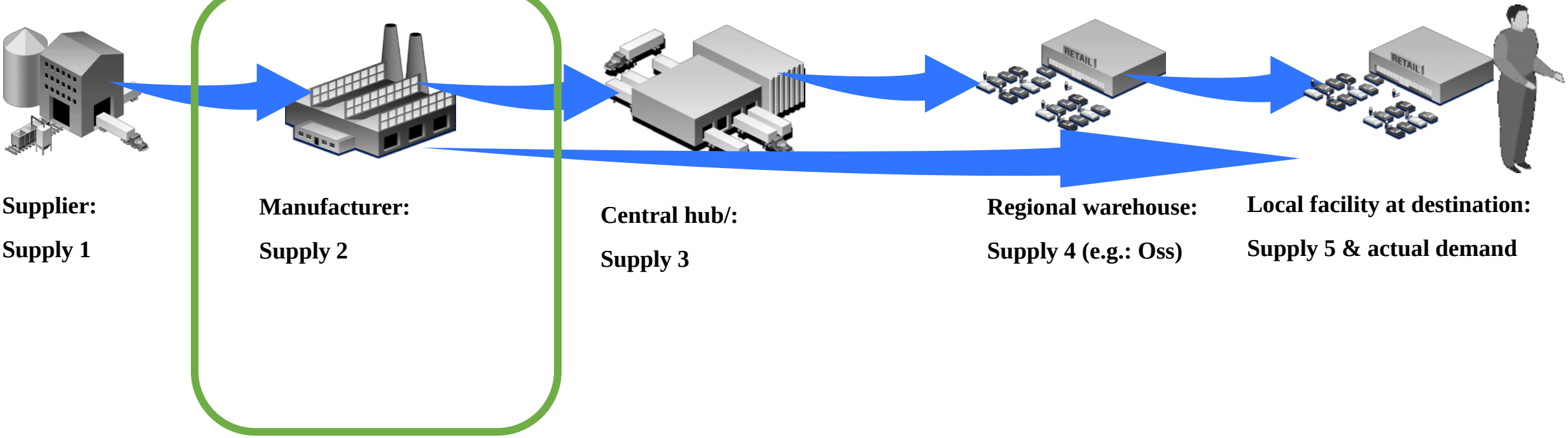

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Tim Coolen, Mei 2021

Vaccine manufacturing supply chain disruptions of Pfizer-BioNTech (mRNA) and Oxford-AstraZeneca (viral vector)

