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Assessing the Predictive Accuracy of the "Dialogue Support Tool for Spine Surgery" in a Portuguese Patient Cohort

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Assessing the Predictive Accuracy of the "Dialogue Support Tool for Spine Surgery" in a Portuguese Patient Cohort

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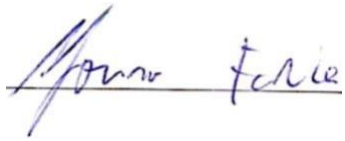

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Aos meus pais e à minha irmã, por estarem presentes a cada passo.

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Abstract

Introduction: Despite advancements in surgical techniques and diagnostic tools, some patients undergoing spine surgery experience dissatisfaction with their postoperative outcomes. This dissatisfaction can occur even when the surgery is technically successful, emphasizing the need for prognostic tools to align patient expectations pre-surgery and improve communication between surgeons and patients.

Objective: This study aims to assess the predictive accuracy of the Dialogue Support (DS) application in predicting one-year post-surgical outcomes for Portuguese patients undergoing spine surgery.

Methods: A retrospective survey study was conducted at Unidade Local de Saúde Santo António (ULS Santo António), involving surgeries performed between October 2021 and July 2022. Patients included had diagnoses of cervical radiculopathy (CR), lumbar disc herniation (LDH), lumbar spinal stenosis (LSS), and lumbar discopathy (LD), totaling 32 CR, 33 LDH, 39 LSS, and 63 LD cases. In the study, LSS was defined in patients with central stenosis/narrow lumbar canal, and LD was defined in patients with isolated discopathy without stenosis, or in patients with spinal instability with spondylolisthesis. The primary outcome measures were the Global Assessment of pain (GA pain) and satisfaction with the surgical outcome. Predictions were generated using the DS tool. Data were analyzed using IBM SPSS Statistics, with significance set at $p<0.05$.

Results: The DS tool generally predicted lower success rates for pain control than observed in the Portuguese cohorts. Satisfaction was higher than expected, except for the CR group. In the CR group, 63% were satisfied and 59.2% reported a successful outcome, compared to the predicted 67% satisfaction and 63.3% successful outcome. For LDH, 77.8% were satisfied (vs. 51.1% predicted) and 74.1% reported successful outcomes (vs. 53% predicted), with higher satisfaction among employed patients. The model's predictive accuracy for LDH was confirmed by high AUC values (0.864 for GA pain and 0.885 for satisfaction, $p<0.001$). For LSS, 71% were satisfied (vs. 46.3% predicted) and 61.3% had successful outcomes (vs. 44.7% predicted). For LD, 65% were satisfied (vs. 63% predicted) and 60% reported successful outcomes (vs. 53% predicted). Higher preoperative pain correlated with better postoperative improvement in LSS and LD groups. ROC curves indicated limited predictive capacity for most groups, except for LDH.

Conclusion: The DS tool's predictive accuracy varies across diagnostic groups, being particularly effective for LDH. Differences between the Portuguese and Swedish populations, such as social economic status and demographics, may affect the generalizability of DS predictions. Discrepancies in sample size and potential selection bias highlight the need for further national validation. Many patients with good postoperative outcomes still expressed dissatisfaction, likely due to unmet expectations and lack of preparedness for residual pain. Improving pre-surgical communication and aligning patient expectations are crucial for enhancing satisfaction. Adapting the DS tool to the unique characteristics of the Portuguese population could improve its predictive accuracy and clinical applicability.

Key words: Spine surgery; Predictive accuracy; Prognostic tools; Patient satisfaction; Dialogue Support application; Global Assessment of pain; Cervical radiculopathy; Lumbar disc herniation; Lumbar spinal stenosis; Lumbar discopathy; Portuguese population; Postoperative outcomes.

Resumo

Introdução: Apesar dos avanços nas técnicas cirúrgicas e ferramentas de diagnóstico, alguns pacientes submetidos a cirurgias da coluna vertebral continuam a expressar insatisfação com os resultados pós-operatórios. Esta insatisfação pode ocorrer mesmo quando a cirurgia é tecnicamente bem-sucedida, evidenciando a necessidade de ferramentas prognósticas para alinhar expectativas pré-cirúrgicas dos pacientes e melhorar a comunicação entre cirurgiões e pacientes.

Objetivo: Este estudo visa avaliar a precisão da aplicação Dialogue Support (DS) na previsão dos resultados pós-cirúrgicos ao fim de um ano para pacientes portugueses submetidos a cirurgia da coluna vertebral.

Métodos: Um estudo retrospetivo foi realizado na Unidade Local de Saúde Santo António (ULS Santo António), Portugal, envolvendo cirurgias realizadas entre outubro de 2021 e julho de 2022. Incluiu pacientes com radiculopatia cervical (RC), hérnia discal lombar (HDL), estenose lombar (EL) e discopatia lombar (DL), totalizando 32 casos de RC, 33 de HDL, 39 de EL e 63 de DL. EL foi definida como estenose central/canal lombar estreito, e DL como discopatia isolada sem estenose ou com instabilidade vertebral com espondilolistese. As principais medidas de resultado foram a Avaliação Global da Dor e a satisfação com o resultado cirúrgico, geradas pela ferramenta DS. Os dados foram analisados utilizando IBM SPSS Statistics, com significância definida em $p<0.05$.

Resultados: A ferramenta DS previu, de uma forma geral, taxas de sucesso no controlo da dor inferiores às observadas nas coortes portuguesas. A satisfação foi superior à esperada, exceto no grupo de RC. No grupo de RC, 63% ficaram satisfeitos e 59,2% relataram sucesso pós-cirúrgico, em comparação com 67% e 63,3% previstos, respetivamente. Para HDL, 77,8% ficaram satisfeitos (vs. 51,1% previstos) e 74,1% relataram sucesso pós-cirúrgico (vs. 53% previsto), com maior satisfação entre os pacientes empregados. A precisão preditiva do modelo para HDL foi confirmada por altos valores de área por baixo da curva (0,864 para AG dor e 0,885 para satisfação, $p<0,001$). Para EEL, 71% estavam satisfeitos (vs. 46,3% previsto) e 61,3% apresentaram bons resultados (vs. 44,7% previsto). Para DL, 65% ficaram satisfeitos (vs. 63% previsto) e 60% relataram sucesso pós-cirúrgico (vs. 53% previsto). Maior dor pré-operatória correlacionou-se com maior melhoria pós-operatória nos grupos de EEL e DL. As curvas ROC indicaram capacidade preditiva limitada para a maioria dos grupos, exceto para HDL.

