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PROBLEM STATEMENT

Sanofi must balance two costly outcomes: insufficient inventory can threaten patient service, while excess inventory ages toward expiry. Forecasts are evaluated at the product-market level, but expiry decisions happen at the site and batch level. This project builds an auditable framework that connects the two without treating them as the same prediction problem.

Inventory aging
leading to significant
write-offs
&
≈€15M
donated annually

Donation is an access commitment and not a disposal route for aging stock, but by surfacing at-risk batches while they still carry usable shelf life, this framework aims to increase the volume we are able to donate.

OUR SOLUTION: A THREE-STAGE FRAMEWORK

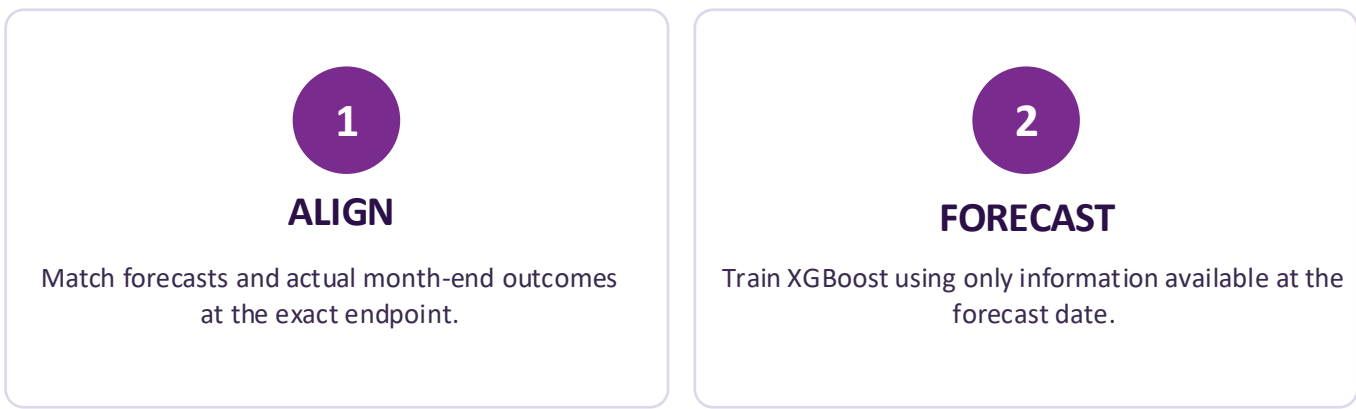


Each stage is tested and validated separately, then connected into one decision-support workflow. No stage automates a donation, transfer, or destruction decision.

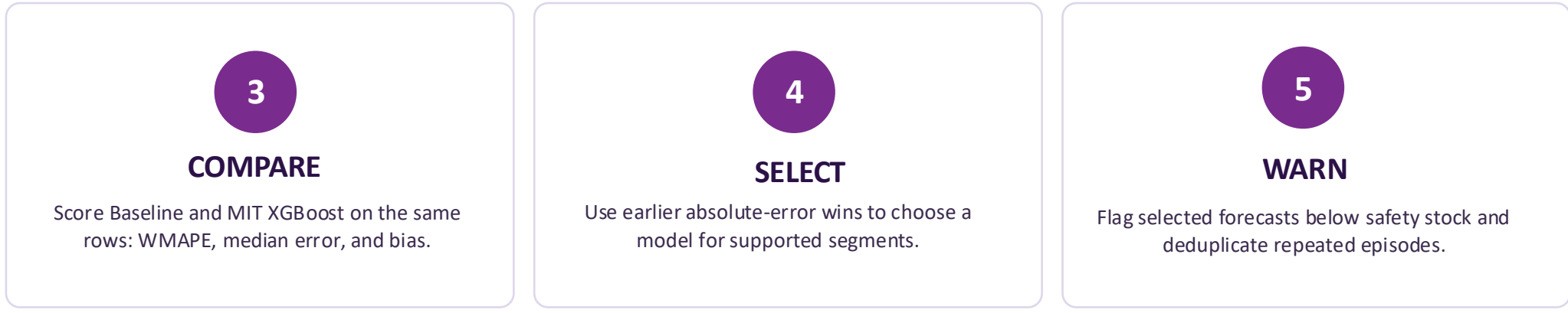
METHODOLOGY

A leakage-safe, auditable pipeline from historical data to a planner-ready review queue.

