



**Operational Excellence 5.0 and the Sustainable
Development Goals: Lessons from Lean Healthcare and
Palliative Care in Brazil**

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Table 1. Analytical approach to Operational Excellence 5.0: dimensions, mechanisms, and indicators

Operational Excellence 5.0 dimension	Intervention mechanisms	Observed indicators
Flow efficiency	Care pathway redesign; standard work; reduction of low-value steps; coordination across hospital units	Length of stay in ICU, intermediate units, and wards; interrupted time series parameters (level and slope)
Human-centred proportionality	Palliative eligibility governance; goals-of-care discussions; de-escalation protocols for non-beneficial interventions	Location of death across care settings; overall mortality trends; volume of hospital medical visits
Sustainability / resource stewardship	Criteria for appropriateness of care setting; prioritization of proportional use of high-intensity beds	Length of stay in high-intensity units; distribution of deaths across care settings
Resilience and maintenance capacity	Multidisciplinary committee governance; protocolization; staff training and routine monitoring	Post-intervention trend behavior in interrupted time series; temporal stability of observed indicators

Legend. The table summarizes how the four dimensions of Operational Excellence 5.0 were operationalized in the case study, linking intervention mechanisms to measurable hospital performance indicators. Source: The authors (2026).

Table 2. Summary statistics of service performance and clinical outcomes before and after palliative care protocol standardization

Variable	Pre (Mean ± SD) (n=17)	Post (Mean ± SD) (n=19)	p (t-test)
Medical Visits	13715 ± 1802	17402.11 ± 1277	<0.0001
Los ICU IU	7.09 ± 1.96	5.48 ± 1.01	0.0055
Los Ward	5.58 ± 0.70	5.00 ± 0.51	0.0088
Deaths ED	9.12 ± 6.29	6.42 ± 2.01	0.1072
Deaths IU	9.29 ± 2.87	6.74 ± 2.64	0.0091
Deaths ICU	8.41 ± 2.94	8.21 ± 2.64	0.8309
Deaths Ward	10.53 ± 5.34	17.53 ± 4.88	0.0003
Total Deaths	35.76 ± 7.10	38.24 ± 7.15	0.3033

Legend. Values are mean ± standard deviation. P-values from Welch's t-test (two- sided) comparing Pre vs. Post. Source: The authors (2025)

Notes. Pre = period before November 2023; Post = period after November 2023 (formalization of palliative care protocols).

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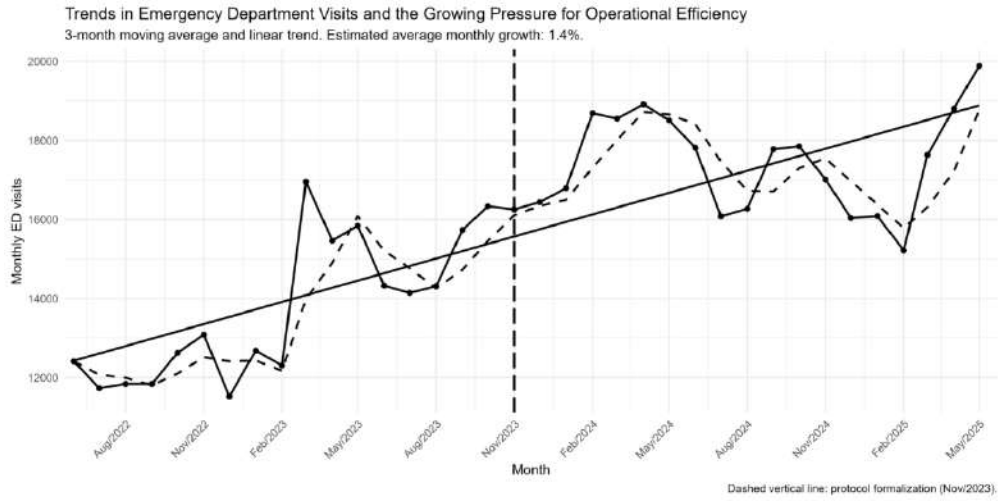


Chart 1. Trend analysis of the number of medical visits. Source: The authors (2025)

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Table 3. Interrupted time series segmented regression for length of stay (LOS)