Conclusão: A precisão da ferramenta DS varia entre os grupos diagnósticos, sendo particularmente eficaz para HDL. As diferenças entre as populações portuguesa e sueca, como diferenças socioeconómicas e demografia, podem afetar as previsões da ferramenta DS, bem como a sua aplicabilidade. Discrepâncias no tamanho da amostra e possível viés de seleção sublinham a necessidade de validação adicional a nível nacional. Muitos pacientes com bons resultados pós-operatórios expressaram insatisfação com o resultado da cirurgia, provavelmente devido a expectativas não correspondidas e falta de preparação para a dor residual. Melhorar a comunicação pré-cirúrgica e alinhar as expectativas dos pacientes é crucial para aumentar a satisfação. Adaptar a ferramenta DS às características únicas da população portuguesa pode melhorar a sua precisão preditiva e aplicabilidade clínica.

Palavras-chave: Cirurgia coluna vertebral; Precisão preditiva; Ferramentas prognósticas; Satisfação do paciente; Aplicação Dialogue Support; Avaliação Global da Dor; Radiculopatia cervical; Hérnia discal lombar; Estenose espinhal lombar; Discopatia lombar; População portuguesa; Resultados pós-operatórios

Abbreviation List:

AUC - Area Under the Curve
BMI – Body Mass Index
ULS Santo António– Unidade Local de Saúde Santo António
CR - Cervical Radiculopathy
DS - Dialogue Support
EQ-5D - Euro-Qol-5D
GA pain - Global Assessment of pain
LD - Lumbar Discopathy
LDH - Lumbar Disc Herniation
LSS - Lumbar Spinal Stenosis
ODI - Oswestry Disability Index
PROMs - Patient-Reported Outcome Measures
ROC - Receiver Operating Characteristic

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Introduction

Despite the developments in surgical techniques and diagnostic advancements, some patients undergoing spine surgery remain dissatisfied with their postoperative outcomes. Even in cases where surgery has been technically successful and adherent to appropriate indications, there exists no absolute guarantee of a satisfactory outcome, as measured by patient-reported outcome measures (PROMs). Enhancing patient satisfaction may be attainable through a more precise alignment of expectations, with prognostic tools emerging as valuable aids in strengthening communication between surgeons and patients' pre-surgery. This study seeks to evaluate the predictive efficacy of the Swedish-based Dialogue Support (DS) tool within a cohort of a Portuguese spine unit, shedding light on its potential to forecast outcomes in spine surgery. A crucial consideration for patients contemplating surgery is the anticipated level of improvement afterward, a question often challenging for surgeons given the variability in patient-reported outcomes following procedures for degenerative spinal conditions. [1,2]

The Dialogue Support (DS) has been available to the public since October 2020, due to the EUROSPINE steering board and the Swespine society of spinal surgeons. This application assists in predicting the outcome of spinal surgery one year after the procedure. It was designed to aid in shared decision-making between healthcare professionals and patients when discussing surgical options for various spinal disorders. The registry includes patients diagnosed with cervical radiculopathy (CR), lumbar disc herniation (LDH), lumbar spinal stenosis (LSS) and lumbar discopathy (LD).[1] In the study, LSS was defined in patients with central stenosis/narrow lumbar canal, and LD was defined in patients with isolated discopathy without stenosis, or in patients with vertebral instability with spondylolisthesis (with or without stenosis). Information regarding lifestyle factors, comorbidities and data on health-related quality of life such as Oswestry Disability Index (ODI), Euro-Qol-5D (EQ-5D) and back and leg pain scores were collected through surveys. Additionally, surgeons recorded diagnosis, surgical procedures, and any complications encountered.[1,3] Significant disparities in baseline characteristics, including age, smoking status, comorbidities, frequency of previous surgeries, and levels of back and leg pain intensity, were observed among the study cohorts.[3]

Portugal and Sweden differ significantly in climate, geography, and population demographics. Sweden, in Northern Europe, has a cold, temperate climate with long winters, while Portugal, in Southern Europe, has a Mediterranean climate with hot, dry summers and mild winters. Sweden's population is more ethnically homogeneous, mainly consisting of ethnic Swedes, whereas Portugal has a more diverse population due to its history of migration and colonization. In terms of genetic attributes, Swedish men have an average height of 1.80m, weight of 87.1kg, and BMI of 26.8, while Portuguese men have an average height of 1.74m, weight of 79.5kg, and BMI of 26.3. Obesity prevalence in Sweden was around 17% for men and 14% for women, compared to approximately 22% for men and 23% for women in Portugal in 2022. [4–10]

Despite inherent differences, similarities in follow-up timing, questionnaire structure, and outcome measures with the Swespine registry allow exploring DS predictions' generalizability to Portugal. This study evaluates DS forecasting accuracy at one-year post-surgical follow-up for Portuguese patients in a specialized spine surgery unit. Assessing its predictive capabilities aims to enhance shared decision-making and improve patient outcomes in Portuguese spinal surgery.

Methods

Patient Sample

The patient registry covers individuals diagnosed with various spinal disorders, including cervical radiculopathy (CR), lumbar disc herniation (LDH), lumbar spinal stenosis (LSS), and lumbar discopathy (LD).