STAGE 1



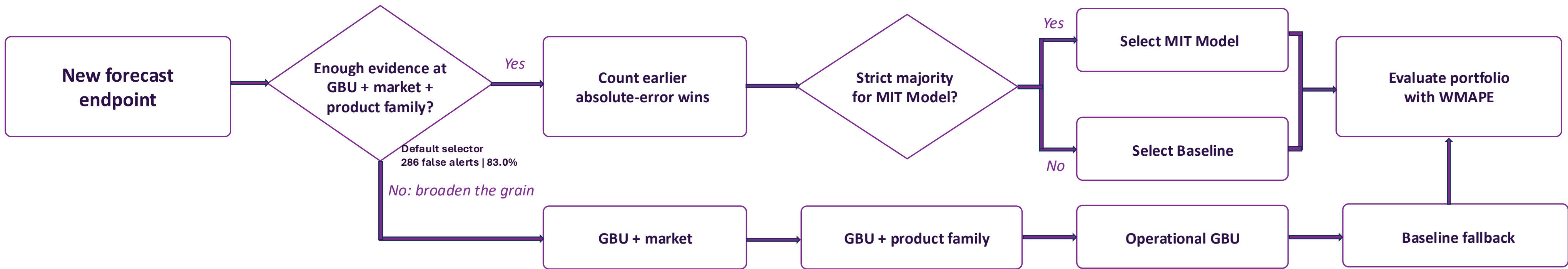
STAGE 2



STAGE 3



HOW THE SELECTOR PICKS A WINNER

