The Septoplasty Healthcare Monitor: an outcome assessment infrastructure to enhance the quality and transparency of care

# ABSTRACT

**Objective and design:** The growing demand for transparency about the efficacy of healthcare has accelerated the use of Patient-Reported Outcome Measures (PROMs), but their integration into daily practice is challenging. This observational study describes how the Septoplasty Healthcare Monitor (SHM) addresses these challenges and highlights the benefits of standardized outcome assessments and visualization for various stakeholders, including physicians and patients.

**Main outcome measures:** Since 2014, all eligible septoplasty patients have been included in the SHM. Patients are automatically offered the Nasal Obstruction Symptom Evaluation (NOSE) scale and bilateral Visual Analogue Scales (VAS) to assess nasal obstruction before initial consultation, and during postoperative visits. Data are entered into a preformatted database and automatically analyzed. Real-time results are visually presented on a user-friendly dashboard.

**Results:** A total of 173 patients participated. First, the dashboard provides insights into outcomes on a cohort level. The mean NOSE scores significantly decreased from 68.8 ± 19.0 at baseline to 19.8 ± 22.3 at 12 months. VAS scores improved from 4.6 ± 3.0 (left) and 4.7 ± 2.9 (right) preoperatively to 7.5 ± 2.1 (left) and 7.6 ± 1.7 (right) at 12 months (*p* < 0.001). Second, quality of care is monitored through annual performance metrics, and can be improved by critically appraising auto-identified underperforming patients. Third, visualization of individual PROM symptom-severity scores in relation to peers assists in patient-counseling and shared decision-making.

**Conclusion:** The integration of standardized outcome assessments into daily practice is highly valuable but challenging. The SHM addresses these challenges and offers opportunities to enhance septoplasty care standards.

# Key words

Septoplasty, nasal septum, nasal obstruction, value-based healthcare, patient-reported outcomes, quality of care, quality of life, patient-empowerment.

# Key points

1. The growing demand for transparency about the quality and efficacy of healthcare has accelerated outcome assessment studies and initiatives.
2. The integration of Patient-Reported Outcome Measures (PROMs) into busy ENT practices is progressing slowly because it is believed to be time-consuming without significant additional benefits.
3. Besides transparency, standardized PROM-based outcome assessments such as the Septoplasty Healthcare Monitor (SHM) provide data-driven opportunities to evaluate and enhance the quality of care.
4. Automated healthcare evaluations and visualization empower and engage patients in the shared-decision making process.
5. Even for elective procedures that are considered effective such as septoplasty, the investment in a standardized outcome assessment routine is valuable.

# INTRODUCTION

In recent decades, advances in diagnostic and treatment modalities, alongside increased healthcare demands from rapidly ageing populations, have contributed to escalating costs and resource utilization in healthcare worldwide. Developed countries face the challenge of sustaining an equitable, efficient, affordable, and high-quality healthcare system (1,2). Cost containment is necessary. Consequently, governments, insurance providers, and hospital boards show an increasing interest in evidence supporting the efficacy of delivered healthcare, and promote the assessment of patient centered outcomes (1,3). Simultaneously, patients are more engaged in the quality and efficacy of healthcare. There is a growing demand for transparent, comprehensible data that provide insights into achieved and anticipated outcomes, allowing patients to make informed choices between treatment options and healthcare providers. Regardless of each stakeholder’s motivation, it is evident that for physicians, the ability to assess and report achieved health outcomes is becoming increasingly critical.  
Ideally, outcome assessments are standardized and based on globally accepted, validated outcome instruments that are integrated into routine practice (4). In the field of otorhinolaryngology this integration is progressing slowly because multiple challenges are encountered, such as lack of methodological knowledge, the variety of existing outcome instruments, fear of benchmarking, uncertainty over data ownership, and most importantly the perceived time and effort required to collect and analyze outcome data (5–7).  
To address these challenges, we developed an infrastructure that automatically collects, evaluates and visualizes the quality and efficacy of surgical care, as experienced by consecutive patients with chronic nasal obstruction (CNO). Real-time, patient-reported outcomes are presented visually on a secure, web-based dashboard that is easy to understand by physicians, patients and policymakers. Over the past decade, this effort has resulted in the development of the Rhinoplasty Healthcare Monitor(8,9), the Cleft Care Healthcare Monitor(10), and the Septoplasty Healthcare Monitor (SHM).  
In this paper we describe the design, implementation and 10-year experience in utilizing the SHM. The purpose of this paper is to demonstrate that automatization of standardized outcome assessments into daily practice, allows physicians to provide full transparency regarding the quality and efficacy of septoplasty care. Furthermore, we demonstrate and discuss the data-driven possibilities to further enhance care standards.