Sector	Term	Estimate	SE (robust)	95% CI	p-value
LOS ICU/IU (days)	Level at baseline	6.468	0.991	[4.525; 8.411]	<0.0001
LOS ICU/IU (days)	Pre-intervention trend (slope)	0.070	0.107	[-0.140; 0.279]	0.5192
LOS ICU/IU (days)	Immediate level change (step)	-1.714	1.081	[-3.833; 0.405]	0.1227
LOS ICU/IU (days)	Post-intervention slope change	-0.115	0.112	[-0.336; 0.105]	0.3121
LOS Ward (days)	Level at baseline	4.703	0.158	[4.393; 5.013]	<0.0001
LOS Ward (days)	Pre-intervention trend (slope)	0.097	0.024	[0.051; 0.143]	0.0002
LOS Ward (days)	Immediate level change (step)	-0.974	0.392	[-1.743; -0.205]	0.0185
LOS Ward (days)	Post-intervention slope change	-0.135	0.039	[-0.212; -0.058]	0.0017

Legend. Coefficients from segmented regression with robust (HC1) standard errors: level at baseline, pre-intervention slope, immediate level change at the intervention, and post-intervention slope change. Source: The authors (2026).

Notes. Intervention cutoff at Nov/2023. Outcome = average length of stay (days).

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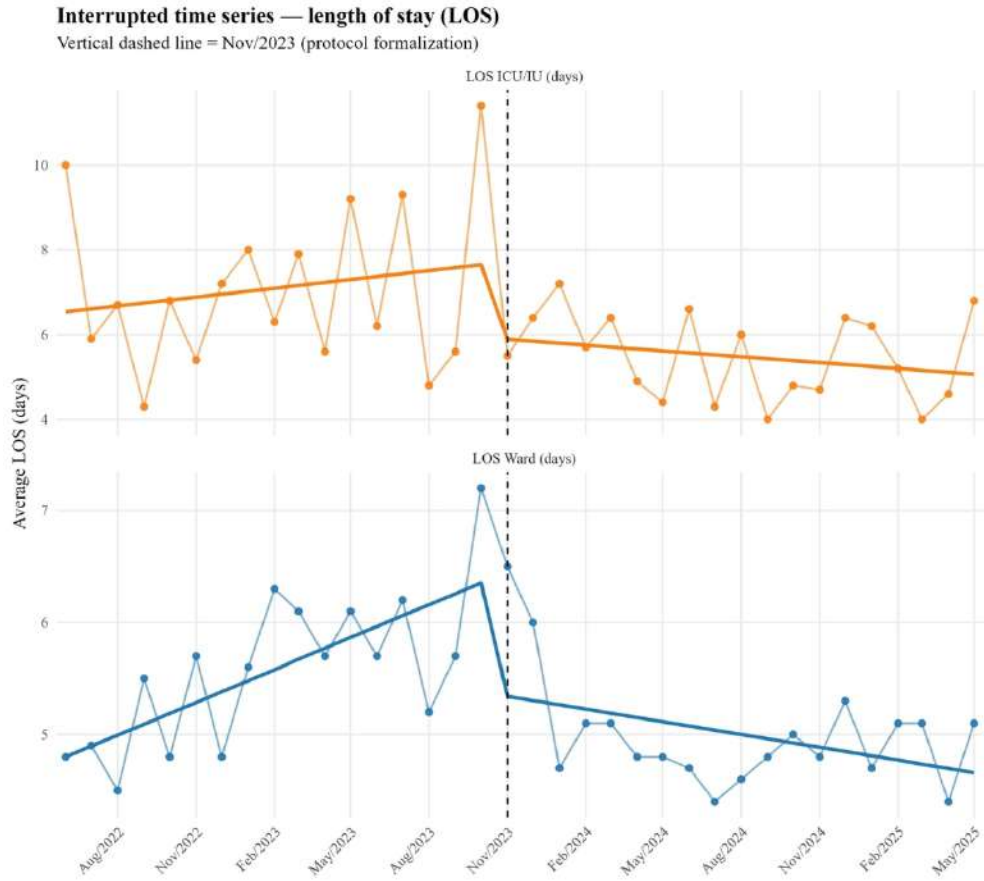


Chart 2. Interrupted time series of Length of Stay data. Source: The authors (2025).

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Table 4. Interrupted time series segmented regression by sector and total.