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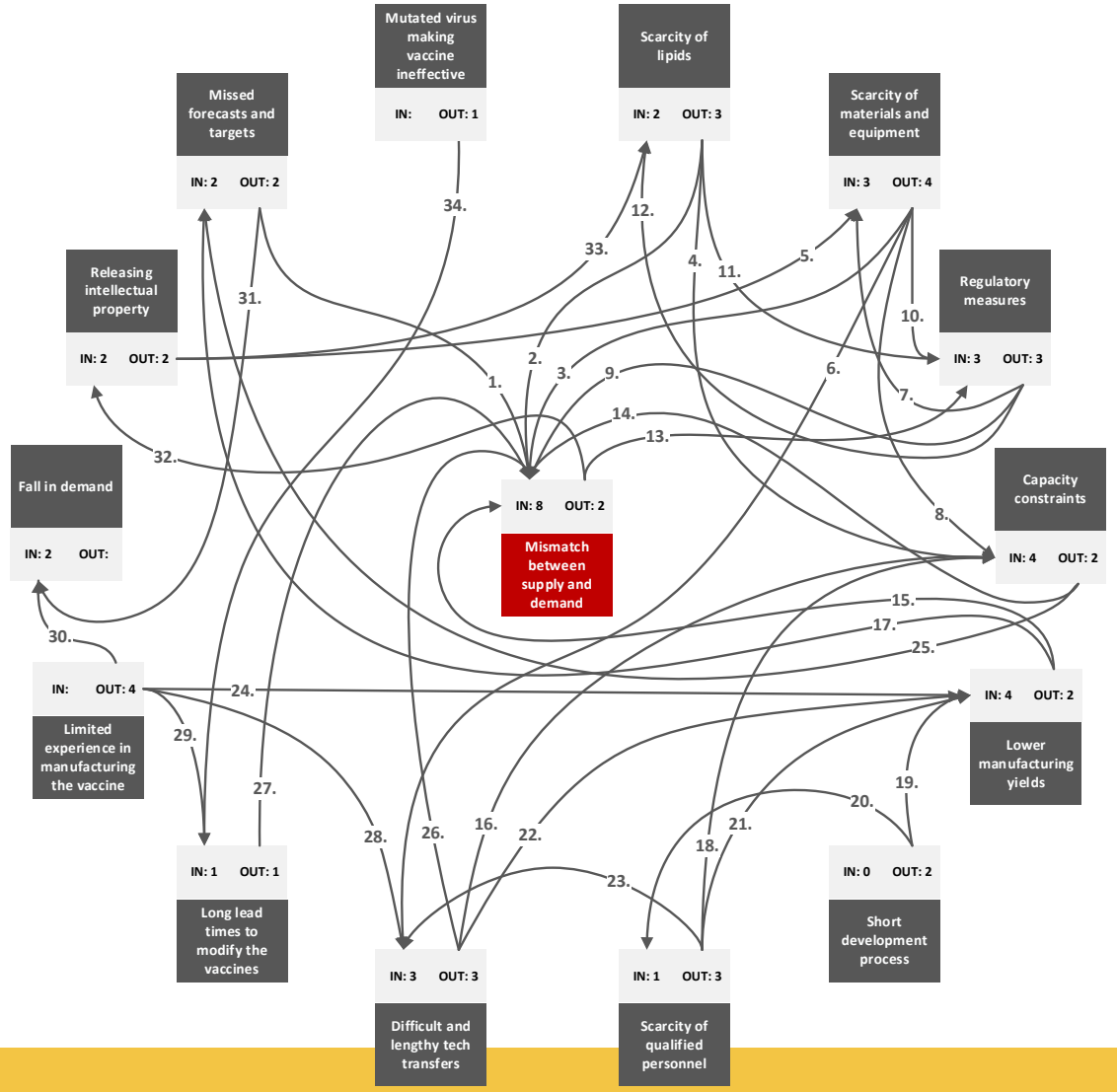
Finding causal relations among the vaccine manufacturing supply chain disruptions



9 EXOGENOUS (external) DISTURBANCE FACTORS

- 6 supply disturbances
- 3 control disturbances
- 3 demand disburbances

6 ENDOGENOUS (internal) DISTURBANCE FACTORS

- 5 process disturbances
- 1 control disturbance

4 ENVIRONMENTAL DISTURBANCE FACTORS

- 1 geopolitical disturbance
- 1 labor force quality disturbance
- 1 cultural disturbance
- 1 Intellectual property rights disturbance

Vaccine manufacturing supply chain disruptions of Pfizer-BioNTech (mRNA) and Oxford-AstraZeneca (viral vector)

Some of the theoretical propositions and proposed mitigation strategies

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PROPOSITIONS

I. Vaccine manufacturers using the viral vector technology are more vulnerable to process disruption than vaccine manufacturing companies working with the mRNA technology.

II. Vaccine manufacturing companies that outsource most of their manufacturing processes are more vulnerable to process disruptions.

III. The scarcity of equipment, raw materials, and consumables is a major problem that causes both process and supply disruptions in vaccine production during a global pandemic.

IV. The scarcity of (qualified) personnel is a major problem leading to capacity constraints in vaccine manufacturing in times of a global pandemic.

V. The application of regulatory measures (including the waive of IPR) during a global pandemic to ban the import and export of key ingredients and/or vaccines is likely to further jeopardize the availability of vaccines to the population worldwide.

MITIGATION STRATEGIES

I. Hard to control this disruption because it is caused by the technology of the vaccine. Chemical is easier to control then biological processes. A way to mitigate this disruption is always having excess capacity in either inventory and/or production capacity and improve the overall efficiency of the equipment of the existing capacity to improve biological yield.

II. Outsource as little as possible. I they choose to do so, select the CMO as carefully as possible on the basis of clear assessment criteria.