A selection process yielded 32 cases with complete preoperative data and at least 1-year follow-up for cervical radiculopathy, 33 cases for lumbar disc herniation, 39 cases for lumbar spinal stenosis, and 63 cases for lumbar discopathy. These cases were collected from the database of patients who underwent spinal surgery at ULS Santo António between October 2021 and July 2022. Out of a total of 185 patients, those with myelopathies were excluded, leaving 167 eligible cases. Patients who met the inclusion criteria were contacted and invited to participate in the survey via telephone. Informed consent was obtained from all participants confirming their understanding of the study, their willingness to participate and their right to withdraw from the study. The survey was administered in Portuguese. Out of the total 167 cases across CR, LDH, LSS and LD, 125 patients participated in the survey. Specifically, 27 out of 32 CR cases responded (84.4% participation rate), 27 out of 33 LDH cases responded (81.8% participation rate), 31 out of 39 LSS cases responded (79.5% participation rate), and 40 out of 63 LD cases responded (66.7% participation rate).
In the absence of an alternative method, the researcher individually contacted each patient, manually inputted the data from the Portuguese cohorts into the DS tool and systematically recorded the outcomes for each case. Despite its necessity, this process proved to be time-consuming and significantly affected the sample size available for analysis. [2]

Outcome measures

This retrospective survey study was conducted at Centro Hospitalar Universitário Santo António, Portugal, spanning surgeries performed between October 2021 and July 2022.
Using a concise survey, the study captured patients' perspectives on their quality of life before and after surgery, with a focus on two primary outcome measures: Global Assessment of Pain (GA pain) and satisfaction with surgical outcomes. The GA pain measure evaluates changes in back or leg pain following surgery, asking patients, "How is your back/leg pain today compared to before the surgery?" The possible responses are "completely pain-free", "much better", "slightly better", "no change" and "worse." Patients who reported no pain prior to surgery were excluded from the predictive modeling.[1,2]
For LDH and LSS, the DS tool predicts outcomes related to GA leg pain, while for the LD group, GA back pain is predicted. [2]
Satisfaction with surgical outcome is gauged using an ordinal Likert scale encompassing three categories: satisfied, hesitant, and dissatisfied. DS presents key findings as proportions of satisfied patients and those achieving successful outcomes. The proportion of satisfied patients is delineated by satisfaction dichotomized into success (satisfied) and failure (hesitant or dissatisfied). Successful outcome proportion is defined by GA pain dichotomized into success (completely pain-free, much better) and failure (somewhat better, unchanged, worse), further represented in DS through a pie chart with corresponding probabilities for the five ordinal categories. [1,2,11]

Obtaining Predictions

Data retrieval for the Portuguese cohorts involved manually entering predictions into the web-based tool accessible through the link:
https://app.molnify.com/app/7wqw6owgrznr76bkaqc6l4bs7q.
The variables needed to use the DS application in order to generate predictions include factors such as the operated levels (LSS and LD), age, gender, employment status, disability status, retirement status, smoking habits, history of prior spine surgery, quality of life as measured by EQ-5D, comorbidity profile, walking distance, duration of leg pain, duration of back pain, preoperative leg and back pain scores, and functional impairment assessed through the Oswestry Disability Index (ODI). [1,2,12]
The researchers recorded the binary outcomes of "Proportion of satisfied patients" and "Proportion of patients with successful outcome" for each of the 125 cases, as calculated and presented by the DS tool. Moreover, they logged the specific probabilities associated with each of the five categories

of GA pain. To assess the alignment between predicted and observed results, the follow-up data for the cohorts were dichotomized based on the outcome criteria defined by the DS tool earlier.[2] Data was collected in Microsoft Excel (Version 16.84, Microsoft Inc, Redmond, WA, USA) and statistical analysis was performed with IBM SPSS Statistics version 29, assuming statistical significance for $p<0.05$. An overall analysis of the cohort was performed. Descriptive statistics were performed to characterize the sample. [13]
This study was approved by the local ethics committee (REF: 2023.272(233-DEFI/224-CE)).

Results

Patient Sample

Cervical Radiculopathy (CR)

For the CR group, the average age of the operated patients was 57.41 years, with the youngest being 41 and the oldest 81 years. Among the 27 patients studied, 10 were men (37%) and 17 were women (63%). Sixteen patients were employed (59.3%) and 11 were unemployed (40.7%), with 7 of those being retired (63.6%). Of the 27 patients, 4 were on disability pension (14.8%). Additionally, 8 patients (29.6%) were smokers, and 8 patients (29.6%) had at least one previous spinal surgery.
Among the 10 male patients, 7 were satisfied with the surgery (70%) and 3 were unsure (30%). Of the 17 female patients, 10 were satisfied (58.8%), 3 were unsure (17.6%), and 4 were dissatisfied (23.5%). The chi-square test indicated no statistically significant relationship between the gender of the patients and their satisfaction with the surgery ($p>0.05$, 0.372).
Among the 16 employed patients, 9 were satisfied (56.3%), 5 were unsure (31.3%), and 2 were dissatisfied (12.5%). Among the 11 unemployed patients, 8 were satisfied (72.7%), 1 was unsure (9.1%), and 2 were dissatisfied (18.2%). The chi-square test indicated no statistically significant relationship between employment status and satisfaction with the surgery ($p>0.05$, 0.394).
Among the 8 smokers, 2 were completely asymptomatic postoperatively (25.0%), 5 showed significant improvement (62.5%), and 1 showed slight improvement (12.5%). The chi-square test indicated no statistically significant relationship between smoking and postoperative pain/complaints ($p>0.05$, 0.156).
Regarding postoperative hospitalization related to pain/complaints, asymptomatic patients had an average hospital stay of 2 days. Patients with significant improvement stayed an average of 2.36 days, and those with slight improvement stayed an average of 2.18 days. The chi-square test indicated no statistically significant relationship between the length of hospital stay and postoperative pain/complaints ($p>0.05$, 0.662).
When assessing whether preoperative pain influenced postoperative pain/complaints, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.199). Similarly, evaluating whether patient age influenced postoperative outcomes, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.239).
Results can be seen on Table I and II.

<u>When compared to the DS tool</u>

For CR, the DS tool predicted that 67% of the patients in the studied sample would be satisfied with the surgery, and that 63.3% of the surgeries would be successful. The observed results indicated that 63% of the patients were satisfied with the surgery, and 59.2% reported a successful outcome. These results illustrate the alignment and discrepancies between the predicted outcomes and the actual postoperative experiences of the Portuguese cohort, with a slightly higher satisfaction and success rate predicted. Results can be seen in Table III.

