Capacity allocation considering fairness metrics: a pharmaceutical supply chain case study

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I Background

Universal access to
Health care & quality of life
UN target for sustainable development

Price & availability of medication
are two of the main factors

Pharmaceutical supply chain

Most common objectives
- Minimize disturbances
- Minimize cost
- Social responsibility (fairness metrics)

Some of the main levers
- Inventory
- Process flexibility
- Agility capacity

! Lack of quantitative metrics for the **impact on patients** on the decision-making process

II Objectives

Balance **capacity utilization**

Integrate the **patient needs** on the decision making process

Support decisions regarding the **trade-off**

Costs - Fairness

Capacity allocation model

API Manufacturers → Drug Product Manufacturers → Production Lines → Markets

III Model

Costs (1)

$$\min \sum Production\ costs + \sum Inventory\ costs + \sum Penalty\ costs + \sum Setup\ costs$$

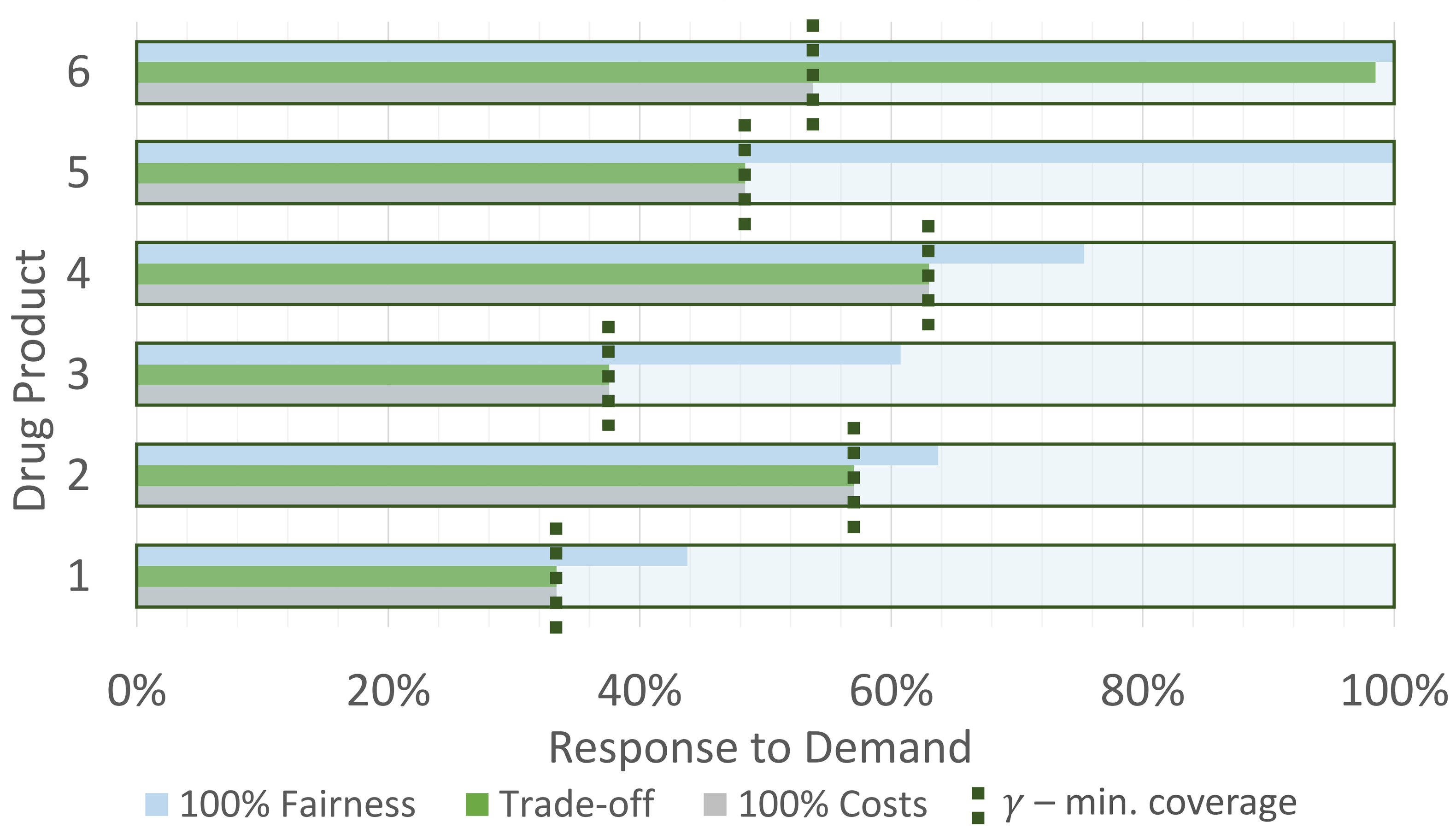
Unmet demand (2)

$$\min\ \xi + 1 - \sum \frac{delivered}{demand}$$

subject to:

$$demand * \gamma \leq delivered$$
$$utilization \geq U_i^{max} + penalty$$
$$utilization \geq U_i^{min} - penalty$$
$$\ldots$$