III. Holding additional stock and maintain redundant critical components. And start partnerships with other pharmaceutical companies to get access to their equipment. And another mitigation strategy is to advocate for speeding up the approval of substitutes so that the manufacturers are able to switch to materials that are not scarce.

IV. Also for this disruption is would be beneficial to start partnerships with other pharmaceutical companies to make use of each other resources in either personnel as equipment

V. It is crucial that global trade is allowed to ensure the availability of key materials/ingredients around the world and enhance the global availability of vaccines.

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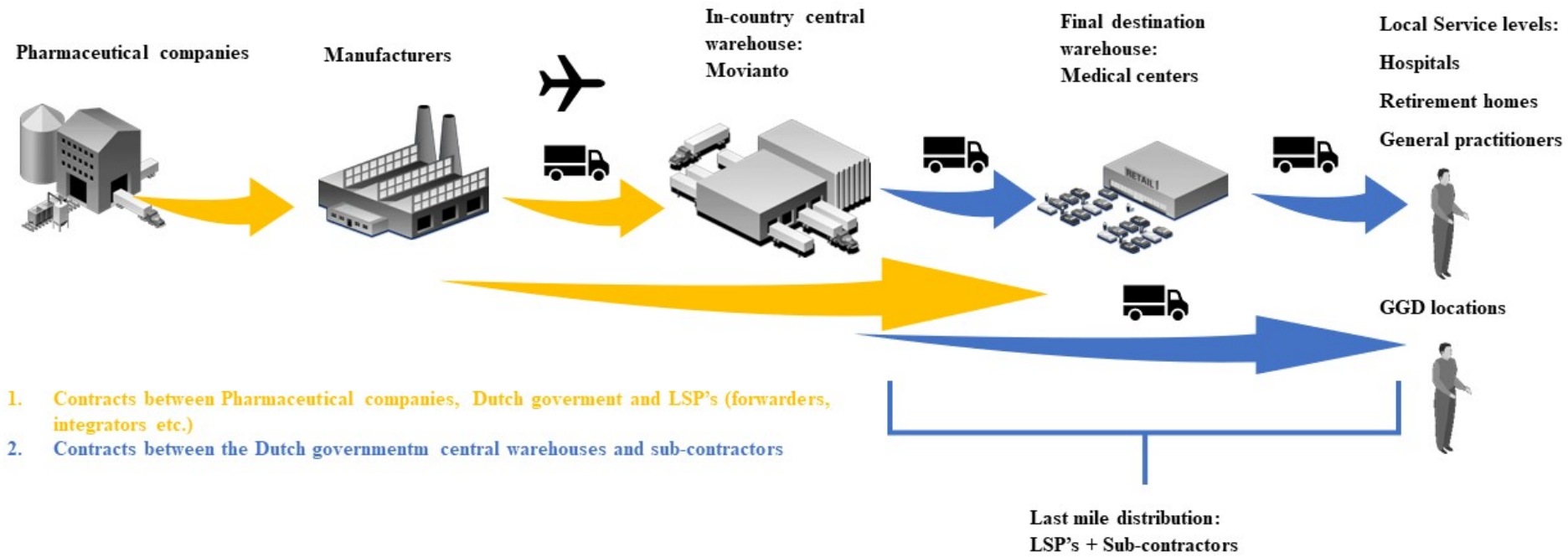
Dutch vaccine supply chain system (simplified)



Jojan Heinen, Mei 2021

Findings (1/3)

Risk of Vaccine Waste First Mile:

- **When asked for waste, hesitant with answering. Do not want to be in the media with losing a shipment and business. Comparing shipments to “gold ”or “diamond” due to high importance.**
- **Stakeholders responsible in the first mile (LSP’s, forwarders,logistic integrators etc.) have high confidence in their role. Except for a few incidents (example pallet left at airport), almost no wastage. 99%+ delivery succes rate due to high traceability, visibility and up to date information systems/control towers with pharmaceuticals.**
- **Also no rocket science, GDP certified companies involved in exisiting vaccine supply chain networks.**

Findings (2/3)