# MATERIALS AND METHODS

## Hospital setting and study population

This observational, longitudinal outcome study was conducted at an academic hospital, focusing on patients undergoing (revision) septoplasty. All consecutive patients referred to the last author with a potential indication for septoplasty since April 2014 were included. Septoplasty is offered as part of a shared decision-making process, provided the following criteria are met: 1. symptoms persist despite a six-week trial of intranasal steroid spray; 2. nasal examination findings align with symptoms that septoplasty can address; 3. the patient expresses a clear desire for surgical intervention and understands the procedure, expected outcomes, potential risks, and required aftercare. Patients requiring septorhinoplasty, perforation closure, extracorporeal septal reconstruction, concurrent inferior turbinate surgery, or sinus surgery were excluded.

## Outcome instruments and the data collection process

After referral, all patients receive a digital appointment confirmation via SMS or email, including a hyperlink to a secure digital platform containing the patient-reported outcome measures (PROMs). Patients are asked to complete the questionnaires prior to their consultations. Questionnaire responses are stored and displayed in the electronic patient record (ChipSoft: *HiX software (version 6.2)*). Patients unable to complete the questionnaires at home were asked to do so in the waiting room (**Figure 1**). This process is repeated at 3 and 12 months post-septoplasty. Patients who missed postoperative appointments were contacted to reschedule or complete the questionnaires at home.

The SHM questionnaire set includes two visual analogue scales (VASs) to rate left- and right-sided nasal obstruction on a 0-10 scale (0 = complete obstruction, 10 = clear nose), and the Nasal Obstruction Symptom Evaluation (NOSE) scale. The NOSE scale contains five questions related to nasal obstruction, rated on a five-point Likert scale. Total scores are multiplied by 5, resulting in a range from 0 to 100, with higher scores indicating more severe obstruction (11). The NOSE scale is categorized by symptom severity: none (<5), mild (5–25), moderate (30–50), severe (55–75), or extreme (80–100) (12).



**Fig. 1** A prospective septoplasty patient completes the SHM PROM Questionnaire set in the waiting room (left). Responses are immediately available in the electronic patient record (HiX, version 6.2, ChipSoft) prior to each consultation.

## The Septoplasty Healthcare Monitor Dashboard

Baseline characteristics, such as gender, age, prior septoplasty, and side of the septal deviation, along with SHM PROM questionnaire responses, are recorded in a preformatted SPSS database (*Version 25, IBM Corp., Armonk, NY*). This database is continuously updated with data from prospective patients and follow-up assessments.  
For automated outcome analysis, a custom-built, secure dashboard was developed using Shiny Web Application Framework for R (*R package version 0.13.112*) (13). Surgeons can upload their personal SPSS database at any time. To ensure security and patient privacy, uploaded databases are anonymized, and no data are stored on the server. The dashboard automatically performs statistical analyses, comparing preoperative and postoperative scores using a paired t-test for normally distributed data, or the Wilcoxon signed-rank test for skewed data. A p-value of < 0.05 is considered statistically significant. The dashboard can be used during consultations, providing visual output or easy interpretation by both physicians and patients ([www.healthcaremonitor.nl](http://www.healthcaremonitor.nl)).

## Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and its later amendments up to 2024, and was approved by the Medical Ethics Review Board of the Erasmus Medical Center, Rotterdam; MEC-2022-0614. Informed consent was obtained from all patients.

# RESULTS

## PROM-Assisted Patient Selection for Septoplasty

Before initial consultation, the SHM PROM questionnaires provide information on the severity and laterality of chronic nasal obstruction, aiding in the selection of patients who most likely will benefit from septoplasty. Overall symptom severity is important when discussing a patient’s motivation for surgery. For example, a patient experiencing *mild* symptoms might be content with a thorough nasal evaluation and counseling over immediate elective surgery. Laterality, combined with NOSE scale responses, assist nasal examination. For example, *bilateral* nasal obstruction mainly during *exercise* (VAS scores combined with NOSE scale question 5) hint towards nasal valve insufficiency.

