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Bariatric procedure volumes during changes to coordinated care and incretin therapy expansion in Poland: a retrospective study of 30 centers, 2022–2025

Michał Robert Janik

mjanik@wiml.waw.pl

Military Institute of Aviation Medicine

Piotr Major

Jagiellonian University Medical College

Ali Aminian

Cleveland Clinic

Research Article

Keywords:

Posted Date: November 13th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11347038/v1

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Additional Declarations: Competing interest reported. Michał Robert Janik reports lecture honoraria from Novo Nordisk. Ali Aminian reports research grants from Amgen, Ethicon, and Medtronic, and consultancy for Amylyx, Eli Lilly, Ethicon, and Medtronic. Piotr Major declares no competing interests.

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Abstract

Introduction: Expanding incretin pharmacotherapy has prompted debate about declining bariatric surgery use. We examined procedure volumes during changes to Poland's coordinated bariatric care pilot (KOS-BAR) and growth in incretin drug sales.

Methods: We analyzed National Health Fund procedure counts for 2022–2025 in 30 centers selected in a health technology assessment report. Nineteen centers had participated in the pilot and 11 had not. The principal comparison was total panel volume in 2023 versus 2024. Four exploratory exact rank-sum and sign tests assessed center changes, with Holm adjustment. Regulations and separate drug-sales aggregates provided context.

Results: Panel volume increased from 5 515 procedures in 2022 to 7 667 in 2023, decreased to 6 735 in 2024 (−12.2%), and increased to 7 455 in 2025 (+10.7%). The 2024 decline comprised 1 023 fewer procedures in pilot centers and 91 additional procedures elsewhere. Median center-level changes were −25.3% and +1.2%, respectively (Holm-adjusted p=0.0112). Regulations implied a 177-day interval outside the pilot's operative timetable in 2024, without establishing center-specific suspension. Combined nominal sales value of semaglutide and tirzepatide increased from PLN 1.376 billion in 2024 to approximately PLN 3.056 billion in 2025. Procedure volume remained 2.8% below its 2023 peak.

Conclusion: Expanding incretin sales were not accompanied by a sustained decline in panel volume. The decline in pilot centers was followed by recovery, highlighting care organization as context. Selected centers, annual aggregation, and sales measures preclude national extrapolation or identification of policy and drug effects.

Key Points

- Panel procedure volume fell in 2024 and partially recovered in 2025.
- The 2024 decline was concentrated in historical KOS-BAR pilot centers.
- Growing incretin sales did not accompany a sustained decline in panel volume.
- Annual aggregate data cannot identify independent policy or medication effects.

Introduction

US studies report increasing glucagon-like peptide-1 (GLP-1) receptor agonist prescribing alongside declining bariatric surgical utilization [1,2,3]. Completed procedures reflect treatment choices and delivery conditions. Changes in referrals, program eligibility, and reimbursement complicate interpretation of concurrent medication and surgical trends.

Poland's KOS-BAR coordinated-care pilot introduced preparation, surgery, and postoperative follow-up in 2021 alongside standard publicly funded surgery [4]. Participating centers could use either reimbursement route; the pilot timetable was repeatedly amended [5,6,7]. Earlier Polish survey [8] and administrative analyses [9] do not resolve the subsequent trajectory within centers across the changing operative timetable.

We examined a fixed panel of 30 centers during 2022–2025 to describe the 2024 volume change, its distribution by historical pilot status, and the trajectory alongside incretin sales. The study concerns panel activity and organizational context, without estimating national access or causal policy effects.

Materials and Methods

Design and setting

This retrospective panel study combined published administrative aggregates, regulatory documents and drug-sales reports. Procedures were financed by Poland's public health insurer, the National Health Fund, regardless of provider ownership; self-funded procedures were outside scope. STROBE and RECORD informed reporting [10,11]. The coordinated-care pilot comprised assessment, preparation, surgery, rehabilitation and follow-up [4]. Center participation did not identify the reimbursement route of each procedure.

Center panel and outcome definition

We included all 30 providers in Table 27 of the Polish Agency for Health Technology Assessment and Tariff System (AOTMiT) report [12]. Its selection criteria were at least 130 bariatric procedures in one year within the preceding three years and at least two operative techniques; one procedure using the second technique was insufficient. Providers did not have to meet these thresholds every year.

All listed providers had counts for 2022–2025 and were retained, including zeros and years below the threshold. Upstream nationwide screening counts and exclusions were unavailable. Selection used activity during observation; this was neither a representative national sample nor a cohort defined solely at baseline.