Risk of Vaccine Waste distribution:

- **Not a fully END to END vaccine supply chain. Decoupling point at final destination, in-country warehouse (Movianto) or medical centers.**
- **The last mile of vaccines was not well prepared on strategic level, only for GGD locations. Hospitals and elderly homes responsible in getting the vaccines, resulted in non-GDP certified transport (example of kroketboer).**
- **Unclear how many vaccination sites, risk of redistributing vaccines end of the day due to lack of planning.**

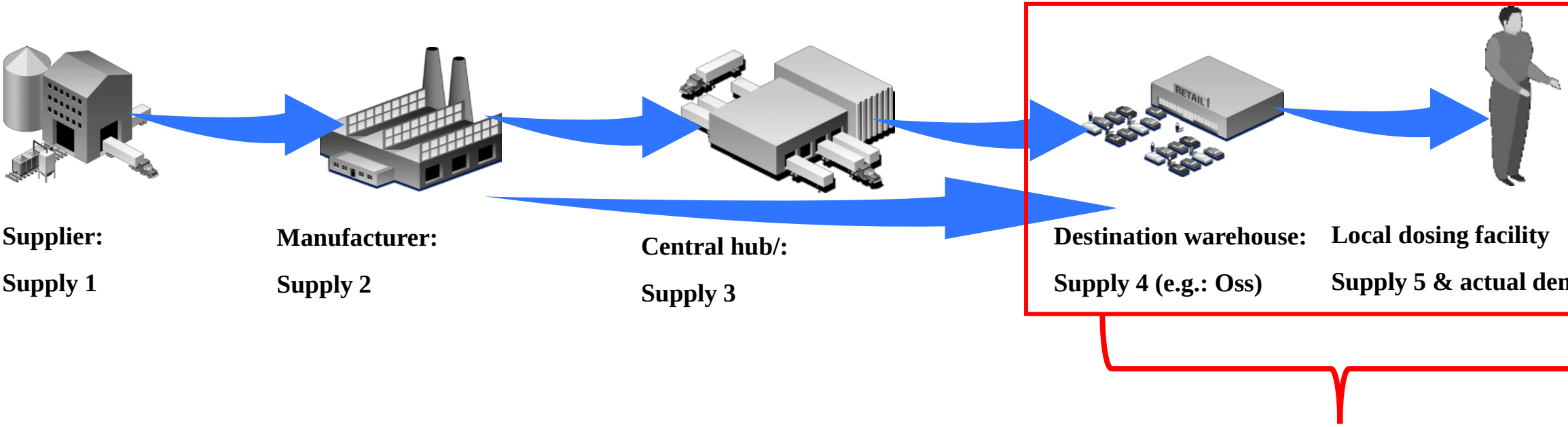
Findings (3/3)

Risk of vaccine waste service level:

- **Low risk of closed vaccine vial wastage, Dutch vaccinators seem to be well prepared and following FIFO system.**
- **High risk in open-vial wastage, lacking national strategy on what to do with leftover doses + unknown doses of vials (example BP 5 or 6 doses? AZ combining leftovers? Every service level stakeholder following own protocol (prullenbakvaccin, general practitioners preparing too many syringes without regarding the no-shows)**

Most logistics experts interviewed agree that the biggest challenge lies in the last mile of the LMIC, with lacking cold chain infrastructures.