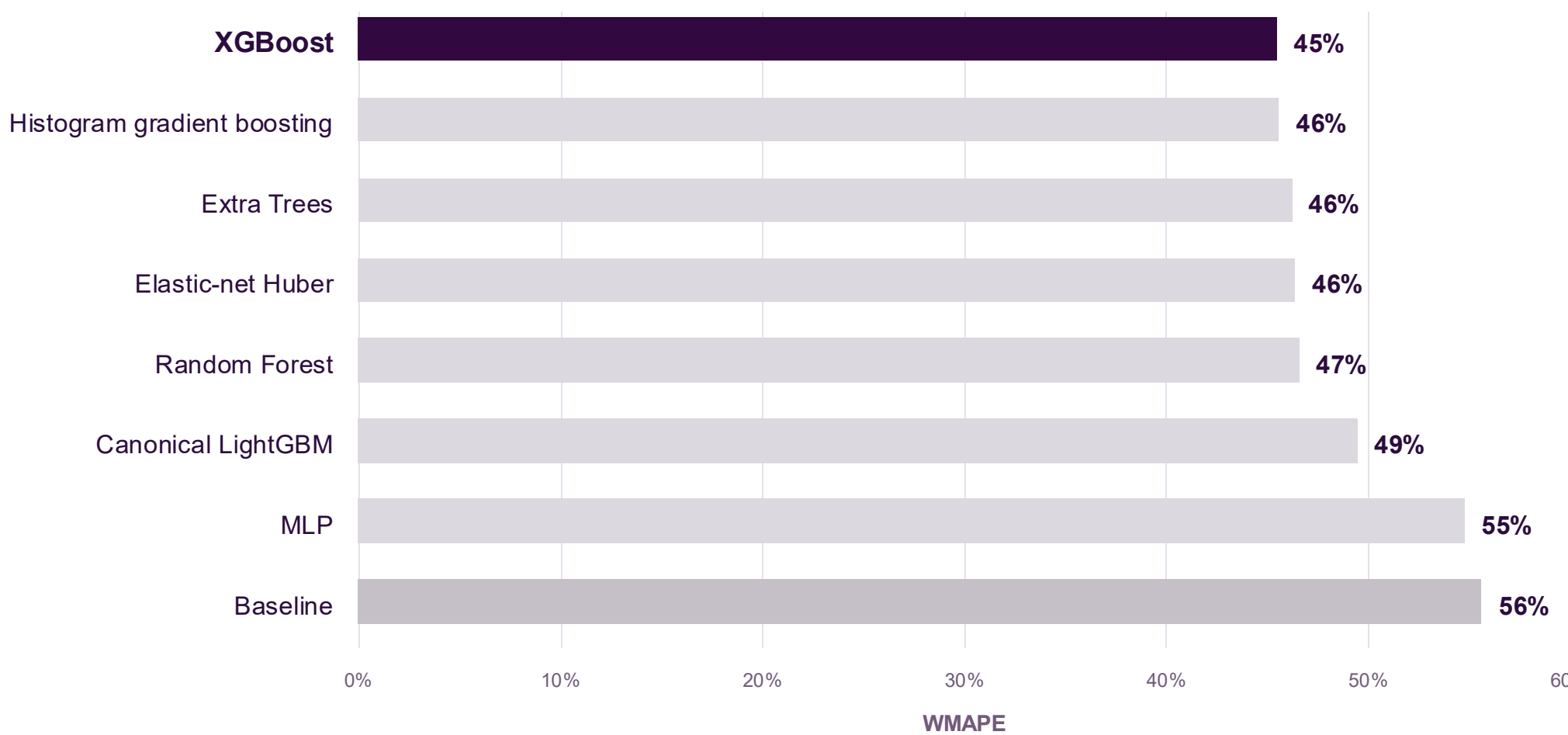


RESULTS

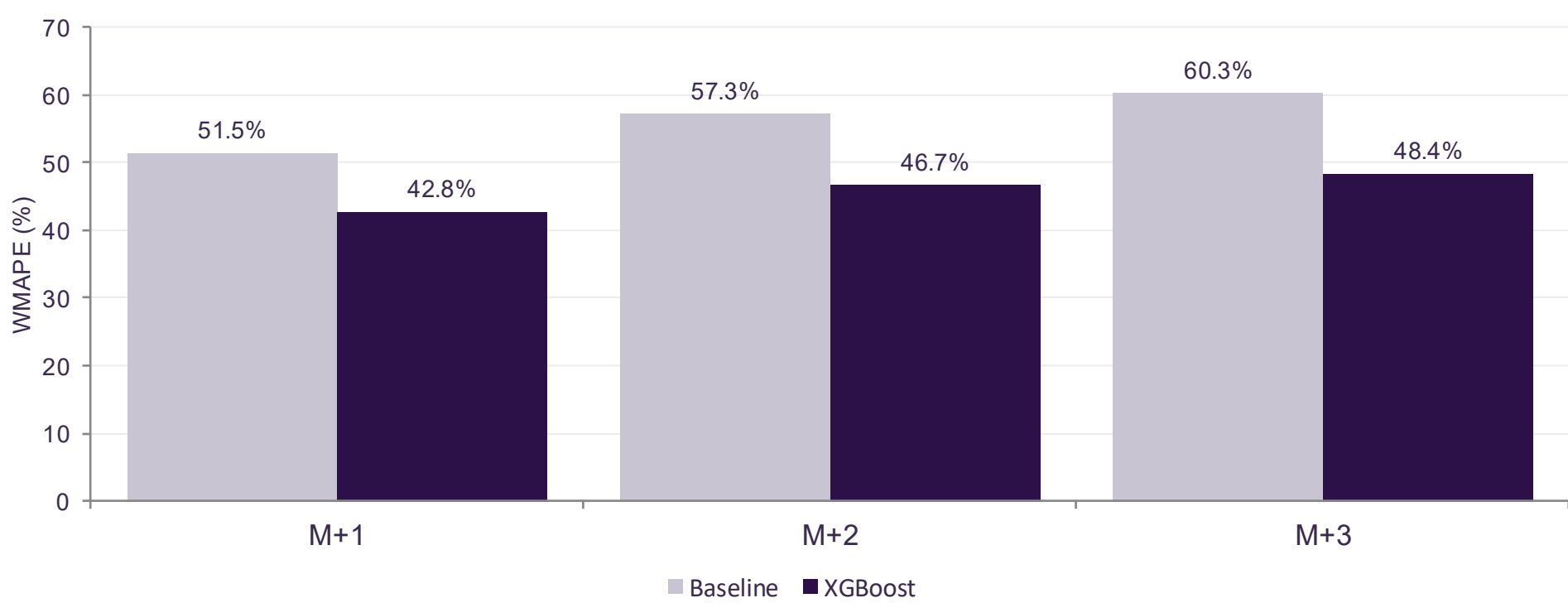
STAGE 1

XGBOOST LEADS THE SHOWN MODEL BENCHMARK