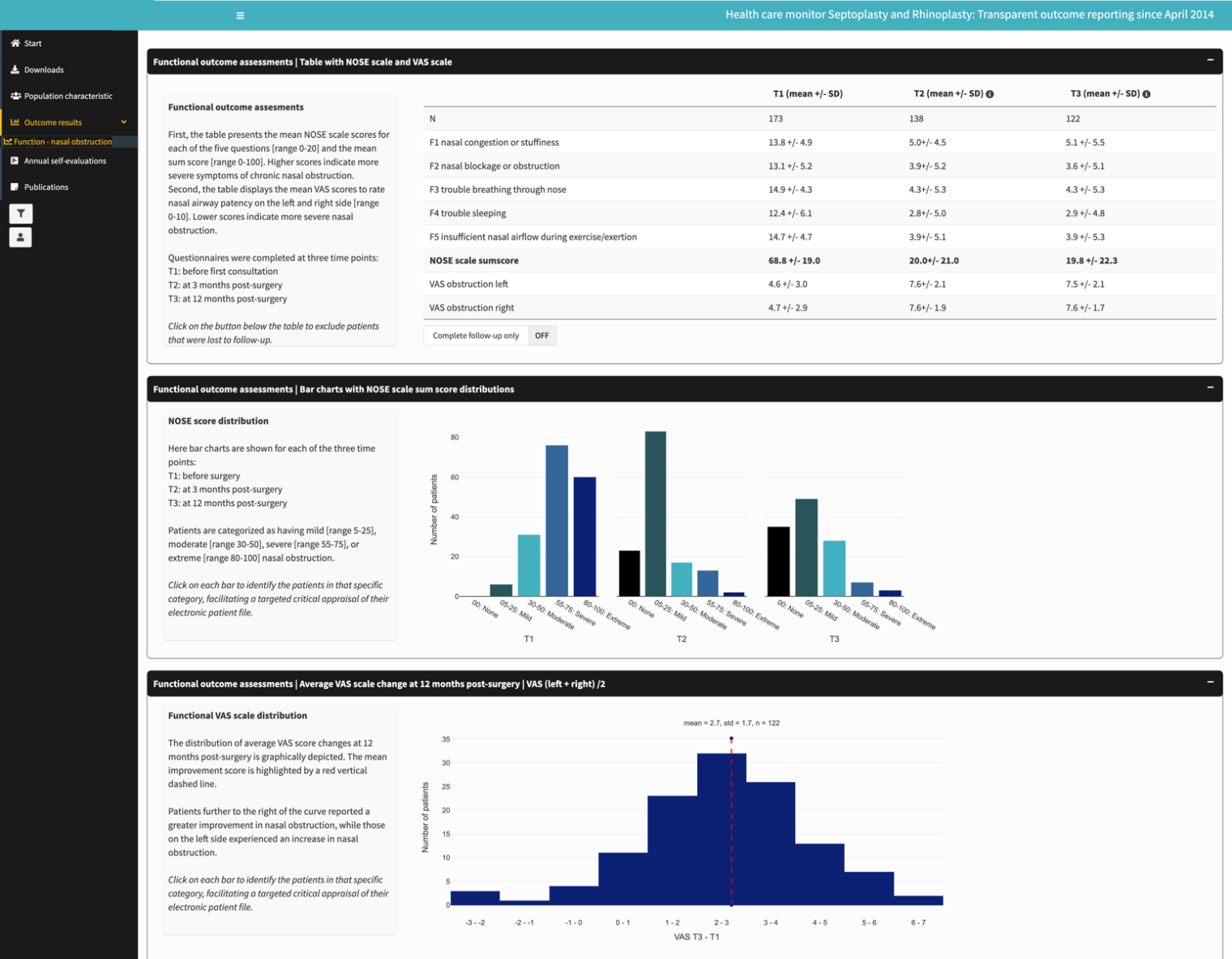
## Baseline and Surgical Population Characteristics

Since 2014, 244 consecutive patients have been referred for septoplasty. Of these, 71 patients (29.0%) did not proceed with surgery for various reasons: 15 patients (6.1%) experienced sufficient symptom relief from anti-inflammatory nasal spray; 15 (6.1%) with mild to moderate obstruction (NOSE < 50) chose not to undergo surgery; 14 (5.7%) cancelled surgery without specific reasons; 12 (4.9%) prioritized cosmetic concerns; 8 (3.3%) had no clinical indication for septoplasty; 6 (2.5%) were awaiting more urgent care; and 1 patient (0.4%) was too young.

The surgical population included 173 patients, with a median age of 30.0 years (range: 18-73). The cohort was predominantly male (*n* = 111; 64.2%), and 27 patients (15.6%) underwent revision septoplasty. Unilateral nasal obstruction was reported by 143 patients (82.7%), and bilateral obstruction by 30 patients (17.3%). To date, 160 patients (92.5%) have undergone septoplasty, and 13 patients (7.5%) remain on the waiting list. As healthcare monitoring is an ongoing process, complete short-term follow-up data are available for 138 patients (86.3%), and long-term follow-up data for 122 patients (76.3%). Despite all efforts, 13 patients (7.5%) were lost to follow-up.