Counts concern adults aged ≥18 years and five ICD-9 categories: Roux-en-Y gastric bypass (43.71), one anastomosis gastric bypass (43.72), sleeve gastrectomy (43.82), laparoscopic gastric restrictive surgery (44.95), and laparoscopic revision of a gastric restrictive procedure (44.96). We retained published counts covering public reimbursement within and outside the pilot.

Counts measure activity, not unique patients; payment routes, individual records, and clinical coding validation were unavailable. Provider aggregates may cover multiple locations. Contemporary clinical terminology is used for ICD-9 code 43.72; the code and source counts were unchanged (Supplementary Table S2).

The 30 providers contributed 120 provider-year records, without missing annual counts. These are repeated observations, not 120 independent centers. Historical pilot status came from Table 27: 19 pilot and 11 other providers; it does not establish continuous exposure. Two other providers reported zero procedures in 2022. Study size followed the published table, without a prospective calculation. Patient demographics, sex, socioeconomic characteristics, and clinical covariates were unavailable (Supplementary Tables S1–S2).

Data extraction and provenance

We retained each published row and its pilot designation, without register linkage, imputation, sampling weights, or national expansion. Panel sums used these rows alone; broader hospitalization totals were excluded to avoid double counting. Separate provider-count, monthly-pack, and annual-sales-value datasets were compared by calendar period without record linkage. Numerical checks addressed transcription and calculation, not clinical validity. Underlying claims, medical charts, and validation of the combined five-code definition were unavailable. Selection during follow-up may favor providers remaining active or using multiple techniques; fixed membership does not remove this bias.

Published NFZ-derived provider aggregates were reused from Table 27 of the AOTMiT report DMiOSZ.4100.3.2026 (Warsaw, July 2026), with attribution to AOTMiT and the underlying NFZ reporting data [12]. Source counts were retained as published; panel aggregations,

calculations, statistical analyses and graphical presentations are the authors' own processing and interpretation. This secondary analysis does not imply endorsement by AOTMiT or NFZ.

Program timetable

Regulations, amendments and National Health Fund reports were used to distinguish operative deadlines from the end of the overall care stage [4,5,6,7,13,14,15]. The preceding operative deadline was 31 December 2023. An amendment effective on 26 June 2024 allowed surgery through 30 June 2025, with the care stage continuing through 30 June 2026 [7,15,16]. The intervening 1 January–25 June 2024 interval comprised 177 days.

These were legal dates, not observed center-specific suspension or restart dates. Standard surgery remained available outside the pilot; annual counts could not isolate the affected months. Likewise, 2025 combined periods before and after the final operative deadline. Supplementary Table S3 provides the chronology.

Drug-sales measures and contextual sources

Sales were assessed at market level without separating indications. PEX-derived monthly semaglutide packs covered January 2021–May 2024 [17], giving two complete years overlapping the panel: 2022 and 2023. Separate PEX/OSOZ reports supplied nominal retail sales values for semaglutide and tirzepatide in 2024 and 2025; 2025 values were rounded [18,19]. Packs and monetary values were analyzed separately. Neither identifies treated patients, and the selected substances do not comprise the entire incretin market. Incomplete 2024 pack data were not annualized.

Public reports permit reproduction of panel counts and comparisons. Non-public attachments and national F14 hospitalization totals were not inputs. Sales values were checked against source images and outputs; this was not blinded duplicate extraction by two human reviewers.

Analysis

The principal outcome was absolute and percentage change in panel procedures from 2023 to 2024, decomposed by center group, with adjacent changes for context. Aggregate changes were descriptive; no model-based test of total volume or causal program effect was performed.

Four exploratory two-sided tests used the center as the unit: exact Wilcoxon rank-sum tests compared percentage-change distributions between pilot and other centers for 2023–2024 and 2024–2025; exact sign tests compared increase and decrease directions within pilot centers, excluding unchanged centers. Holm adjustment covered all four tests at a 0.05 threshold. We report medians, interquartile ranges, directions and rank-based effect measures. Centers receive equal weight in these tests, whereas aggregate changes reflect procedure volumes. Analyses were selected after data inspection and were not preregistered. Further details, including nominal confidence intervals, are provided in the supplementary appendix.

Descriptive sensitivity analyses excluded the two zero-baseline centers and omitted each center in turn; percentage changes from zero were undefined. Four annual observations and heterogeneous sales measures did not support causal policy models or sales regressions. SAS 9.4 M9 results were independently checked in Python; figures and tables use verified exports.