Sector	Term	Estimate	SE (robust)	95% CI	p-value
ED	Level at baseline	16.949	2.040	[12.951; 20.946]	<0.0001
ED	Pre-intervention trend (slope)	-0.870	0.186	[-1.234; -0.506]	<0.0001
ED	Immediate level change (step)	4.457	1.952	[0.631; 8.283]	0.0292
ED	Post-intervention slope change	0.851	0.207	[0.445; 1.257]	0.0003
IU	Level at baseline	9.162	1.245	[6.721; 11.602]	<0.0001
IU	Pre-intervention trend (slope)	0.015	0.127	[-0.234; 0.263]	0.9084
IU	Immediate level change (step)	-3.798	1.598	[-6.930; -0.665]	0.0236
IU	Post-intervention slope change	0.098	0.161	[-0.219; 0.414]	0.5494
ICU	Level at baseline	9.426	1.589	[6.312; 12.541]	<0.0001
ICU	Pre-intervention trend (slope)	-0.113	0.127	[-0.361; 0.136]	0.3806
ICU	Immediate level change (step)	1.262	1.506	[-1.690; 4.214]	0.4083
ICU	Post-intervention slope change	0.057	0.154	[-0.246; 0.359]	0.7164
Ward	Level at baseline	5.324	1.459	[2.463; 8.184]	0.0009
Ward	Pre-intervention trend (slope)	0.578	0.159	[0.267; 0.890]	0.0010
Ward	Immediate level change (step)	0.633	2.472	[-4.213; 5.478]	0.7997
Ward	Post-intervention slope change	-0.405	0.213	[-0.823; 0.013]	0.0668
Total	Level at baseline	40.860	3.988	[33.044; 48.677]	<0.0001
Total	Pre-intervention trend (slope)	-0.390	0.382	[-1.139; 0.360]	0.3158
Total	Immediate level change (step)	2.554	5.208	[-7.654; 12.762]	0.6272
Total	Post-intervention slope change	0.600	0.425	[-0.232; 1.433]	0.1673

Legend. Coefficients from segmented regression with robust (HC1) standard errors: level at baseline, pre-intervention slope, immediate level change at the intervention, and post-intervention slope change. Source: The authors (2025).

Notes. Intervention cutoff at Nov/2023. Outcome = deaths per month.

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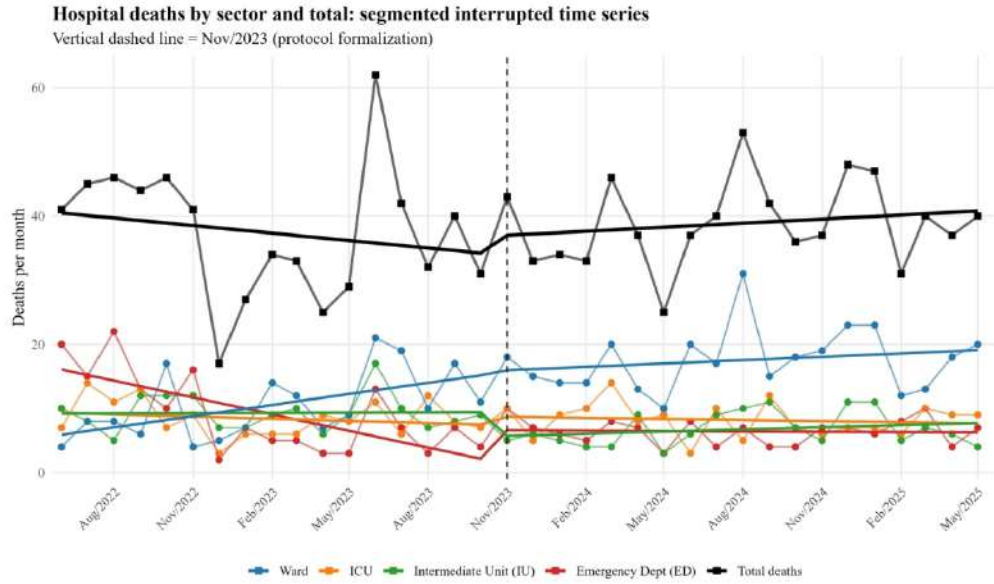


Chart 3. Interrupted time series of Hospital deaths by sector and total. Source: The authors (2025).