## PROM-Based Outcome Assessment of the Surgical Population

The SHM presents baseline and follow-up NOSE scores and VAS scores in both table and bar chart format (**Figure 2**). The mean preoperative NOSE score was 68.8 ± 19.0, indicating severe nasal obstruction (12). Postoperatively, the mean NOSE score improved to 20.0 ± 21.0 at 3 months, and to 19.8 ± 22.3 at 12-months, indicating mild nasal obstruction (*p* < 0.001). Baseline mean VAS scores for left- and right-sided nasal obstruction were 4.6 ± 3.0 and 4.7 ± 2.9, respectively. These scores improved to 7.6 ± 2.1 (left) and 7.6 ± 1.9 (right) at 3 months, and to 7.5 ± 2.1 (left) and 7.6 ± 1.7 (right) at 12 months (*p* < 0.001).  
Notably, 10 patients (8.2%) who reported severe to extreme nasal obstruction postoperatively, warrant further attention (**Figure 3,** see “auto-identification of patients with poor outcomes” below). The change in average VAS score (calculated as the mean of left and right sides) at 12 months, shows a mean improvement of 2.7 ± 1.7. No significant differences were observed between the 3- and 12-month follow-up results for either instrument (*p* = 0.65; *p* = 0.31).



**Fig. 2** Screenshot of the functional outcome assessment section of the SHM dashboard. The top section displays a table with mean NOSE scale and VAS scores at baseline (T1), 3 months post-septoplasty (T2), and 12 months post-septoplasty (T3). The middle section features bar charts showing the distribution of mean NOSE scale scores at each time point. The bottom section presents bar charts illustrating the average VAS score change from baseline to 12 months post-septoplasty.

## Auto-Identification of Patients with Poor Outcomes

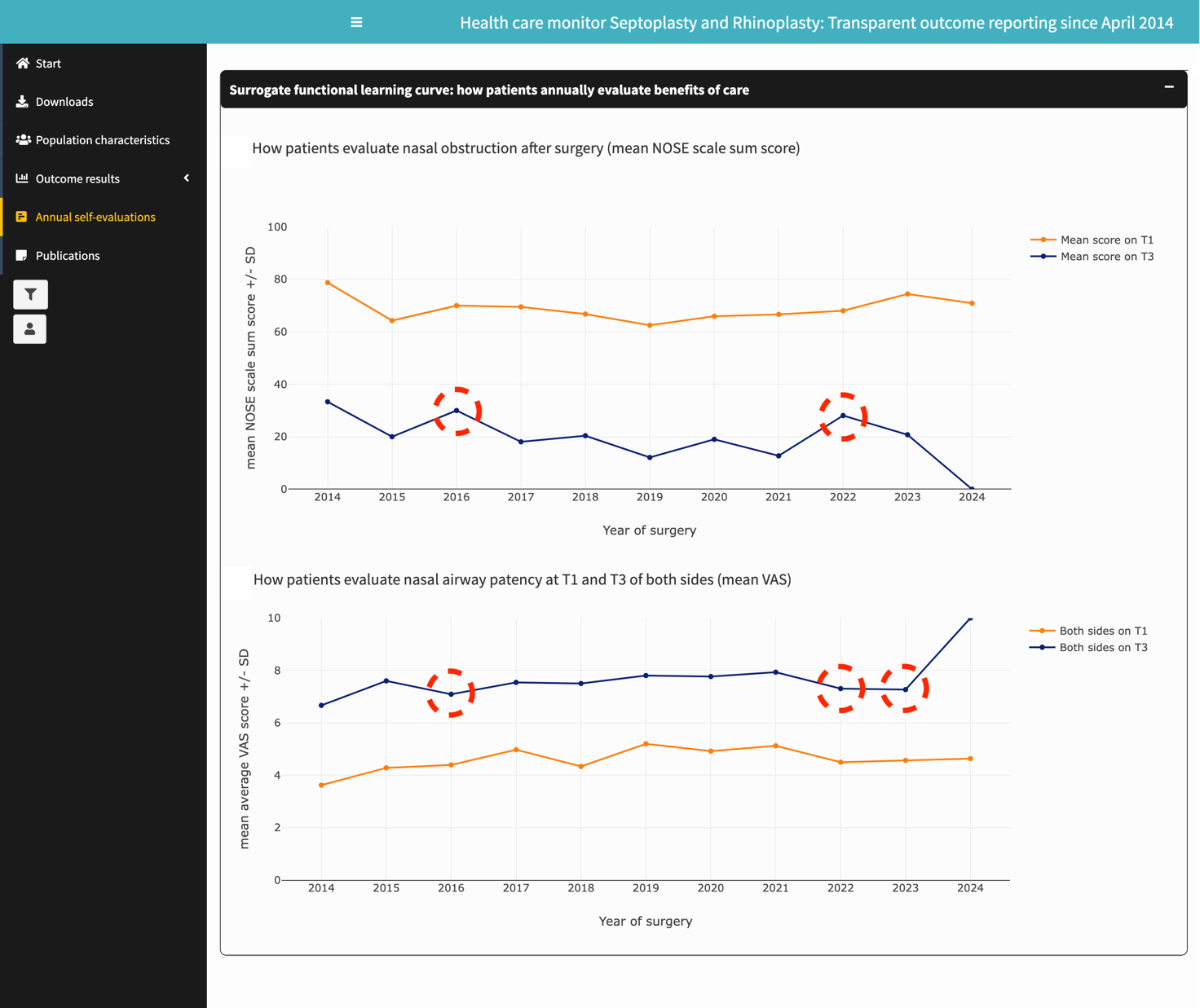
Selecting any category in the NOSE scale symptom severity bar chart and 1-year post-septoplasty VAS score bar chart generates a list of patients within that category. Special attention is given to patients who report persistent severe to extreme nasal obstruction or worsened VAS scores, as their records may offer valuable insights that could help prevent similar outcomes in future cases (see discussion). (**Figure 3**).



