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LESLIE DAN FACULTY OF PHARMACY

Developing a drug shortages predictive model using real-world Canadian drug utilization

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Drug Shortages – a growing global crisis

- 1 in 4 Canadians has experienced a drug shortage in the last 3 years
- Record high of 323 drug shortages in US in 2024, highest since 2001

Shortages impact patient care and the healthcare system

- Shortages are associated with :
  - Adverse events
  - Increased medication errors
  - Non-adherence
  - Inferior treatment
  - Hospitalization
  - Mortality

- Burden healthcare system through
  - prolonged recovery times, delayed treatment, increased recovery costs
- Shortages strain pharmacists and physicians to find drug alternatives
  - Pharmacists report spending 10 hours/week on managing shortages

Policies are being considered to prevent severe shortages

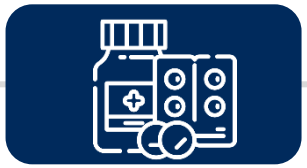
Stockpiling

Buffer Stock

Exceptional

We can’t use preventive policies for all drugs

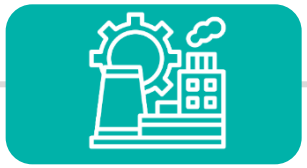
Need to Prioritize Drugs



Current essential medicines lists focus on clinical importance

Clinical importance varies

Different across specialties and healthcare settings



Supply chain risk is equally important

Factors such as manufacturers, ingredients, complex formulations

Not considered when creating medicine lists

Need to determine supply chain factors associated with shortages

Our Solution

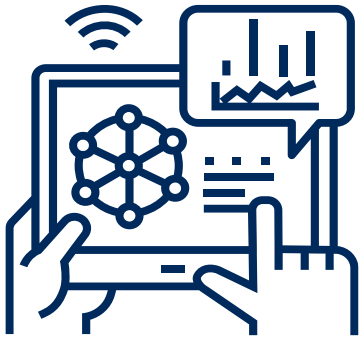
Develop a predictive model to score supply chain related risk of facing a significant shortage for all Canadian drugs

Objectives

1. Determine how many reported Canadian supply chain events lead to a meaningful decrease in drug supply of ≥33%

2. Discover drug characteristics associated with ≥33% decrease

3. Create a predictive model to ascertain shortage-risk



Data Sources

IQVIA MIDAS

- Monthly wholesale purchasing, sales and manufacturer data 2017-2021

Drug Shortages Canada

- Shortage & discontinuation reports Mar 2017-Dec 2021

Health Canada

Drug Product Database

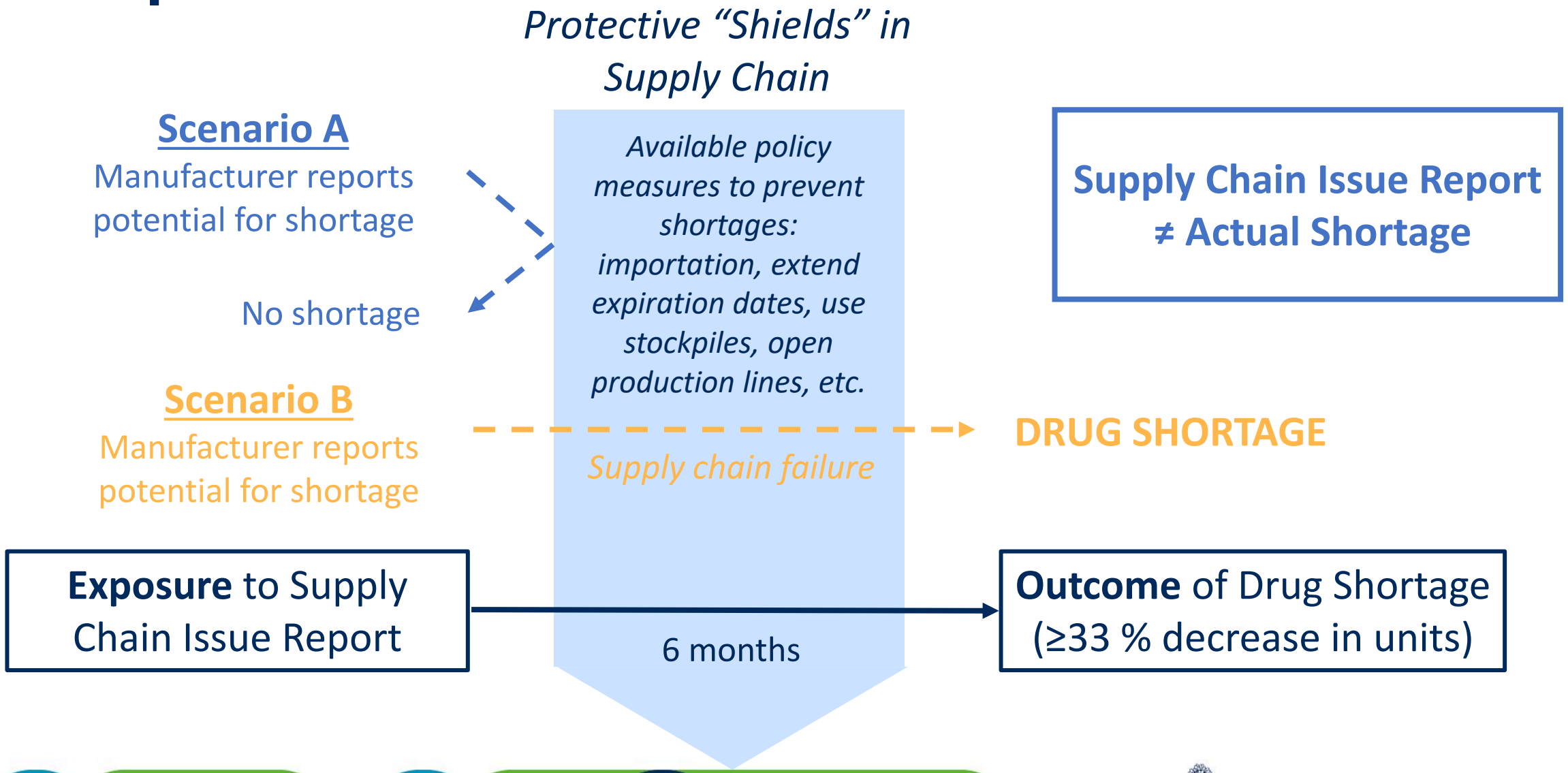
- Drug covariate data: drug schedule, age, number of DINs, number of API