ξ : max percentage of unmet demand (amongst products)
γ : min coverage percentage (per product)
U : min/max recommended capacity utilization (per facility)



IV Results

Preliminary analysis

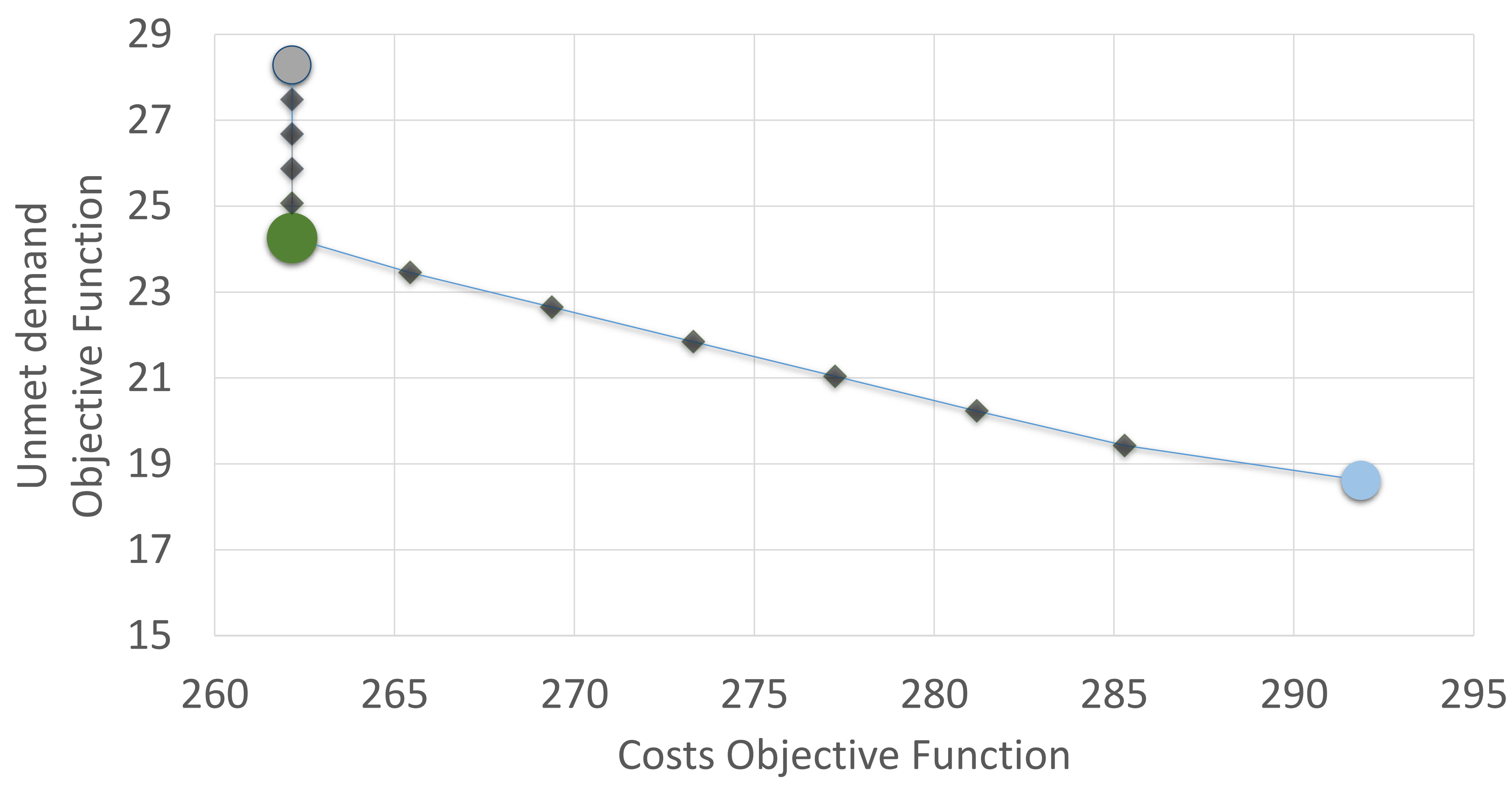
Considered instance

3 API Manufacturers → 4 Drug Product Manufacturers → 3 Production Lines (each)

4 API references · 6 DP references · 9 years

Trade-off analysis

Augmented ε-constraint method



Reducing **14 %** of the unmet demand does not require additional costs to the company

The minimum coverage of demand, representative of the importance of each product to the patients - γ - is respected in all scenarios

V Future Steps

Demand uncertainty
Robust MILP model for resilient network
Incorporate agility capacity on manufacturers

Technology-Production fit
Account for specific capabilities of facilities

Dimension challenge
Scale up the instance size to a real-world problem

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