The supplement includes the retrospective analytical specification and additional extraction details. OpenAI Codex assisted computational checks; these do not replace human source-data verification.

Results

Overall panel activity

The 30 centers reported 5 515 procedures in 2022, 7 667 in 2023, 6 735 in 2024 and 7 455 in 2025 (Table 1; Figure 1). The principal 2023–2024 comparison showed a reduction of 932

procedures, or 12.2%. Nineteen centers recorded decreases, ten increases and one no change. The median center-level change was −8.7% (interquartile range, −26.1% to +6.8%).

Panel volume increased by 720 procedures (+10.7%) in 2025. This represented a partial recovery: volume remained 212 procedures (2.8%) below 2023. The 2022–2023 increase had been 39.0%, demonstrating that the four-year trajectory was not a steady decline.

Distribution between pilot and other centers

The 2024 reduction comprised 1 023 fewer procedures in pilot centers, from 5 777 to 4 754 (−17.7%), and 91 additional procedures in other centers, from 1 890 to 1 981 (+4.8%). Fourteen pilot centers decreased, four increased and one was unchanged. Among other centers, five decreased and six increased (Table 2).

Median percentage changes were −25.3% in pilot centers and +1.2% in other centers. Their rank distributions differed (exact p=0.0028; Holm-adjusted p=0.0112). In 82.3% of the 209 cross-group center pairs, the pilot center had the lower percentage change. These pairs describe an effect measure; they are not independent observations. The sign test within pilot centers had an unadjusted p=0.0309 and adjusted p=0.0927 (Table 3).

From 2024 to 2025, summed volume rose by 12.9% in pilot centers and 5.4% in other centers. The between-group rank comparison was not statistically significant (adjusted p=0.7348); this did not demonstrate equivalence. Earlier, from 2022 to 2023, summed volume had increased by 25.7% and 105.4%, respectively, indicating substantial differences in prior growth. Center-level changes are displayed in Supplementary Figure S1.

Drug market and sensitivity analyses

Semaglutide sales increased from 820 673 packs in 2022 to 2 094 328 in 2023. The combined nominal retail sales value of semaglutide and tirzepatide increased from PLN 1 375 642 187 in

2024 to approximately PLN 3 056 000 000 in 2025 (Table 4; Figure 2). Thus, both complete-year comparisons available within the panel period showed increasing sales alongside increasing panel procedure counts. The available sales series did not support a continuous, consistently measured four-year exposure–outcome analysis.

Excluding the two centers with zero activity in 2022 retained a 13.6% panel decline in 2024 and a 9.0% increase in 2025. However, the remaining nine non-pilot centers had a 2.8% decline in 2025 rather than the 5.4% increase observed across all 11 non-pilot centers. When individual centers were omitted in turn, the 2024 decline ranged from 10.5% to 13.5% and the 2025 increase from 8.0% to 12.2%. Direction of the overall changes was therefore not dependent on a single center (Supplementary Table S4).

Discussion

In this selected panel of 30 Polish centers, publicly funded bariatric procedure volume fell by 12.2% in 2024 and increased by 10.7% in 2025. The decline was concentrated in centers participating in the coordinated-care pilot, whereas other centers recorded a modest increase. Its timing coincided with the interval outside the pilot's operative timetable. Both available complete-year comparisons of drug sales showed pharmaceutical expansion alongside increasing panel procedure counts. These findings support examining care organization when interpreting surgical trends, without separating the independent effects of program policy and pharmacotherapy.

Program continuity and surgical activity

The concentration of the 2024 decline in pilot centers is compatible with disruption to pilot-related pathways. Operative deadlines might affect preparation, referral, scheduling or reimbursement, but these mechanisms were unmeasured. Legal dates do not establish center-

specific suspension or restart, and standard reimbursement remained available. The additional 91 procedures in other centers did not offset the reduction of 1 023 in pilot centers; patient migration and changes outside the panel or in self-funded care were unobserved [20].

The 2025 increase cannot establish restoration of the volume expected without timetable changes. Consultation records, the later AOTMiT recommendation and ongoing work on routine coverage represent distinct policy stages, rather than proof of implementation during the observation period [21,22,23]. Unequal prior growth and provider selection during follow-up also prevent treating other centers as an untreated control. Earlier Polish studies address historical development and pandemic disruption, rather than this program transition [24,25].