Other Sources

- ODB coverage – ICES
- WHO essential medicine
- Tier-3 Status
- Brand vs generic
- Therapeutic equivalents

For this project drugs defined at ingredient + formulation level

Conceptual Framework



Conduct a matched cohort study to obtain risk scores

Drugs with a supply chain report

+

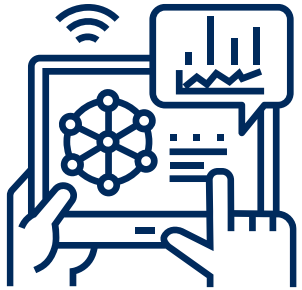
Drugs without a supply chain report

Exposure Density Sampling

Matched drugs with and without a supply chain report using index date

Meaningful ≥33% decrease

Flag observations with outcome within 6 months



Logistic regression with random effects

Compare odds of meaningful decreases for drugs with report and without

Score Risk

Use predicted probabilities to score risk of individual drugs

Findings suggest that most supply chain events do not face significant shortages

	Meaningful ≥33% Decrease	Severe ≥66% Decrease
Supply Chain Report	**11.3% (216)**	**5.2% (100)**
Control	6.6% (1271)	2.2% (429)

- 1 in 10 reports faced a ≥33% decrease in supply
- 1 in 20 reports faces a ≥66% decrease in supply

What is most predictive of a shortage?

1.

Sales less than $100,000

(OR: 4.01)

2.

Anti-infectives

(OR: 3.07)

3.

Unit price greater than $100

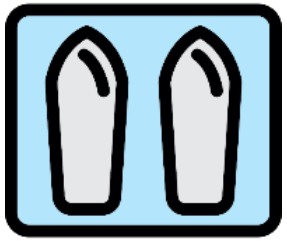
(OR: 2.91)

What is most protective of a shortage?

1.

Rectal formulations

(OR: 0.165)



2.

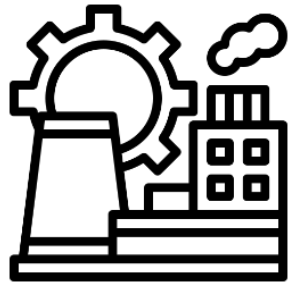
ODB coverage for 50-99% of DINs

(OR: 0.405)

