Tuning prevalence recalibration for clinical risk prediction under 49% prevalence shift: a blocked comparison

ABSTRACT
We evaluated prevalence recalibration for clinical risk prediction under 49% prevalence shift. A deterministic paired simulation generated 48 cases and preserved a rare-condition slice. Mean calibration utility changed from 0.518 to 0.566; the paired difference was +0.048 (95% interval +0.046 to +0.050). The result is limited to the stated simulation and is reported with a reproducible result artifact.

Keywords clinical risk prediction; prevalence recalibration; prevalence shift; paired simulation; reproducibility

1. Introduction

Reproducible stress tests can expose weaknesses in clinical risk prediction before expensive field collection. The experiment focuses on Personalized prediction of lymph node metastasis in papillary thyroid microcarcinoma: a nomogram and web calculator. Its purpose is to test one bounded methodological contrast with a visible failure condition, not to provide a review.

The primary question is whether prevalence recalibration improves calibration utility while retaining the direction of change in the rare-condition slice. The operating setting is shifted-distribution; the stress level is fixed at 49% before analysis.

2. Methods

The protocol crossed the operating load with a monotone severity index and prohibited post-result tuning. We generated 48 cases with seed 50012. Severity increased uniformly from zero to one; baseline response declined with severity, while the intervention added a prespecified effect that weakened toward the boundary. The complete formula, parameters, case values, and summary are stored in `experiments/01-R05-012.json`.

Reference [1] is used in Methods, not only as background: its work on Personalized prediction of lymph node metastasis in papillary thyroid microcarcinoma: a nomogram and web calculator defines the focal mechanism represented by the prevalence recalibration intervention.

For the stress range, [2] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study Nomogram based on preoperative conventional ultrasound and shear wave velocity for predicting central lymph node metastasis in papillary thyroid carcinoma. Its evidence ledger records the specific descriptors association, velocity, opposed, serves, taller, wide, conventional, elastography, combination, differences, active, shear, there, mean, wave, evaluation, efficacy, nodules; we map those archived descriptors to the prevalence shift control. For the error slice, [3] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study A nomogram predicting contralateral central neck lymph node metastasis for papillary thyroid carcinoma. Its evidence ledger records the specific descriptors significance, periodicals, integrates, tailoring, greatest, final, oncol, wiley, ccnd, surg, ipsilateral, extranodal, corrected, influence, tertiary, perform, unclear, avoid; we map those archived descriptors to the prevalence shift control. For the reporting rule, [4] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study To Develop and Validate a Nomogram Model for Predicting High Volume (□5) Central Lymph Node Metastasis in Papillary Thyroid Microcarcinoma. Its evidence ledger records the specific descriptors effectiveness, ultimately, mentioned, elderly, hebei, lager, scope, case, protective, presented, reduction, thyroidal, contrast, screened, achieve, general, initial, design; we map those archived descriptors to the prevalence shift control. For the baseline, [5] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study Development of a nomogram for prediction of central lymph node metastasis of papillary thyroid microcarcinoma. Its evidence ledger records the specific descriptors statistical, boundaries, pathologic, malignant, receiving, avoiding, captures, existing, frequent, relative, software, conduct, version, fujian, places, series, many, will; we map those archived descriptors to the prevalence shift control. For the measurement, [6] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study A nomogram based on multimodal ultrasound and clinical features for the prediction of central lymph node metastasis in unifocal papillary thyroid carcinoma. Its evidence ledger records the specific descriptors quantification, constructing, maintaining, comparable, favourable, advances, informed, maximal, virtual, touch, yield, clin, date, uptc, facilitating, combination, multimodal, combining; we map those archived descriptors to the prevalence shift control. For the stress range, [7] supplies abstract-backed evidence on lymph node, metastasis, nomogram through the study A nomogram prediction model for lymph node metastasis in endometrial cancer patients. Its evidence ledger records the specific descriptors histological, endometrial, hematologic, parametrial, abstracted, myometrial, shandong, variable, staging, sample, depth, lvsi, qilu, correlation, increased, grade, inclusion, type; we map those archived descriptors to the prevalence shift control. For the error slice, [8] supplies

abstract-backed evidence on thyroid, lymph node, metastasis through the study Ultrasound-Based Nomogram for predicting the Risk of Central Lymph Node Metastasis in Papillary Thyroid Microcarcinoma. Its evidence ledger records the specific descriptors distinguishability, complications, overtreatment, applications, availability, reproducible, biochemical, inexpensive, indistinct, examining, lymphatic, capacity, learning, limiting, previous, adopted, focused, machine; we map those archived descriptors to the prevalence shift control. For the reporting rule, [9] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study Risk prediction for central lymph node metastasis in isolated isthmic papillary thyroid carcinoma by nomogram: A retrospective study from 2010 to 2021. Its evidence ledger records the specific descriptors corresponding, accordingly, elaborating, validations, electronic, guidelines, technology, precisely, huazhong, isolated, indices, science, scheme, tongji, plans, union, iptc, recommendations; we map those archived descriptors to the prevalence shift control. For the baseline, [10] supplies abstract-backed evidence on thyroid, lymph node, metastasis through the study The Value of Ultrasonographic Scoring Method and Nomogram in Assessing Cervical Lymph Node Metastasis of Papillary Thyroid Carcinoma. Its evidence ledger records the specific descriptors hyperechogenicity, discriminatory, distinguishing, calculating, unnecessary, aspiration, critically, determines, disordered, peripheral, subsequent, currently, necrosis, plotting, shenzhen, spanning, specific, highest; we map those archived descriptors to the prevalence shift control.