Lumbar Disc Herniation (LDH)

For the lumbar disc herniation group, the average age of the operated patients was 51.07 years, with the youngest being 25 and the oldest 84 years. Of the 27 patients studied, 13 (48.1%) were men and 14 were women (51.9%). Seventeen patients were employed (63%) and 10 were unemployed (37%), with 5 of these 10 being retired. Of the 27 patients, 5 were on disability pension (18.5%). Additionally, 7 patients (25.9%) were smokers, and 10 patients (37%) had at least one previous spinal surgery.

Among the 13 male patients, 10 were satisfied with the surgery (76.9%), 1 was unsure (7.7%), and 2 were dissatisfied (15.4%). Among the 14 female patients, 11 were satisfied (78.6%), 1 was unsure (7.1%), and 2 were dissatisfied (14.3%). The chi-square test indicated no statistically significant relationship between the sex of the patients and their satisfaction with the surgery ($p>0.05$, 1.000).

Among the 17 employed patients, 16 were satisfied (94.1%) and 1 was dissatisfied (5.9%). Among the 10 unemployed patients, 5 were satisfied (50.0%), 2 were unsure (20.0%), and 3 were dissatisfied (30%). The chi-square test indicated a statistically significant relationship between employment status and satisfaction with the surgery ($p<0.05$, 0.024), where employed patients were more satisfied with the outcome of the surgery when compared to unemployed ones.

Among the 7 smokers, 4 showed significant improvement (57.1%), 1 showed slight improvement (14.3%), and 2 experienced worsening symptoms post-operation (28.6%). The chi-square test indicated no statistically significant relationship between smoking and postoperative pain/complaints ($p>0.05$, 0.370).

Regarding postoperative hospitalization related to pain/complaints, asymptomatic patients had an average hospital stay of 2 days. Patients with significant improvement stayed an average of 2.06 days, those with slight improvement stayed an average of 3.33 days, and those with worsening symptoms stayed an average of 1.67 days. The chi-square test indicated no statistically significant relationship between the length of hospital stay and postoperative pain/complaints ($p>0.05$, 0.565).

When assessing whether preoperative pain influenced postoperative pain/complaints, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.679). Similarly, evaluating whether patient age influenced postoperative outcomes, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.735).

Results can be seen on Table IV and V.

<u>When compared to the DS tool</u>

For LDH, the DS tool estimated that 51.1% of patients would be satisfied with their surgical results, and that 53% would achieve a successful outcome as measured by the GA pain. However, the actual observed outcomes differed significantly, with 77.8% of patients reporting satisfaction with the surgery, and 74.1% achieving a successful outcome.

These findings highlight the differences between the predicted and actual postoperative experiences of patients undergoing surgery for lumbar disc herniation, with a notably higher satisfaction and success rate than anticipated. Results can be seen on Table VI.

Lumbar Spinal Stenosis (LSS)

For the lumbar spinal stenosis group, the average age of the operated patients was 68.19 years, with the youngest being 54 and the oldest 89 years. Among the 31 patients studied, 15 (48.4%) were men and 16 were women (51.6%). Three patients were employed (9.7%) and 28 were unemployed (90.3%), with 21 of these 28 being retired (67.7%). Of the 31 patients, 5 were on disability pension (16.1%). Additionally, 4 patients (12.9%) were smokers, and 5 patients (16.1%) had at least one previous spinal surgery.

Among the 15 male patients, 10 were satisfied with the surgery (66.7%) and 5 were dissatisfied

(33.3%). Among the 16 female patients, 12 were satisfied (75%), 2 were unsure (12.5%), and 2 were dissatisfied (12.5%). The chi-square test indicated no statistically significant relationship between the sex of the patients and their satisfaction with the surgery ($p>0.05$, 0.192).
Among the 3 employed patients, 2 were satisfied (66.7%) and 1 was dissatisfied (33.3%). Among the 28 unemployed patients, 20 were satisfied (71.4%), 2 were unsure (7.1%), and 6 were dissatisfied (21.4%). The chi-square test indicated no statistically significant relationship between employment status and satisfaction with the surgery ($p>0.05$, 1.000).
Among the 4 smokers, 2 were completely asymptomatic postoperatively (50.0%) and 2 showed significant improvement (50.0%). The chi-square test indicated no statistically significant relationship between smoking and postoperative pain/complaints ($p>0.05$, 0.423).
Regarding postoperative hospitalization related to pain/complaints, asymptomatic patients had an average hospital stay of 4.43 days. Patients with significant improvement stayed an average of 3.75 days, those with slight improvement stayed an average of 3.17 days, and those with worsening symptoms stayed an average of 3.33 days. The chi-square test indicated no statistically significant relationship between the length of hospital stay and postoperative pain/complaints ($p>0.05$, 0.732).
When assessing whether preoperative pain influenced postoperative pain/complaints, the chi-square test indicated a statistically significant relationship ($p<0.05$, 0.043), where patients that presented with higher level of pain prior to surgery, are more often pain free or present a significant improvement post-surgery. However, evaluating whether patient age influenced postoperative outcomes, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.268).
Results can be seen on Table VII and VIII.

<u>When compared to the DS tool</u>

According to the DS tool, for LSS, it was anticipated that 46.3% of patients would be satisfied with their surgical results, and that 44.7% would achieve a successful outcome as measured by the GA pain. In contrast, the actual observed outcomes were significantly higher, with 71% of patients reporting satisfaction with the surgery and 61.3% achieving a successful outcome.
Results can be seen on Table IX.