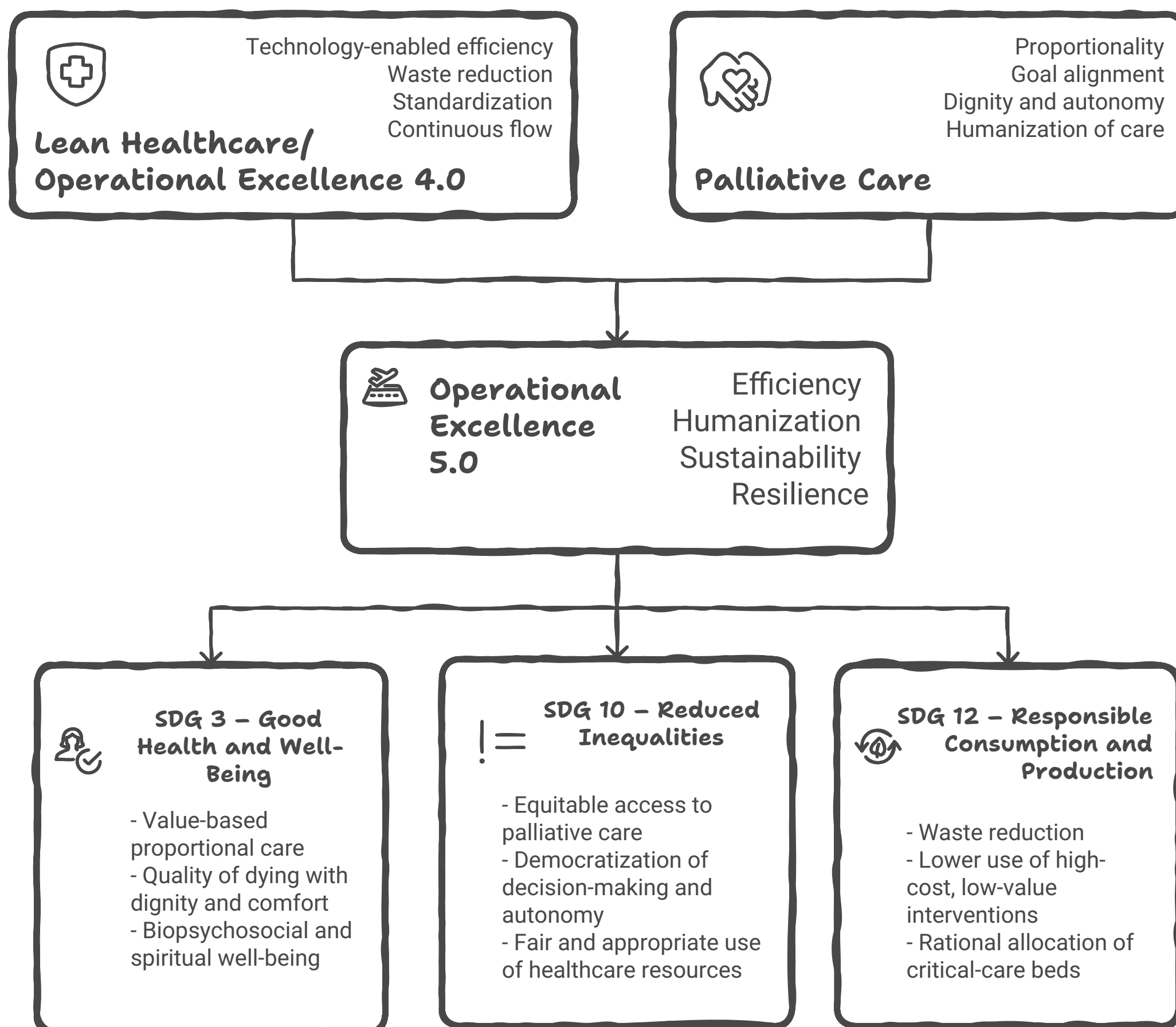
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Table 5. Quantitative findings across the dimensions of Operational Excellence 5.0

Operational Excellence 5.0 dimension	Observed quantitative results
Flow efficiency	Monthly medical visits increased by 26.9% (13,715 → 17,402), while average length of stay decreased in ICU/IU (7.09 → 5.48 days; $p = 0.0055$) and ward settings (5.58 → 5.00 days; $p = 0.0088$). Interrupted Time Series analysis identified a significant immediate reduction in ward LOS (-0.97 day) followed by a sustained downward trend (-0.135 day/month), indicating improved throughput.
Human-centred proportionality	End-of-life care shifted toward the ward (10.53 → 17.53 deaths/month; $p < 0.001$, Welch's t-test), with no significant change in total hospital deaths over time (ITS $p = 0.3033$). This redistribution reflects adjustment of care intensity according to therapeutic goals without expansion in overall death volume.
Sustainability / resource stewardship	Reductions in ward LOS (ITS significant) and intermediate unit deaths (9.29 → 6.74; $p = 0.0091$) indicate decreased reliance on higher-complexity resources at end of life. These changes occurred without increase in total deaths, suggesting more proportionate use of critical-care capacity.
Resilience and maintenance capacity	Despite a 26.9% increase in service demand, ward LOS showed sustained structural reduction (-0.97 immediate; -0.135/month), while total hospital deaths remained statistically stable (ITS $p = 0.3033$), demonstrating maintained system performance under increased pressure.

Legend. The table consolidates the main quantitative findings across the four dimensions of Operational Excellence 5.0, linking statistical results (Welch's t-test and Interrupted Time Series) to operational and clinical performance outcomes. Source: The authors (2026).

Conceptual Integration



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