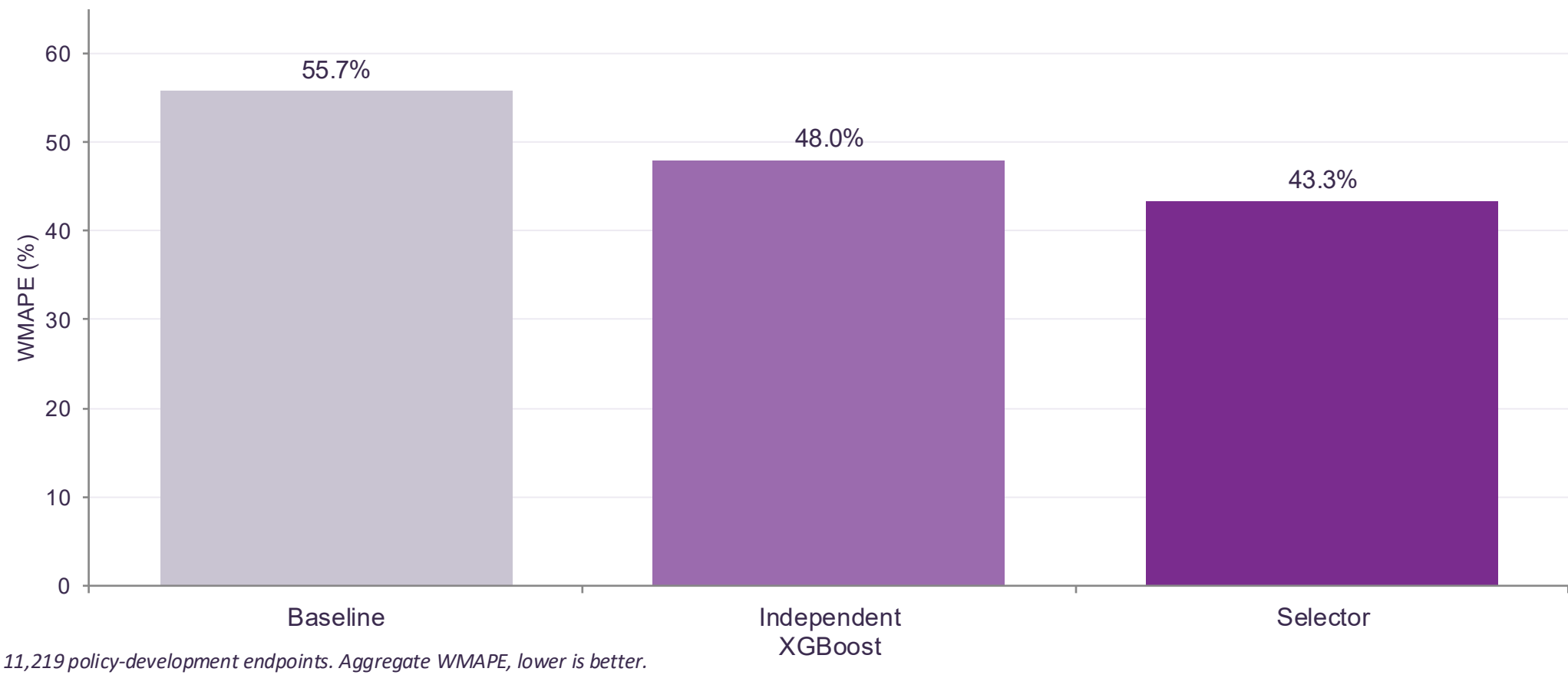
Same 13,776 mature endpoints across 16 markets | WMAPE, lower is better