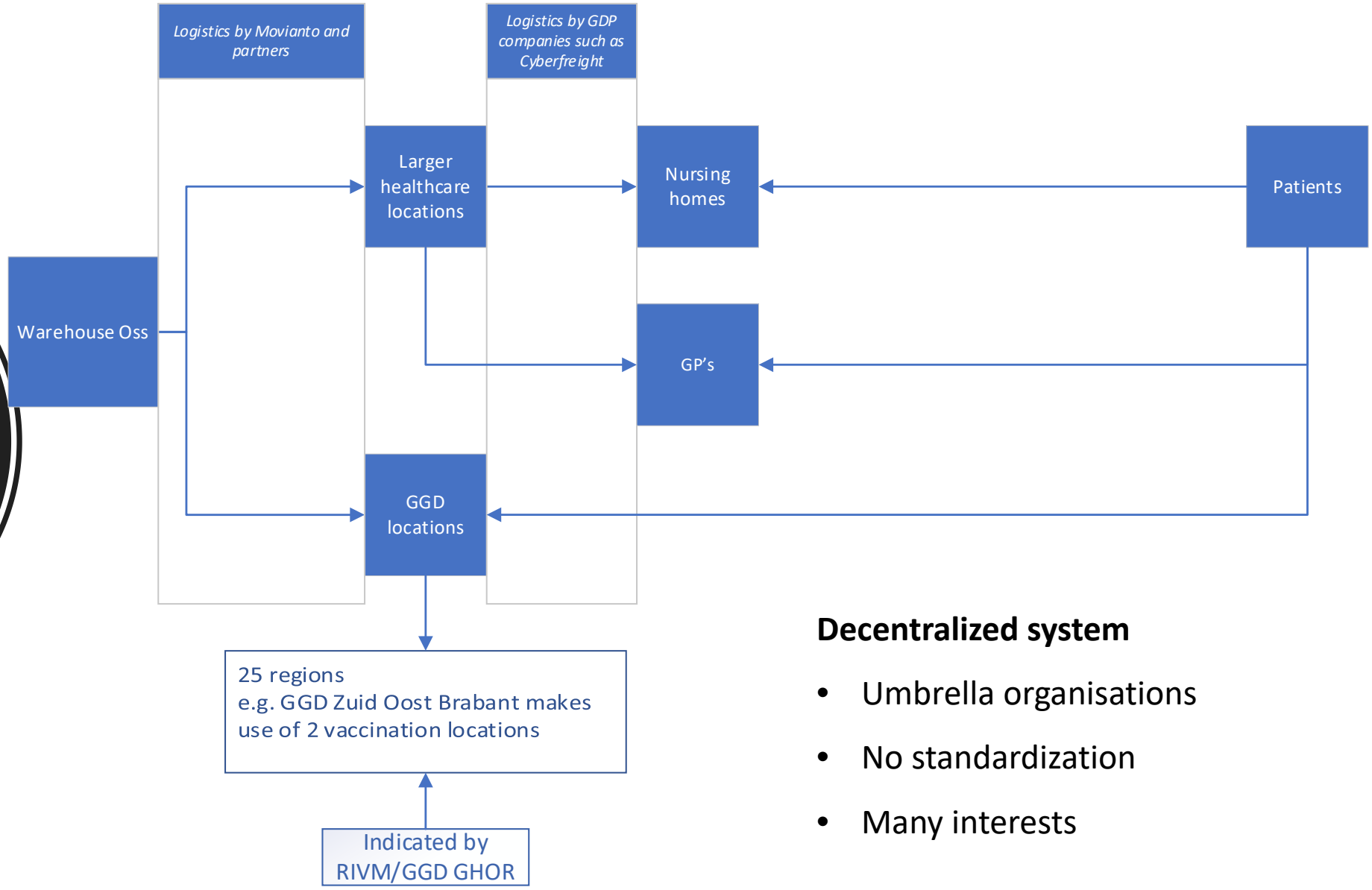
Improving the ramp-up of the last-mile logistics process in the Dutch vaccine supply chain



1. **RIVM rolls out vaccination programme on behalf of Ministry of VWS**
2. **RIVM designates GGDs, GPs and others to execute the vaccination programme**
3. **Main part of distribution carried out by Movianto (Oss)**

Alexander Rus, Mei 2021

Supply chain design



Decentralized system

- Umbrella organisations
- No standardization
- Many interests

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Main bottlenecks in the last mile supply chain process

Vaccination strategy

Supplier uncertainty and production ramp-up

- Planning
- Slow ramp-up vaccination process
  - Positive effect on the Dutch vaccination process?

Unreadiness of the Dutch vaccine supply chain

- Lack of expertise?!
- Amount of suitable locations and qualified personnel
- Efficiency in the vaccination process
  - Negative news reports

Possible supply chain disruptions

Lack of digitalization in healthcare

- No accurate data on vaccine uptake

Appointment scheduling system