Lumbar Discopathy (LD)

For the LD, the average age of the operated patients was 59.60 years, with the youngest being 35 and the oldest 80 years. Among the 40 patients studied, 10 (25%) were men and 30 were women (75%). Thirteen patients were employed (32.5%) and 27 were unemployed (67.5%), with 13 of these 27 being retired (32.5%). Of the 40 patients, 7 were on disability pension (17.5%). Additionally, 2 patients (5.0%) were smokers, and 10 patients (25.0%) had at least one previous spinal surgery.
Among the 10 male patients, 7 were satisfied with the surgery (70%) and 3 were unsure (30%). Among the 30 female patients, 19 were satisfied (63.3%), 5 were unsure (16.7%), and 6 were dissatisfied (20.0%). The chi-square test indicated no statistically significant relationship between the sex of the patients and their satisfaction with the surgery ($p>0.05$, 0.331).
Among the 13 employed patients, 9 were satisfied (69.2%), 3 were unsure (23.1%), and 1 was dissatisfied (7.7%). Among the 27 unemployed patients, 17 were satisfied (63.0%), 5 were unsure (18.5%), and 5 were dissatisfied (18.5%). The chi-square test indicated no statistically significant relationship between employment status and satisfaction with the surgery ($p>0.05$, 0.781).
Among the 2 smokers, 1 showed significant improvement (50.0%) and 1 experienced worsening symptoms (50.0%). The chi-square test indicated no statistically significant relationship between smoking and postoperative pain/complaints ($p>0.05$, 0.681).
Regarding postoperative hospitalization related to pain/complaints, asymptomatic patients had an average hospital stay of 3 days. Patients with significant improvement stayed an average of 3.47 days, those with slight improvement stayed an average of 4.25 days, those with no change in

symptoms stayed an average of 3 days, and those with worsening symptoms stayed an average of 4 days. The chi-square test indicated no statistically significant relationship between the length of hospital stay and postoperative pain/complaints ($p>0.05$, 0.133).
When assessing whether preoperative pain influenced postoperative pain/complaints, the chi-square test indicated a statistically significant relationship ($p<0.05$, 0.028), where patients that presented with higher level of pain prior to surgery, are more often pain free or present a significant improvement. However, evaluating whether patient age influenced postoperative outcomes, the chi-square test indicated no statistically significant relationship ($p>0.05$, 0.706).
Results can be seen on Table X and XI.

When compared to the DS tool

For LD, the DS tool predicted that 63% of patients would be satisfied with their surgical outcomes and that 53% would achieve a successful outcome as measured by GA pain. However, the actual observed outcomes indicated that 65% of patients were satisfied with the surgery, and 60% reported a successful outcome.
These findings highlight the slight discrepancies between the DS tool's predictions and the actual postoperative results for patients undergoing surgery for lumbar discopathy, with both satisfaction and success rates being slightly higher than predicted.
Results can be seen on Table XII.

Outcome measures

The Receiver Operating Characteristic (ROC) curve is a graphical representation used to evaluate the diagnostic performance of a test, distinguishing between successful and failed cases. It plots the false positive rate (1-specificity) on the x-axis against the sensitivity on the y-axis for various threshold settings. The closer the ROC curve is to the upper left corner, where sensitivity is 1 and the false positive rate is 0 (specificity is 1), the higher the test's accuracy. [14]
The Area Under the Curve (AUC) quantifies the overall performance of the diagnostic test. An AUC of 1.0 represents a perfect test, while an AUC greater than 0.5 indicates that the test performs better than random chance. [14]
ROC curves were generated for both GA pain and Satisfaction for each diagnostic group (Table XIII). The AUC values varied across groups and outcomes, ranging from 0.326 to 0.885. These results indicate that the prediction models generally lack the ability to discriminate between successes and failures at the individual level, except for the Lumbar Disc Herniation (LDH) group, where the AUC was 0.864 for GA pain and 0.885 for satisfaction, both with $p<0.001$. [1,2,14]
These findings suggest that the study's predictive model is particularly effective for the LDH group, providing reliable discrimination between successful and unsuccessful outcomes. This implies that the model can be applied effectively to patients with Lumbar Disc Herniation, offering valuable insights into their postoperative outcomes.
Results can be seen on Table XIII.

Discussion

This study aimed to assess the predictive accuracy of the Dialogue Support (DS) application in predicting one-year post-surgical outcomes for a cohort of 125 Portuguese patients undergoing spine surgery at ULS Santo António between October 2021 and July 2022. The focus was on GA pain and satisfaction with surgical outcomes. In addition to comparing the predicted results from the DS tool, we evaluated whether variables such as employment status, smoking habits, sex, age, length of hospital stay, and preoperative pain influenced postoperative outcomes and satisfaction within each diagnostic group.
Our findings show that the study’s predictive model is particularly effective for the lumbar disc

herniation group, where employed patients tended to report higher satisfaction. Additionally, in the lumbar spinal stenosis and lumbar discopathy groups, higher preoperative pain levels were associated with better postoperative outcomes. No significant relationships were found between satisfaction and other demographic or clinical factors across the groups.

Based on ROC curves and AUC values, the predictive model demonstrated high accuracy for the LDH group, suggesting that the DS tool could be effectively applied to these patients. However, AUC and accuracy may not always reflect actual performance, as dropouts in registers may tend to have worse outcomes than those who consent, possibly leading to overestimating success in the model.

Lumbar disc herniation (LDH) is one of the most common spinal degenerative disorders. Consequently, surgical intervention for LDH is also among the most frequently performed procedures, leading to extensive clinical practice and potentially better postoperative outcomes. There is a documented positive volume-outcome relationship for most medical procedures, indicating that the more frequently these surgeries are performed, the better the patient outcomes tend to be. [14–20]

Nevertheless, despite the abundance of literature on spinal surgeries, there is a lack of comparative studies evaluating the efficacy of surgeries across the other groups of spinal pathologies. This gap highlights the need for further research to comprehensively assess and compare surgical outcomes among these conditions. [18–21]

Given these findings, it is essential to consider the differences between the Portuguese and Swedish populations when applying the DS tool. Sweden's homogeneous population, highly developed economy, and extensive welfare system contrast with Portugal's diverse demographics, economic inequality, and regional development challenges. [6–10,22–28] These factors can potentially affect DS predictions despite similar methodologies. These differences could affect the DS predictions, despite the methodological alignment in follow-up timing, survey structure, and outcome measures with the Swespine registry. [1,2]

One other possible explanation for the differing results is the discrepancy in sample size between our study and the original Swedish data. Additionally, since our samples were collected from a single Portuguese center, a selection bias cannot be ruled out. Ideally, the DS tool should be validated on a national cohort.[1,2] Furthermore, variations in surgical techniques, processes, training, support, equipment, and medications could influence outcomes.[1]

Interestingly, it was noted that many patients reported a good postoperative outcome (asymptomatic or significantly improved) but still expressed uncertainty or dissatisfaction with the surgery. Understanding this discrepancy is crucial. Reasons include differing expectations of the surgery, highlighting the importance of aligning patient expectations pre-surgery, and improving communication between surgeons and patients. Patients should be informed that some residual pain after surgery may remain, as not being prepared for this can lead to dissatisfaction.