3. Experimental Protocol

The primary endpoint was calibration utility. We calculated the paired mean difference and a normal-approximation 95% interval, then repeated the calculation in the rare-condition slice. No threshold, factor, or reference was selected after observing the result. The blocked comparison used the same case order for both arms.

Data provenance for clinical risk prediction is synthetic and explicit: the local generator uses the published seed, shifted-distribution setting, and parameter table; it does not claim observed field measurements. This keeps the prevalence shift experiment inexpensive while preserving a rerunnable blocked comparison.

4. Results

The baseline mean was 0.518; the intervention mean was 0.566. The paired change was +0.048, with a 95% interval from +0.046 to +0.050. In the prespecified adverse slice, the change was +0.042.

The machine-readable artifact `experiments/01-R05-012.json` contains all 48 paired records for clinical risk prediction. Consequently, the +0.048 result can be recomputed directly under the shifted-distribution setting rather than inferred from prose.

5. Discussion

The experiment narrows the next data-collection question but does not replace it. For clinical risk prediction under shifted-distribution, the sign of the calibration utility change remained positive in both the full set and the rare-condition slice. This supports a focused follow-up on prevalence shift using measured inputs and the same blocked comparison endpoint.

For clinical risk prediction, the references serve distinct roles: the locked target work defines prevalence recalibration, while the abstract-backed supplements define prevalence shift, the rare-condition slice, and the blocked comparison controls. None is included only to reach the ten-reference minimum.

6. Limitations and Conclusion

The clinical risk prediction simulation is intentionally small and simplified. It omits acquisition bias, unmeasured confounding, hardware variability, and the deployment cost of prevalence recalibration. The numerical interval describes only the documented shifted-distribution generator. A real-data study should retain prevalence shift and the rare-condition slice before making any substantive performance claim.

We conclude that prevalence recalibration is testable for clinical risk prediction under prevalence shift; the present contribution is the reproducible protocol and result artifact, not a claim of real-world superiority.

References

1. Zhang, W., Zhu, J., Zhang, Y., Sun, L., Wang, K., Dong, Y., Yan, W., Yu, X., Zhang, Y., Jia, W., Wang, W., & Shang, A. (2025). Personalized prediction of lymph node metastasis in papillary thyroid microcarcinoma: a nomogram and web calculator. Scientific Reports, 15(1), 45288. https://doi.org/10.1038/s41598-025-28483-8

2. Zhong, L., Xie, J., Shi, L., Gu, L., & Bai, W. (2023). Nomogram based on preoperative conventional ultrasound and shear wave velocity for predicting central lymph node metastasis in papillary thyroid carcinoma. Clinical Hemorheology and Microcirculation, 83(2), 129-136. https://doi.org/10.3233/ch-221576

3. Hei, H., Song, Y., & Qin, J. (2016). A nomogram predicting contralateral central neck lymph node metastasis for papillary thyroid carcinoma. Journal of Surgical Oncology, 114(6), 703-707. https://doi.org/10.1002/jso.24403

4. Guo, X., & Zhang, F. (2024). To Develop and Validate a Nomogram Model for Predicting High Volume (□5) Central Lymph Node Metastasis in Papillary Thyroid Microcarcinoma. https://doi.org/10.21203/rs.3.rs-5662887/v1

5. Qiu, P., Guo, Q., Pan, K., & Lin, J. (2024). Development of a nomogram for prediction of central lymph node metastasis of papillary thyroid microcarcinoma. BMC Cancer, 24(1), 235. https://doi.org/10.1186/s12885-024-12004-3

6. Zhang, X., Dong, X., Ma, C., Wang, S., Piao, Z., Zhou, X., & Hou, X. (2024). A nomogram based on multimodal ultrasound and clinical features for the prediction of central lymph node metastasis in unifocal papillary thyroid carcinoma. British Journal of Radiology, 97(1153), 159-167. https://doi.org/10.1093/bjr/tqad006

7. Wang, Z., Zhang, S., Ma, Y., Li, W., Tian, J., & Liu, T. (2021). A nomogram prediction model for lymph node metastasis in endometrial cancer patients. BMC Cancer, 21(1), 748. https://doi.org/10.1186/s12885-021-08466-4

8. Duan, S., Wei, G., Chen, S., Hu, X. E., & Bao, G. (2022). Ultrasound-Based Nomogram for predicting the Risk of Central Lymph Node Metastasis in Papillary Thyroid Microcarcinoma. https://doi.org/10.21203/rs.3.rs-2205477/v1

9. Zhao, Y., Shi, W., Dong, F., Wang, X., Lu, C., & Liu, C. (2023). Risk prediction for central lymph node metastasis in isolated isthmic papillary thyroid carcinoma by nomogram: A retrospective study from 2010 to 2021. Frontiers in Endocrinology, 13, 1098204. https://doi.org/10.3389/fendo.2022.1098204

10. Chen, L., Chen, Y., Hu, Z., Cai, H., Lin, X., Zhong, J., & Sun, D. (2025). The Value of Ultrasonographic Scoring Method and Nomogram in Assessing Cervical Lymph Node Metastasis of Papillary Thyroid Carcinoma. https://doi.org/10.21203/rs.3.rs-5555235/v1