**Fig. 3** Screenshot of the functional outcome assessment section of the SHM dashboard, showing patient IDs (red squares) when respective bars are selected. In this example, three underperforming patients are identified for critical review of their medical records (highlighted within the red dashed-line circles). For privacy, patient IDs are blurred. One patient expressed dissatisfaction due to unaddressed aesthetic concerns; two patients with a history of extensive nasal trauma exhibited a paramedian caudal septum, possibly due to insufficient re-fixation of the corrected septum to the anterior nasal spine, and one patient with allergic rhinitis failed to restart prescribed medication.

## Quality Evaluation with Annual Performance Assessments

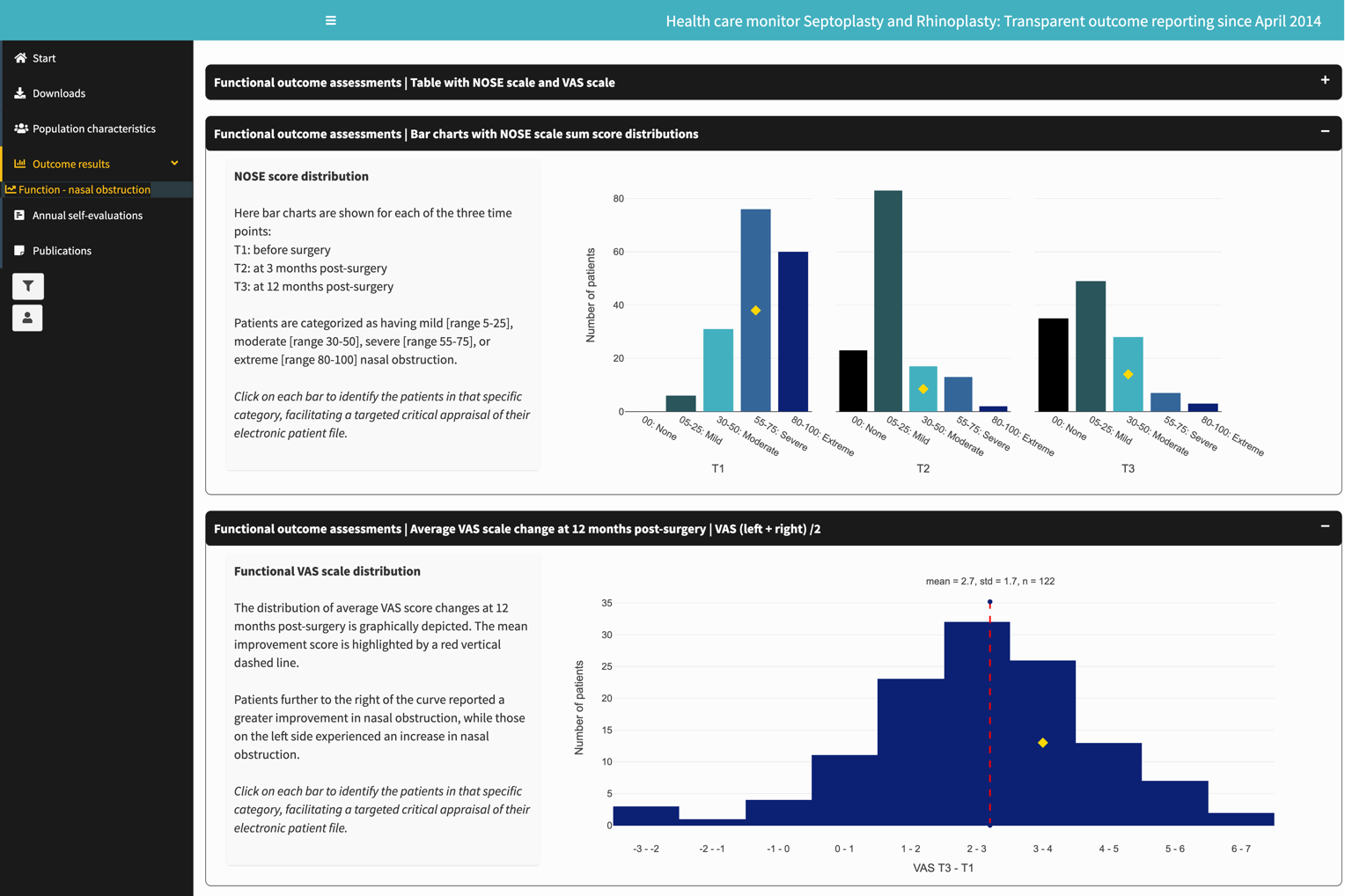
The annual self-evaluations tab visually presents mean preoperative (orange) and 1-year post-septoplasty (blue) PROM scores per year (**Figure 4**). These plots allow tracking a surgeon’s performance over time. In case of stagnation or decline in outcomes, the surgeon can review the care process, considering factors such as reduced focus on septoplasty, health-related performance issues, increased patient complexity, suboptimal indications, or insufficient expectation management.