The DS tool holds significant importance as it can serve as a critical aid for both patients and surgeons in discussing surgical treatments for degenerative conditions in the lumbar and cervical spine, helping to predict whether surgery will be the optimal solution or if conservative treatment would be more appropriate. [29,30] By providing a structured framework for evaluating patient-specific factors, surgical risks, and potential outcomes, the DS tool facilitates informed decision-making. This ensures that patients are well-informed about their options and helps align surgical decisions with their preferences and clinical indications. Additionally, the DS tool can improve preoperative planning and postoperative satisfaction by setting realistic expectations and enhancing patient engagement in the treatment process. [1,2]

Currently, there is no other tool comparable to the DS tool, despite numerous attempts to develop similar predictive models. Identifying unequivocal predictor factors that can accurately forecast surgical outcomes remains exceedingly challenging. Many predictor factors are contentious or highly specific to the patient profile, diagnosis, and surgical technique being investigated, and potentially even to the institution where the investigation is conducted. Additionally, variables such as the length and type of follow-up and the scientific rigor of the studies investigating these factors play a decisive role, making it nearly impossible to provide a simple, universally applicable formula

for predicting surgical outcomes with certainty on an individual basis. [31–33]

In conclusion, the DS tool's predictive accuracy needs further validation and adaptation to better accommodate the unique characteristics of the broader Portuguese patient population. Given that the initial study was conducted exclusively at ULS Santo António, it is imperative to extend validation efforts across diverse clinical settings within Portugal to ensure the findings' robustness and generalizability. Additionally, increasing the sample size is crucial to enhance the reliability and applicability of the results.

Integrating the DS tool into clinical practice not only supports personalized patient care but also promotes evidence-based surgical decisions. This integration aims to improve overall patient outcomes and satisfaction by providing a structured framework for evaluating patient-specific factors, surgical risks, and potential outcomes. Addressing these considerations will significantly enhance the tool's applicability and effectiveness in optimizing treatment strategies for degenerative spinal conditions.[1,2]

Tables

Table I - Demographic characteristics, satisfaction and post-operative outcomes of patients with CR.

Parameter	Value
Average Age	57.41 years (range: 41-81 years)
Sex Distribution	10 men (37%), 17 women (63%)
Employment Status	16 employed (59.3%), 11 unemployed (40.7%)
Retirement Status	7 out of 11 unemployed retired (63.6%)
Disability Pension	4 (14.8%)
Smokers	8 (29.6%)
Previous Spinal Surgery	8 (29.6%)
Satisfaction (Men)	7 satisfied (70%), 3 unsure (30%)
Satisfaction (Women)	10 satisfied (58.8%), 3 unsure (17.6%), 4 dissatisfied (23.5%)
Employment Satisfaction	9 satisfied (56.3%), 5 unsure (31.3%), 2 dissatisfied (12.5%)
Unemployment Satisfaction	8 satisfied (72.7%), 1 unsure (9.1%), 2 dissatisfied (18.2%)
Post-op Pain (Smokers)	2 asymptomatic (25.0%), 5 significant improvement (62.5%), 1 slight improvement (12.5%)
Hospital Stay (Days)	Asymptomatic: 2, Significant improvement: 2.36, Slight improvement: 2.18

Table II - Chi-square test results for factors influencing satisfaction and postoperative pain in CR patients.

Parameter	Chi-square test
Sex of the patients and satisfaction with the surgery	no statistically significant relationship ($p>0.05$, 0.372)
Employment Status and satisfaction with the surgery	no statistically significant relationship ($p>0.05$, 0.394)
Postoperative pain/complaint in smokers	no statistically significant relationship ($p>0.05$, 0.156)
Postoperative hospitalization related to pain/complaints	no statistically significant relationship ($p>0.05$, 0.662)
Influence of preoperative pain in postoperative pain/complaints	no statistically significant relationship ($p>0.05$, 0.199)
Influence of patient age in postoperative outcomes	no statistically significant relationship ($p>0.05$, 0.239)

Table III - Comparison of predicted and observed outcomes for CR surgeries using the DS tool.

Outcome Measure	Predicted (%)	Observed (%)
Proportion of Satisfied Patients	67.0%	63.0%
Proportion with Successful Outcome	63.3%	59.2%

Table IV - Demographic characteristics, satisfaction and post-operative outcomes of patients with LDH.

Parameter	Value
Average Age	51.07 years (range: 25-84 years)
Sex Distribution	13 men (48.1%), 14 women (51.9%)
Employment Status	17 employed (63%), 10 unemployed (37%)
Retirement Status	5 out of 10 unemployed retired
Disability Pension	5 (18.5%)
Smokers	7 (25.9%)
Previous Spinal Surgery	10 (37%)
Satisfaction (Men)	10 satisfied (76.9%), 1 unsure (7.7%), 2 dissatisfied (15.4%)
Satisfaction (Women)	11 satisfied (78.6%), 1 unsure (7.1%), 2 dissatisfied (14.3%)
Employment Satisfaction	16 satisfied (94.1%), 1 dissatisfied (5.9%)
Unemployment Satisfaction	5 satisfied (50.0%), 2 unsure (20.0%), 3 dissatisfied (30.0%)
Post-op Pain (Smokers)	4 significant improvement (57.1%), 1 slight improvement (14.3%), 2 worsening symptoms (28.6%)
Hospital Stay (Days)	Asymptomatic: 2, Significant improvement: 2.06, Slight improvement: 3.33, Worsening symptoms: 1.67

Table V - Chi-square test results for factors influencing satisfaction and postoperative pain in LDH patients.

Parameter	Chi-square test
Sex of the patients and satisfaction with the surgery	no statistically significant relationship ($p>0.05$, 1.000)
Employment Status and satisfaction with the surgery	statistically significant relationship ($p<0.05$, 0.024)
Postoperative pain/complaint in smokers	no statistically significant relationship ($p>0.05$, 0.370)
Postoperative hospitalization related to pain/complaints	no statistically significant relationship ($p>0.05$, 0.565)
Influence of preoperative pain in postoperative pain/complaints	no statistically significant relationship ($p>0.05$, 0.679)
Influence of patient age in postoperative outcomes	no statistically significant relationship ($p>0.05$, 0.735)

Table VI - Comparison of predicted and observed outcomes for LDH surgeries using the DS tool.