Pharmaceutical expansion and interpretation of surgery trends

The corrected analysis by Lin and colleagues reported an 8.7% reduction in surgical utilization between the second halves of 2022 and 2023 alongside increasing GLP-1 prescribing [1,2]; subsequent research extended observation through 2025 [3]. Our selected provider counts differ from rates in insured or clinically eligible populations in denominators, financing and observation periods, precluding direct comparison of treatment responses.

Expanding pharmaceutical sales were not accompanied by a sustained decline in this panel, but this does not exclude a drug effect. Substitution might be delayed, confined to particular patients or masked by other growth; surgery might have increased more without pharmaceutical expansion. Patient-level treatment histories and an adequate counterfactual are needed to distinguish these explanations.

Sales measures describe market context rather than exposure among surgical candidates. Complete-year pack counts cover 2022–2023, while sales values cover 2024–2025; the incomplete 2024 pack series cannot bridge these measures. Monetary growth reflects prices and

product mix as well as quantities, and packs do not identify unique patients, equivalent doses or treatment duration. Reports combine indications and omit some incretin molecules. A continuous exposure series or lagged dose–response relationship therefore cannot be inferred.

Relevance for European health services

The 2025 Polish expert consensus places surgery within multidisciplinary obesity care and addresses pharmacotherapy as an adjunct or alternative [26]. This provides clinical context for evaluating surgical provision during pharmaceutical expansion, without establishing the effects of KOS-BAR timetable changes. For European services, distinct deadlines for surgery and follow-up illustrate why program status alone might not capture changes in delivery.

Evaluation requires monthly activity, referrals, waiting lists, and prescribing data where feasible. Our data measure activity; they cannot establish unmet need, provider migration, or whether an extension would have prevented the decline.

Strengths and limitations

This fixed-panel analysis complements the 2023 survey of 54 centers [8]. Different selection and unverified provider concordance preclude claiming independent replication or a revised national estimate.

Complete annual observations, regulatory sources, and reproducible analyses support description of this panel. All four exploratory tests and their multiplicity adjustment are reported.

Selection using activity and techniques during follow-up precludes national extrapolation and might omit providers with different trajectories. Only four annual time points are available: 120 provider-year records do not resolve the 177-day interval or separate concurrent policy and pharmaceutical changes. Unequal prior growth further limits between-group interpretation.

Published procedure totals could not be validated against individual clinical records and do not identify unique patients. Provider aggregates might combine locations; demographics, case mix, referrals, waiting times and private activity were unavailable. Historical pilot participation does not establish continuous exposure or individual reimbursement routes. Sales measures are ecological and heterogeneous. Post-inspection analysis, exact testing and Holm adjustment do not remove confounding or dependence from shared system changes.

Conclusion

Bariatric procedure volume in this selected panel declined in 2024, principally in pilot centers, and partially recovered in 2025. Expanding incretin sales were not accompanied by a sustained decline in panel volume. Care-delivery arrangements deserve consideration when interpreting surgical trends, while the independent effects of policy and pharmacotherapy remain unresolved.

Funding

The study was self-funded by an author and received no external funding. No external funder participated in study design, data collection, analysis, interpretation, manuscript preparation, or the decision to submit.

Use of Artificial Intelligence

OpenAI Codex assisted English drafting and revision, literature and reference checks, data-extraction checks, analysis and plotting code, and computational cross-checks. Statistical analyses were executed in SAS and checked in Python; figures were generated with reproducible code. The authors reviewed the outputs and retain responsibility for final content and underlying-data verification.

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Tables

Table 1 Annual reported procedures in the fixed center panel

Year	All 30 centers	Changes from the previous year, %	Pilot centers (n=19)	Other centers (n=11)
2022	5 515	—	4 595	920
2023	7 667	+39.0	5 777	1 890
2024	6 735	-12.2	4 754	1 981
2025	7 455	+10.7	5 368	2 087

Pilot refers to historical center participation, not the reimbursement route of each procedure. Counts include the five selected ICD-9 codes among adults. Source: Polish health technology assessment report [12].