**Fig. 4** Screenshot of the SHM dashboard displaying annual performance curves. The top section plots mean preoperative (orange) and 1-year post-septoplasty (blue) NOSE scale sum. The bottom section plots the corresponding VAS scale scores. For quality analysis, narrow T3-T1 gaps (e.g., in 2016, 2022, and 2023) may prompt the surgeon to investigate potential reasons for limited improvements.

## Patients Like Me

The “highlight patient” button in the left sidebar of the SHM enables outcome analysis of individual patients in relation to their peers. A yellow diamond in the center of the respective column depicts that patient within the cohort. Patients appreciate visualization of symptom severity compared to others, both before and after surgery. Postoperatively, showing patients their improvement can be helpful during counseling - such as improving from extreme to moderate nasal obstruction, and while not perfect, this improvement is well above the mean VAS score of the cohort (**Figure 5**).



**Fig. 5** Screenshot of the SHM dashboard (similar to Figures 3 and 4), highlighting one specific patient (yellow diamond). In this example, following revision-septoplasty, the patient improved from severe to moderate CNO according to the NOSE scale. The VAS score, however, improved well above the mean. Visualization of a patient’s improvement set against a cohort of peers can assist in patient counseling regarding their outcomes.

# DISCUSSION

This study presents the design, implementation, and results of the Septoplasty Healthcare Monitor (SHM), an automated infrastructure designed to integrate disease-specific PROMs into routine ENT practice. The SHM results are displayed on a user-friendly, web-based dashboard that can be easily interpreted by patients, physicians, and policymakers. The aim of the SHM is to address the growing demand for transparency regarding health outcomes, in the context of septoplasty (14).

The transition from experience-based outcome estimates (‘gut feeling’) to data-driven outcome assessments requires motivation, resources and the conviction about its usefulness. As previously described, there are several challenges to the adoption of routine outcome assessments in busy rhinology practices (5–7). To assist clinicians in overcoming these challenges, the SHM was developed as a freely accessible application, based on globally accepted, validated, disease-specific PROMs.

The postoperative improvements reported in this study align with those of studies using PROM-based septoplasty outcomes (15,16). However, this study contributes to the existing literature by focusing on how an ongoing, prospective, standardized outcome infrastructure, integrated into daily practice, can enhance the quality and transparency of healthcare.

The benefits for all stakeholders of the SHM framework are summarized in **Table 1**, as experienced in our clinic over the past 10 years. Clinically, one of the most valuable aspects of the SHM is its ability to educate patients about the severity of their symptoms in comparison to a cohort of peers, and to manage their expectations based on a visualization of achieved outcomes. Patients feel empowered by data-driven expectation management and appreciate the shared-decision making process. Additionally, the ability for a surgeon to track and critically appraise underperforming patients has helped improve care standards. Some examples are: include patients in the decision to undergo septoplasty and make sure that the purpose and expectations of the procedure is well understood; clearly explain to patients with mild to moderate nasal obstruction and additional aesthetic concerns that septoplasty is primarily a functional procedure and test their motivation for surgery; actively remind patients with mucosal disorders to restart prescribed medication following surgery; and focus on stabilizing the damaged or weakened caudal septum with batten grafts and/or suture fixation techniques, particularly in revision cases.  
From an academic perspective, health care monitoring has the potential to enhance the education and training of ENT residents. PROMs complement anamnesis and physical findings, aiding in the selection of patients who are likely to benefit most from septoplasty. Furthermore, residents can track the development of their surgical learning curve by evaluating prospective outcomes.  
Insurance carriers and policymakers may be interested in the stability of overall achieved outcomes at 3 months and 12 months postoperatively. This supports the transition from long-term physical follow-up to digital follow-up with physical follow-up conducted only on demand. In our hospital this approach would save €170 per patient and free up time and resources for other patients. Considering that 250.000 septoplasties are performed annually in the United States and 12.000 in the Netherlands, there is potential for substantial cost savings (17,18).