Outcome Measure	Predicted (%)	Observed (%)
Proportion of Satisfied Patients	51.1%	77.8%
Proportion with Successful Outcome	53.0%	74.1%

Table VII - Demographic characteristics, satisfaction and post-operative outcomes of patients with LSS.

Parameter	Value
Average Age	68.19 years (range: 54-89 years)
Sex Distribution	15 men (48.4%), 16 women (51.6%)
Employment Status	3 employed (9.7%), 28 unemployed (90.3%)
Retirement Status	21 out of 28 unemployed retired (67.7%)
Disability Pension	5 (16.1%)
Smokers	4 (12.9%)
Previous Spinal Surgery	5 (16.1%)
Satisfaction (Men)	10 satisfied (66.7%), 5 dissatisfied (33.3%)
Satisfaction (Women)	12 satisfied (75%), 2 unsure (12.5%), 2 dissatisfied (12.5%)
Employment Satisfaction	2 satisfied (66.7%), 1 dissatisfied (33.3%)
Unemployment Satisfaction	20 satisfied (71.4%), 2 unsure (7.1%), 6 dissatisfied (21.4%)
Post-op Pain (Smokers)	2 asymptomatic (50.0%), 2 significant improvement (50.0%)
Hospital Stay (Days)	Asymptomatic: 4.43, Significant improvement: 3.75, Slight improvement: 3.17, Worsening symptoms: 3.33

Table VIII - Chi-square test results for factors influencing satisfaction and postoperative in LSS patients.

Parameter	Chi-square test
Sex of the patients and satisfaction with the surgery	no statistically significant relationship ($p>0.05$, 0.192)
Employment Status and satisfaction with the surgery	no statistically significant relationship **(**$p>0.05$, 1.000**)**
Postoperative pain/complaint in smokers	no statistically significant relationship ($p>0.05$, 0.423)
Postoperative hospitalization related to pain/complaints	no statistically significant relationship ($p>0.05$, 0.732)
Influence of preoperative pain in postoperative pain/complaints	statistically significant relationship ($p<0.05$, 0.043)
Influence of patient age in postoperative outcomes	no statistically significant relationship ($p>0.05$, 0.268)

Table IX - Comparison of predicted and observed outcomes for LSS surgeries using the DS tool.

Outcome Measure	Predicted (%)	Observed (%)
Proportion of Satisfied Patients	46.3%	71.0%
Proportion with Successful Outcome	44.7%	61.3%

Table X - Demographic characteristics, satisfaction and post-operative outcomes of patients with LD.

Parameter	Value
Average Age	59.60 years (range: 35-80 years)
Sex Distribution	10 men (25%), 30 women (75%)
Employment Status	13 employed (32.5%), 27 unemployed (67.5%)
Retirement Status	13 out of 27 unemployed retired (32.5%)
Disability Pension	7 (17.5%)
Smokers	2 (5.0%)
Previous Spinal Surgery	10 (25.0%)
Satisfaction (Men)	7 satisfied (70%), 3 unsure (30%)
Satisfaction (Women)	19 satisfied (63.3%), 5 unsure (16.7%), 6 dissatisfied (20.0%)
Employment Satisfaction	9 satisfied (69.2%), 3 unsure (23.1%), 1 dissatisfied (7.7%)
Unemployment Satisfaction	17 satisfied (63.0%), 5 unsure (18.5%), 5 dissatisfied (18.5%)
Post-op Pain (Smokers)	1 significant improvement (50.0%), 1 worsening symptoms (50.0%)
Hospital Stay (Days)	Asymptomatic: 3, Significant improvement: 3.47, Slight improvement: 4.25, No change: 3, Worsening symptoms: 4

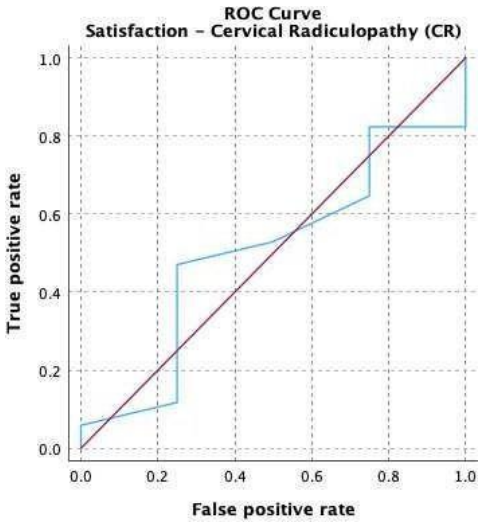
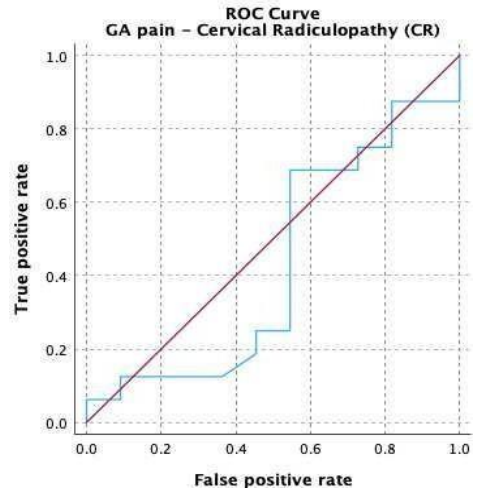
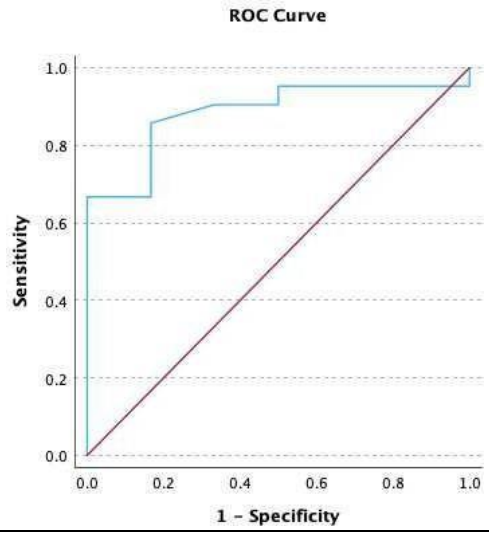
Table XI - Chi-square test results for factors influencing satisfaction and postoperative in LD patients.