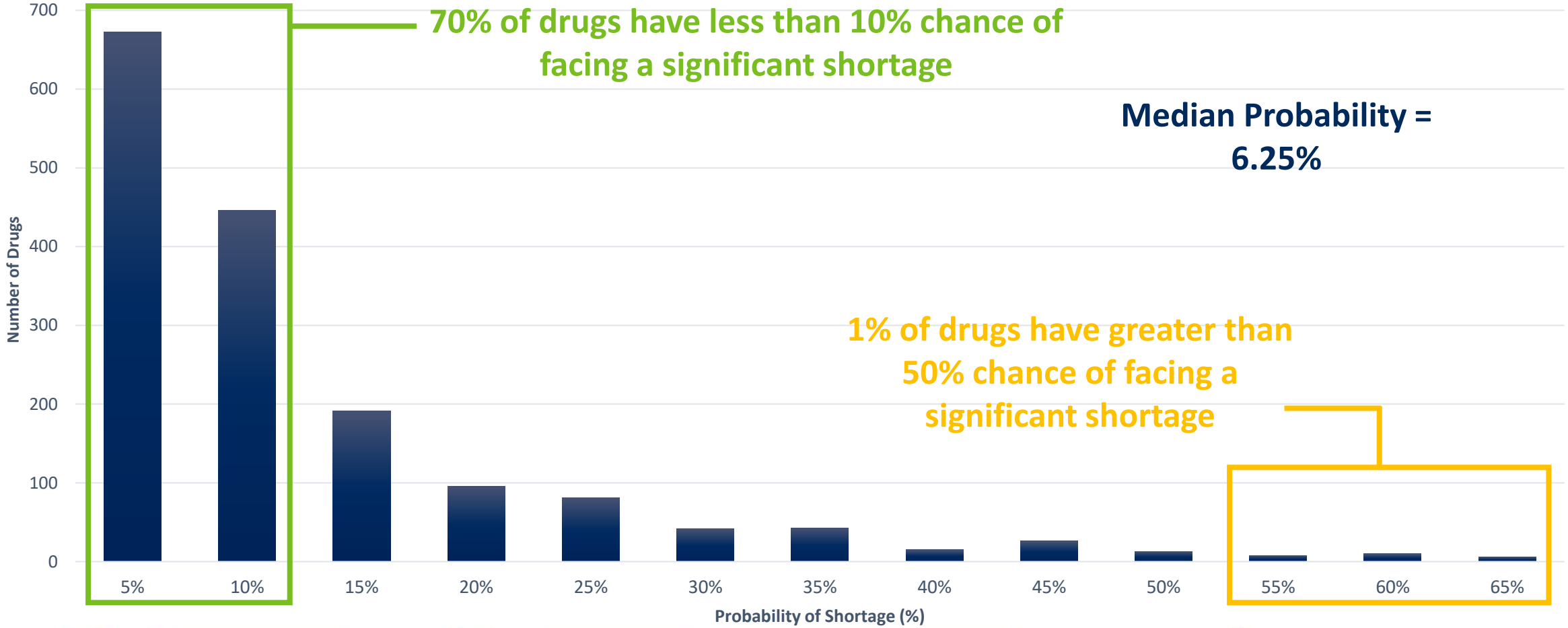
3.

5-9 manufacturers

(OR: 0.454)



Most Canadian drugs have low probability of experiencing a significant shortage



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Main Take-Aways

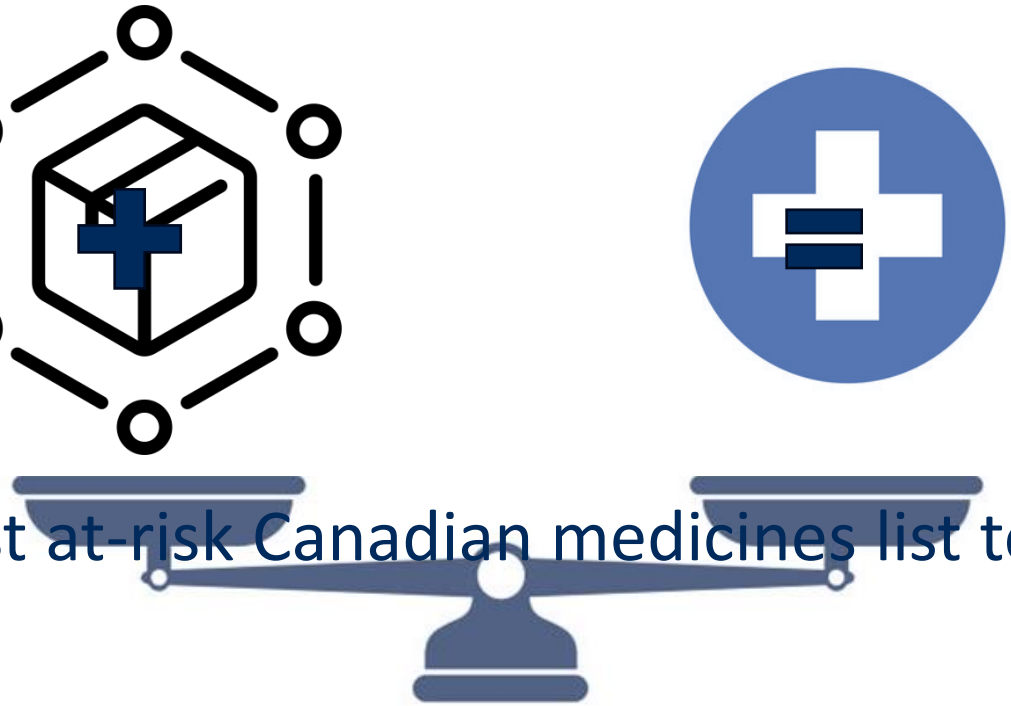
- Only 1 in 10 supply chain reports led to meaningful decreases
  - Built in protective “shields” in the supply chain prevent shortages
- We now know supply chain factors strongly associated with significant drug shortages
  - Only 1% of Canadian drugs have a greater than 50% chance of facing a significant shortage

Big Picture: Developing a national at-risk medicines list

- Combine supply chain risk and clinical risk of shortage

Supply chain risk

Which drugs are likely to have a supply chain issue



Clinical risk

Which drugs when in shortage will impact patient health

Risk Stratification

- To create a robust at-risk Canadian medicines list to guide shortage policy

Thank You!

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