# Table 1. Summary of the Benefits of Automated Outcome Assessment and Visualization per Stakeholder

|  |  |
| --- | --- |
| Stakeholder | Benefits |
| Patient | * **Empowerment & Trust:** Ability to review surgeon outcomes over time, helping make informed decisions. * **Data-driven Expectation Management:** Gaining insights into septoplasty efficacy, understanding that full resolution of CNO symptoms may not always occur. * **Confidence in Results:** Observing the shift in symptom severity from baseline to 1-year post-septoplasty, compared to peers. * **Cost-effectiveness:** Reducing unnecessary long-term follow-up appointments by only attending in person when needed. |
| Surgeon | * **Productivity:** Immediate insights into the annual volume populations served. * **Patient selection:** PROMs help differentiate pathologies causing CNO and facilitate talking about a patient’s motivation for surgery, especially for mild/moderate symptoms. * **Resource Management:** Justifying responsible use of resources for elective healthcare. * **Empowerment:** Outcome data offer certainty about septoplasty efficacy, beyond reliance on gut feeling. * **Preparation:** Beforehand availability of post-septoplasty PROM data aids in consultation preparation. * **Quality improvement:** Visualizing annual performance trends to identify areas for improvement. |
| Resident | * **Learning Curve Visualization:** Achieved PROM score improvement plotted against time. * **Learning Curve Acceleration:** Improve patient selection with PROMs and learning from poor outcomes. |
| Hospital Board | * **Justification:** Demonstrating effective healthcare resource use. * **Cost-Effectiveness:** Replacing physical follow-ups with digital ones, freeing up resources. * **Best Practices:** Promoting a culture of continuous quality improvement by critically appraising outcomes. |
| Policy Makers | * **Standardized, Prospective Assessments**: Integration into national quality registries, creating uniform big-data repositories. * **Complementary Insights:** Findings from real-world, uncontrolled outcome evaluations complement findings from controlled settings (RCTs), justifying the continuation of subsidization of elective surgical procedures. |
| Abbreviations; PROMs: patient-reported outcome measures, CNO: chronic nasal obstruction, RCT: randomized controlled trial | |

Strengths of this study are that findings are based on a consecutive, prospective cohort, reducing the risk of bias. The strict inclusion criteria help minimize the influence of mucosal disorders and limit the confounding effects of concurrent procedures, such as inferior turbinate surgery (19). Furthermore, the 12-months lost-to-follow-up rate of only 7.7% strengthens the validity of the long-term results.

Limitations of this study are that the academic nature of our patient population may differ from a general patient population, which could explain a higher proportion of revision cases and the relatively modest number of septoplasties performed over a 10-years period. Furthermore, no objective outcome measures were used, as the literature is still inconclusive on the correlation between objective measures and patient-reported symptoms (20–22). Nevertheless, the application of PROMs has become an increasingly accepted method to assess the effectiveness of septoplasty (7). Finally, while the SHM is free to use, its success depends on thorough data collection. In our hospital, this process is automated, but in other hospitals this may first require funding and technical support, as well as the involvement of data privacy officers.

Future goals include expanding the SHM functionality and accessibility. First, database compatibility will be expanded to support Microsoft Excel (.xls) and comma-separated values (.csv) files. Second, to improve the clinical interpretation of PROM score changes, both NOSE scale and VAS score changes will be presented as the percentage of patients achieving the minimal clinically important difference (MCID) (23).Finally, a broader implementation of an outcome assessment infrastructure such as the SHM, potentially within a national quality registry, could support the aggregation of ‘big data’. This would provide valuable insights into practice variations, including the number of annual septoplasty procedures performed per surgeon or hospital, baseline symptom severity on which indications are based, revision rates, and overall achieved patient satisfaction. These data could help us learn from each other and further improve national care standards.

# CONCLUSION

This study demonstrates that the Septoplasty Healthcare Monitor (SHM) provides a structured, automated approach to integrating standardized outcome assessments into routine ENT practice. With the integration of validated PROMs, the SHM facilitates transparent reporting, shared decision-making, and continuous quality monitoring. The dashboard offers real-time insights into both individual and cohort-level outcomes, supporting data-driven patient selection and postoperative monitoring. Its ability to identify underperforming cases enables targeted quality improvements.