Table 2 Distribution of percentage changes across centers

Transition	Group	Median change, % (IQR)	Decrease / unchanged / increase
2023–2024	All	-8.7 (-26.1 to +6.8)	19 / 1 / 10
2023–2024	Pilot	-25.3 (-35.9 to -3.4)	14 / 1 / 4
2023–2024	Other	+1.2 (-6.0 to +24.0)	5 / 0 / 6
2024–2025	All	+7.9 (-15.1 to +27.9)	11 / 0 / 19
2024–2025	Pilot	+6.4 (-10.1 to +31.2)	6 / 0 / 13
2024–2025	Other	+9.3 (-17.4 to +17.3)	5 / 0 / 6

IQR, interquartile range. Center-level medians are not percentage changes in the summed volume. All 30 centers had positive denominators for these transitions. Quantiles use linear interpolation (type 7).

Table 3 Exploratory statistical comparisons

Comparison	Exact two-sided p	Holm-adjusted p
Between groups, 2023–2024	0.0028	0.0112
Between groups, 2024–2025	0.7348	0.7348
Direction within pilot, 2023–2024	0.0309	0.0927
Direction within pilot, 2024–2025	0.1671	0.3341

Between-group comparisons use exact Wilcoxon rank-sum tests; within-pilot comparisons use exact sign tests, excluding unchanged centers. Holm adjustment covers all four tests. These p values do not test the change in the total panel count or establish program causality.

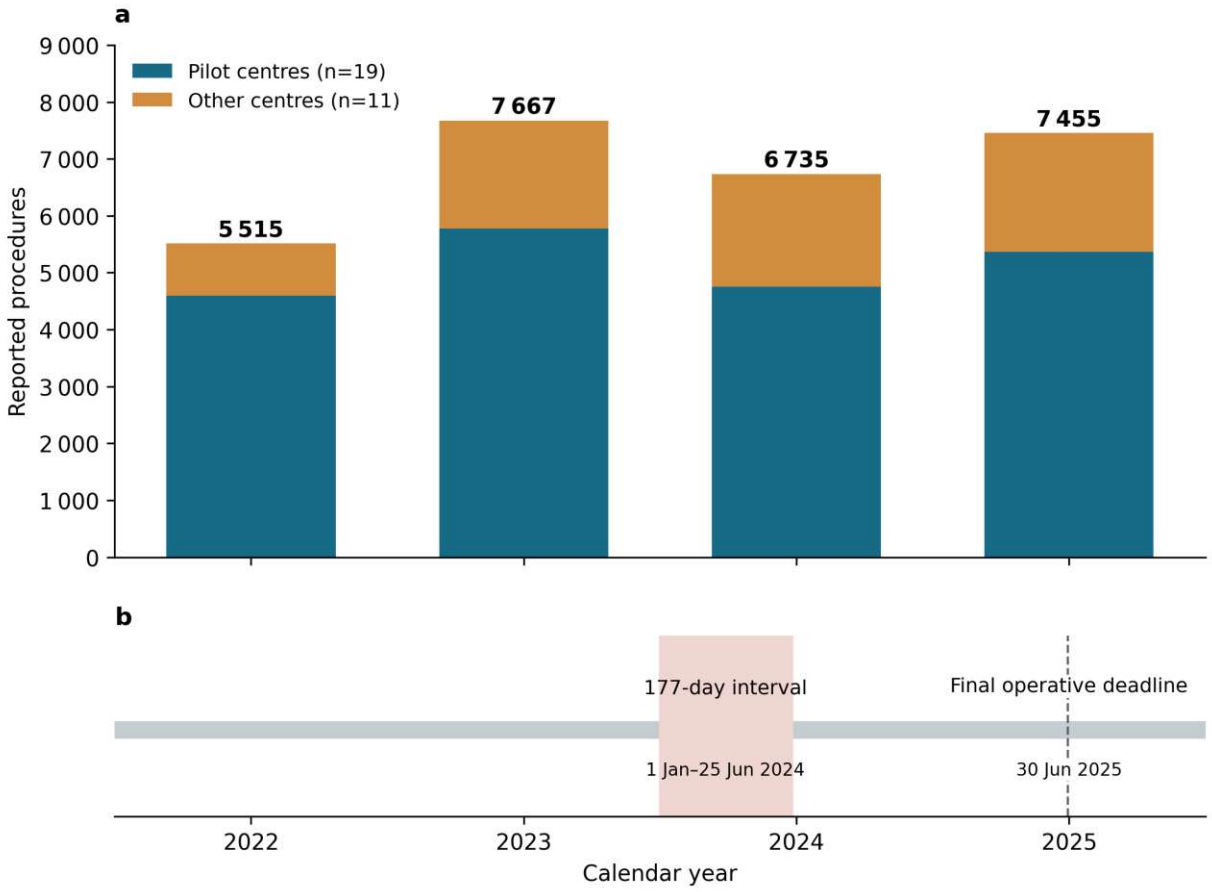
Table 4 Available comparable annual drug-sales measures