The Independent Model Reduces Error at Every Horizon

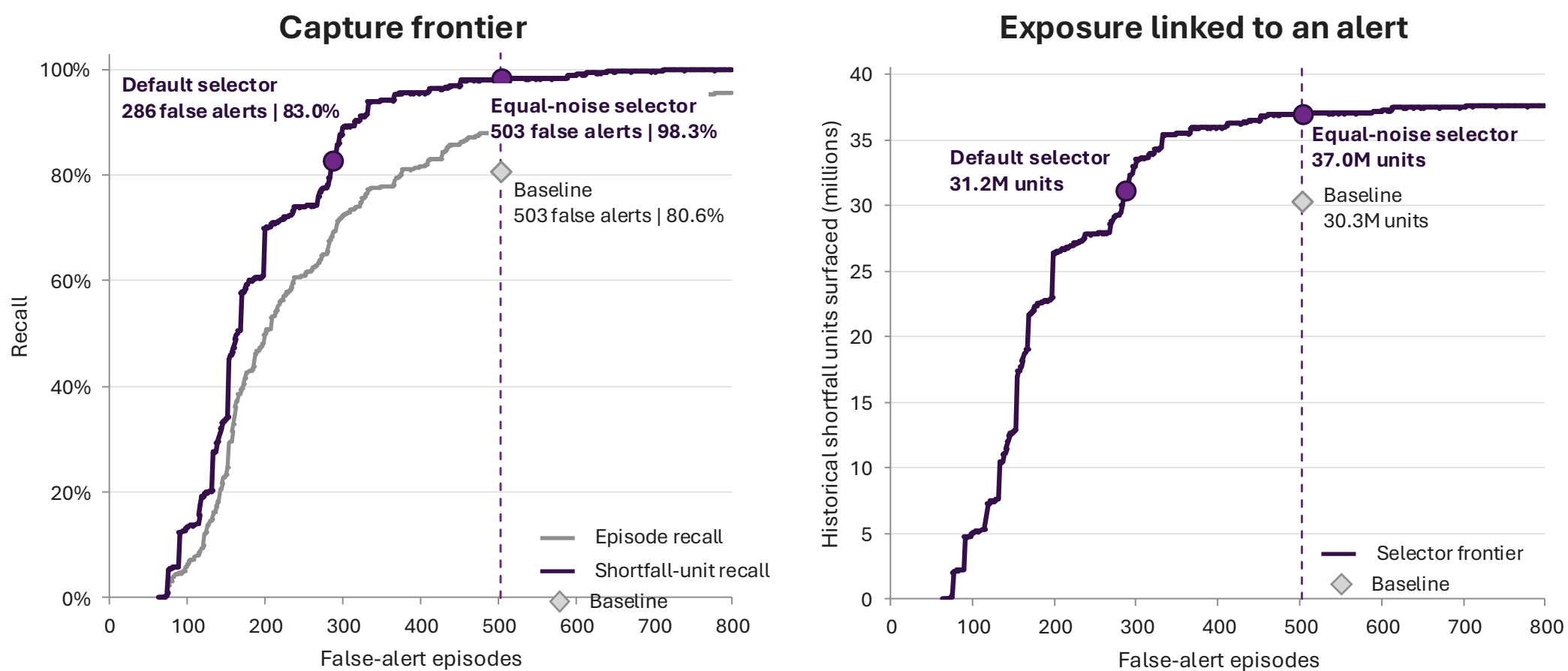


The Selector Captures the Best of Both Forecasts



Safety-stock decision frontier for the current XGBoost selector

All retrospectively tested thresholds are shown; marked points identify the default and matched-noise policies



BUSINESS IMPACT

FORECAST VALUE

+ 22%

improvement in
weighted MAPE (over
baseline)

DECISION VALUE

43%

reduction in false
alerts

+ 22%

capture of safety stock
breaches

"Inventory decisions at Sanofi's scale touch millions of patients across 130+ countries. Getting even a little more precision here has an outsized effect on both cost and access. These MIT students got more than just a little..."

— Carlos Cortes, Advanced Analytics Manager ,Sanofi