# REFERENCES

1. Kroneman M, Boerma W, van den Berg M, Groenewegen P, de Jong J, van Ginneken E. Netherlands: Health System Review. Health Syst Transit. 2016 Mar;18(2):1–240.
2. Robert S Kaplan, Michael E Porter. How to solve the cost crisis in health care. Harv Bus Rev. 2011 Sep;89(9):46–61.
3. Porter M, Teisberg EO. Redefining Health Care: Creating Value-Based Competition on Results. Boston: Harvard Business School Press; 2006.
4. Colaianni CA, Levesque PA, Lindsay RW. Integrating Data Collection Into Office Work Flow and Electronic Health Records for Clinical Outcomes Research. JAMA Facial Plast Surg. 2017 Nov;19(6):528–32.
5. Batty MJ, Moldavsky M, Foroushani PS, Pass S, Marriott M, Sayal K, et al. Implementing routine outcome measures in child and adolescent mental health services: from present to future practice. Child Adolesc Ment Health. 2013 May;18(2):82–7.
6. Wolpert M. Uses and abuses of patient reported outcome measures (PROMs): potential iatrogenic impact of PROMs implementation and how it can be mitigated. Adm Policy Ment Health. 2014 Mar;41(2):141–5.
7. Warinner C, Loyo M, Gu J, Wamkpah NS, Chi JJ, Lindsay RW. Patient-Reported Outcomes Measures in Rhinoplasty: Need for Use and Implementation. Facial Plastic Surgery. 2023 Oct 8;39(05):517–26.
8. Datema FR, van Zijl FVWJ, van der Poel EF, Baatenburg de Jong RJ, Lohuis PJFM. Transparency in Functional Rhinoplasty: Benefits of Routine Prospective Outcome Measurements in a Tertiary Referral Center. Plast Reconstr Surg. 2017 Oct;140(4):691–702.
9. van Zijl FVWJ, Lohuis PJFM, Datema FR. The Rhinoplasty Health Care Monitor: Using Validated Questionnaires and a Web-Based Outcome Dashboard to Evaluate Personal Surgical Performance. Facial Plast Surg Aesthet Med. 24(3):207–12.
10. van Zijl FVWJ, Versnel S, van der Poel EF, Baatenburg de Jong RJ, Datema FR. Use of Routine Prospective Functional and Aesthetic Patient Satisfaction Measurements in Secondary Cleft Lip Rhinoplasty. JAMA Facial Plast Surg. 2018 Nov;20(6):488–94.
11. Stewart MG, Smith TL, Weaver EM, Witsell DL, Yueh B, Hannley MT, et al. Outcomes after Nasal Septoplasty: Results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) Study. Otolaryngology–Head and Neck Surgery. 2004 Mar 17;130(3):283–90.
12. Lipan MJ, Most SP. Development of a severity classification system for subjective nasal obstruction. JAMA Facial Plast Surg. 2013;15(5):358–61.
13. Chang W, Cheng J, Allaire J, Xie Y, McPherson J. https://CRAN.R-project.org/package=shiny. 2016. shiny: Web Application Framework for R, 2016. R package, version 13.1.
14. Fukami T. Enhancing Healthcare Accountability for Administrators: Fostering Transparency for Patient Safety and Quality Enhancement. Cureus. 2024 Aug;16(8):e66007.
15. Carrie S, O’Hara J, Fouweather T, Homer T, Rousseau N, Rooshenas L, et al. Clinical effectiveness of septoplasty versus medical management for nasal airways obstruction: multicentre, open label, randomised controlled trial. BMJ. 2023 Oct 18;e075445.
16. Fearington FW, Awadallah AS, Hamilton GS, Olson MD, Dey JK. Long-Term Outcomes of Septoplasty With or Without Turbinoplasty: A Systematic Review. Laryngoscope. 2024 Jun;134(6):2525–37.
17. Bhattacharyya N. Ambulatory sinus and nasal surgery in the United States: demographics and perioperative outcomes. Laryngoscope. 2010 Mar;120(3):635–8.
18. van Egmond MMHT, Rovers MM, Tillema AHJ, van Heerbeek N. Septoplasty for nasal obstruction due to a deviated nasal septum in adults: A systematic review. Rhinology. 2018;56(3):195–208.
19. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. Concept, indications and results of the Messerklinger technique. Eur Arch Otorhinolaryngol. 1990;247(2):63–76.
20. Spataro E, Most SP. Measuring Nasal Obstruction Outcomes. Otolaryngol Clin North Am. 2018 Oct;51(5):883–95.
21. Maniam P, Bray A, Drinnan M, Fouweather T, Teare MD, Carrie S, et al. Exploring the Relationships Between Clinical Examination Findings, Subjective Reported Symptoms and Objective Nasal Patency Measures in Nasal Obstruction: A Baseline NAIROS Sub‐Study Analysis. Clinical Otolaryngology. 2025 Jan 8;50(1):22–30.
22. Aziz T, Biron VL, Ansari K, Flores-Mir C. Measurement tools for the diagnosis of nasal septal deviation: a systematic review. J Otolaryngol Head Neck Surg. 2014 Apr 24;43(1):11.
23. Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Control Clin Trials. 1989 Dec;10(4):407–15.