Measure	Earlier year	Later year	Change, %
Semaglutide packs	2022: 820 673	2023: 2 094 328	+155.2
Semaglutide sales, PLN million	2024: 862.295	2025: ≈1 454	+68.6
Tirzepatide sales, PLN million	2024: 513.348	2025: ≈1 602	+212.1
Combined sales, PLN million	2024: 1 375.642	2025: ≈3 056	+122.2

Nominal retail values; no inflation or price adjustment. The 2025 values were rounded in the source. Packs and sales values are separate measures and cannot be combined into a continuous exposure series. Sources: PEX-derived reports [17,18,19].

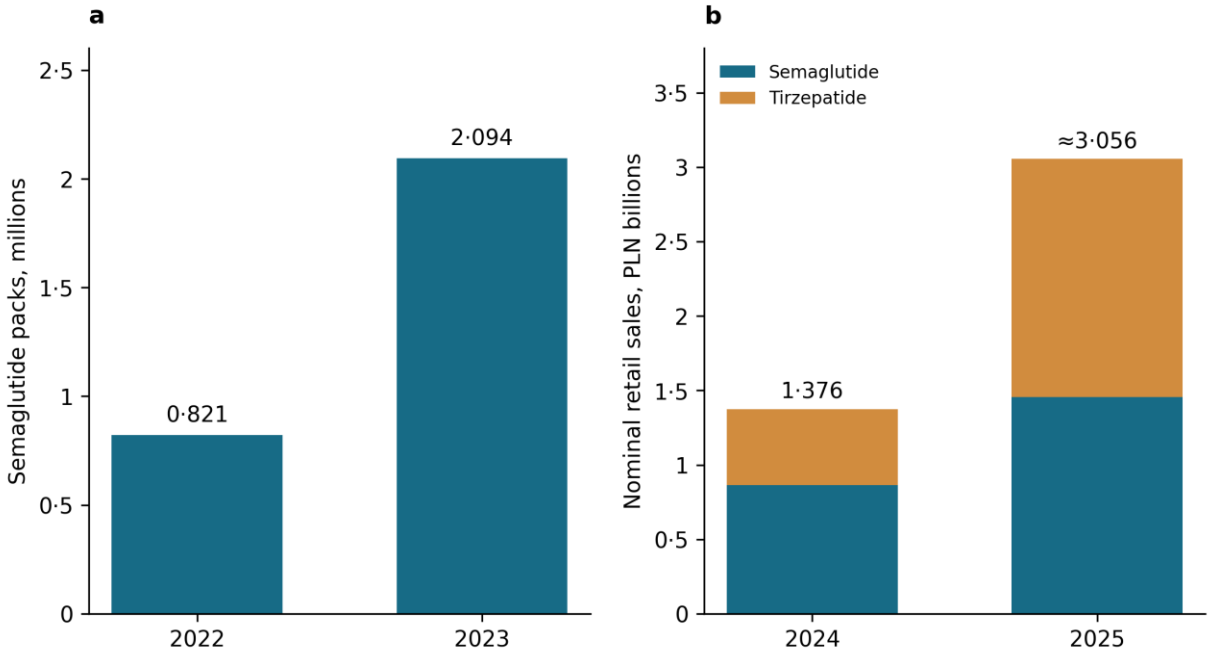
Figure legends

Figure 1 Procedure volumes and program timetable



Annual reported bariatric procedures in the fixed panel of 30 centers, grouped by historical participation in KOS-BAR. Stacked segments describe center groups, not reimbursement routes. The lower panel shows the interval outside the pilot's operative timetable from 1 January to 25 June 2024 and the final operative deadline of 30 June 2025. These dates do not establish cessation of standard surgical reimbursement or center-specific suspension dates. The timeline is contextual; monthly procedure counts are unavailable.

Figure 2 Available complete-year incretin sales measures



Panel a shows semaglutide packs in 2022 and 2023. Panel b shows nominal retail sales values of semaglutide and tirzepatide in 2024 and 2025. The two panels have different units and are not a continuous four-year exposure series. Values for 2025 are rounded at source. Sales include the indications and products covered by the reports and do not identify treatment exposure among surgical candidates. Sources: PEX-derived reports [17,18,19].

Supplementary Files

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- SupplementObesitySurgeryPortal.docx