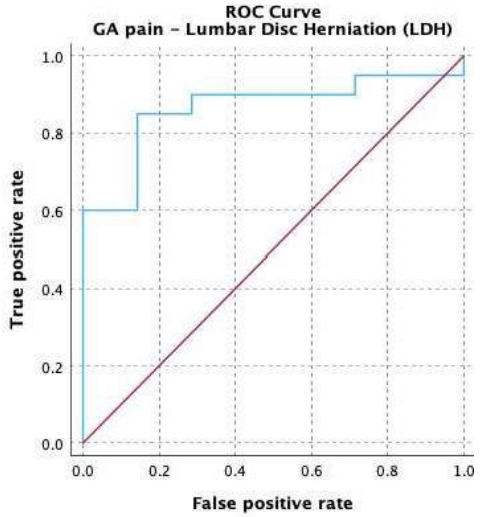
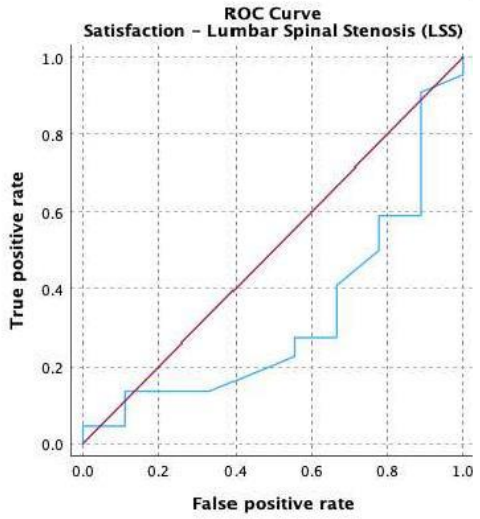
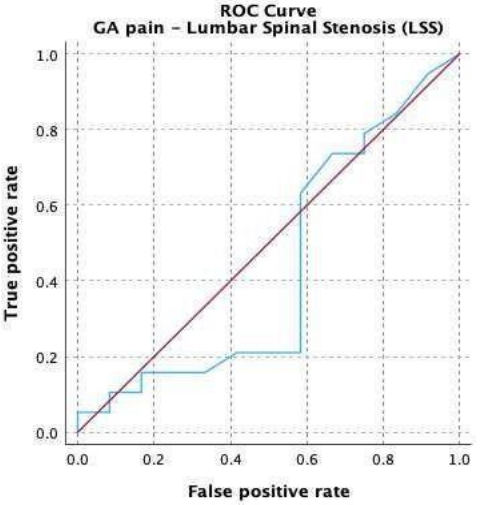
Parameter	Chi-square test
Sex of the patients and satisfaction with the surgery	no statistically significant relationship ($p>0.05$, 0.331)
Employment Status and satisfaction with the surgery	no statistically significant relationship **(**$p>0.05$, 0.781)
Postoperative pain/complaint in smokers	no statistically significant relationship ($p>0.05$, 0.681)
Postoperative hospitalization related to pain/complaints	no statistically significant relationship ($p>0.05$, 0.133)
Influence of preoperative pain in postoperative pain/complaints	statistically significant relationship ($p<0.05$, 0.028)
Influence of patient age in postoperative outcomes	no statistically significant relationship ($p>0.05$, 0.706)

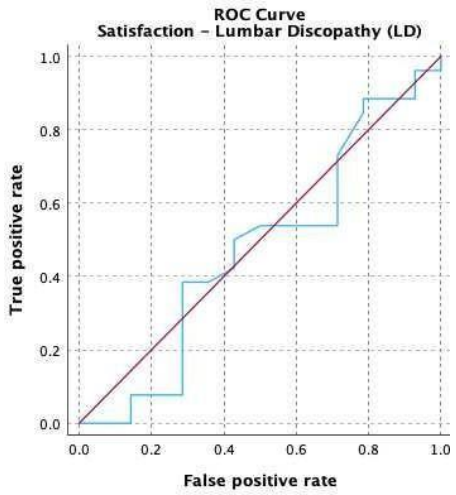
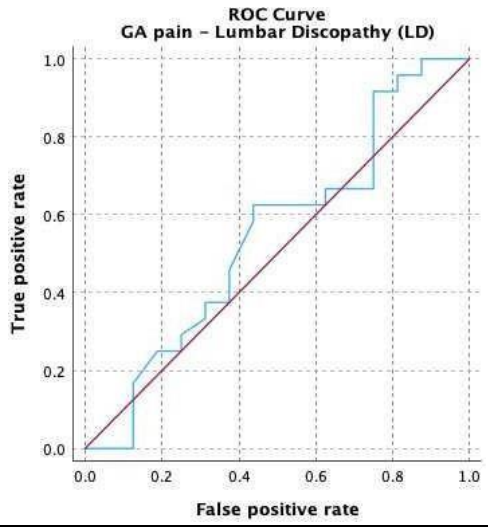
Table XII - Comparison of predicted and observed outcomes for LD surgeries using the DS tool.

Outcome Measure	Predicted (%)	Observed (%)
Proportion of Satisfied Patients	63%	65%
Proportion with Successful Outcome	53%	60%

Table XIII - ROC Curve analysis for outcome measures in different diagnostic groups.

Diagnostic Group	Outcome Measure	ROC Curve Image	AUC	p-value
CR	Satisfaction		0.500	> 0.05
	GA Pain		0.429	> 0.05
LDH	Satisfaction		0.885	< 0.001

	GA Pain		0.864	< 0.001
LSS	Satisfaction		0.326	> 0.05
	GA Pain		0.432	> 0.05

LD	Satisfaction		0.471	> 0.05
	GA Pain		0.547	> 0.05

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