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The Structured Medication Use Questionnaire: A Proposed Framework for Capturing Analgesic Medication Use Alongside Patient-Reported Pain Outcomes

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Abstract

Patient-reported outcome measures (PROMs) are widely used to assess pain and recovery following surgery. However, pain-related outcomes are observed in the context of ongoing analgesic treatment, and similar patient-reported outcomes may therefore occur under substantially different levels of pharmacological treatment. Information on concurrent analgesic medication use may provide important complementary context when interpreting postoperative PROMs. The Structured Medication Use Questionnaire (SMUQ) is proposed as a pragmatic framework for systematically capturing analgesic medication use alongside postoperative patient-reported outcomes. The questionnaire is designed to be administered alongside PROM assessments, using a 24-hour recall period during the first two postoperative weeks and a 14-day recall period thereafter. Reported medications are classified according to the World Health Organization Anatomical Therapeutic Chemical classification system. Medication exposure can be quantified using defined daily doses, while opioid exposure can additionally be expressed as oral morphine milligram equivalents. By documenting the pharmacological context in which patient-reported pain and recovery are observed, the SMUQ is intended to complement rather than replace conventional PROM assessment. The SMUQ is presented as a proposed methodological framework and has not yet undergone formal prospective validation.

Categories: Pain Management, Quality Improvement, Orthopedics
Keywords: analgesic consumption, analgesic medication, orthopaedic surgery, patient-reported outcome measures (proms), postoperative pain

Introduction

Patient-reported outcome measures (PROMs) are a clinical standard used to evaluate symptoms, function, and recovery following surgery. Pain is an important component of postoperative recovery and may be assessed directly using pain intensity scales or as part of broader patient-reported outcome instruments. Recent international consensus work has emphasized the need for standardized patient-reported assessment of postoperative pain to improve consistency and comparability across clinical studies [1].

The interpretation of pain-related outcomes, however, is closely related to the treatment received by the patient. A reported level of pain represents the patient's experience under the prevailing clinical circumstances, including ongoing analgesic treatment. Consequently, comparable pain scores may represent different clinical situations. A patient reporting minimal pain without analgesic medication and a patient reporting the same level of pain while receiving regular multimodal analgesia have achieved a similar patient-reported outcome under different levels of pharmacological treatment. Analgesic medication use should therefore be considered complementary to patient-reported assessment of pain and recovery.

The importance of this distinction is increasingly recognized in perioperative outcome research. Recent consensus recommendations for standardized perioperative endpoints identify pain intensity, supplementary analgesic use, and subjective analgesic effectiveness as distinct outcomes [2]. Analgesic consumption is also frequently reported alongside pain outcomes in clinical trials. A systematic review of 565 randomized trials following hip and knee arthroplasty identified pain, analgesic consumption, and PROMs as separate outcome domains, although substantial heterogeneity existed in how these outcomes were measured and reported [3]. Similar heterogeneity has been demonstrated across other areas of postoperative pain research, limiting comparison between studies and highlighting the need for greater standardization [4].

Several approaches have been proposed to quantify analgesic use. Robinson-Papp et al. developed the Quantitative Analgesic Questionnaire (QAQ) to systematically capture patient-reported chronic pain medication use, including the type, dose, and frequency of analgesic medication [5]. Their work

demonstrated the feasibility of obtaining structured information on actual medication use directly from patients and highlighted discrepancies between prescribed medication and medication as actually taken. However, approaches to recording analgesic medication use remain heterogeneous, particularly in longitudinal surgical studies in which medication use may change substantially during recovery.

The Structured Medication Use Questionnaire (SMUQ) is proposed as a pragmatic framework for systematically recording analgesic medication use alongside postoperative PROMs. It captures the medication used, dose and frequency of administration, indication for treatment, perceived analgesic effect, and changes in medication use over time. Medication exposure can subsequently be standardized using established pharmacological measures, including defined daily doses (DDD) and morphine milligram equivalents (MME). The SMUQ is intended to supplement, rather than replace, PROM assessment by providing information on the pharmacological context in which patient-reported pain and recovery are observed. This paper describes the rationale, structure, and proposed application of the SMUQ in longitudinal studies evaluating postoperative patient-reported outcomes.

Technical Report

Development and structure of the SMUQ

The SMUQ was developed by the author of the present study for use alongside PROMs following elective hip and knee arthroplasty. It has not been previously published and is presented here for the first time as a framework for systematically recording analgesic medication use alongside postoperative patient-reported outcomes more broadly.

The SMUQ was developed in preparation for a separate clinical study. Item selection was primarily informed by clinical experience and the analgesic medications commonly used by patients following surgery at our institution, with selected elements informed by the existing literature. No systematic literature review was conducted during instrument development, and patients were not directly involved in item generation or cognitive interviewing.

The questionnaire was originally developed in Danish, using straightforward terminology intended to facilitate future translation and adaptation to other languages. It was piloted over six months in connection with a separate clinical study, using electronic administration through Research Electronic Data Capture (REDCap) and telephone administration for patients who did not respond electronically. This provided practical experience with questionnaire administration but did not constitute formal validation.

For each medication, the SMUQ records the medication name, strength, formulation, route of administration, dose per administration, frequency of use within the specified recall period, indication for use, perceived analgesic effect, and changes in medication use (Table *1*). These details allow medication exposure to be quantified while accounting for differences between formulations and administration routes. Perceived analgesic effect is recorded as a subjective patient assessment rather than an estimate of the independent pharmacological effect of each medication, which may be difficult to determine during multimodal analgesic treatment.

Domain	SMUQ item	Response
1. Analgesic medication use	Have you used any pain medication during the specified recall period?	No/Yes
Medication	Which pain medication did you use?	Drug name/Predefined medication list including strength and units, formulation, and route
2. Dose and frequency	How many tablets/units did you take per dose?	Number of tablets/Units per administration
	How frequently did you use the medication during the recall period?	Number of days used/Number of doses per day/regular or as needed (PRN)
3. Indication for use	What was the medication taken for?	Pain related to your operated hip/knee/Other pain (please specify)/Both
4. Perceived analgesic effect	How much pain relief do you feel this medication provides during the specified recall period?	0–10 NRS/Unable to assess separately
5. Change in medication use	Are you taking more or less pain medication than before?	Less /The same/More

TABLE 1: The Structured Medication Use Questionnaire (SMUQ)

SMUQ, Structured Medication Use Questionnaire; NRS, Numeric Rating Scale. Medication name, dose, and frequency are subsequently used to derive standardized medication exposure according to the prespecified defined daily doses (DDD) and morphine milligram equivalents (MME) methodology. The recommended recall period is 24 hours during the first two postoperative weeks and 14 days thereafter.

Source: Original table created by the author.

A 24-hour recall period is recommended during the first two postoperative weeks, followed by a 14-day recall period thereafter. These recall periods are recommended to promote consistency across assessments; any deviations should be justified, predefined, and explicitly reported.

Classification and quantification of medication use

Reported medications are classified according to the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification system. Medication exposure is quantified using DDD according to the WHO ATC/DDD Index [6]. For each medication, the average daily dose is calculated across all days within the recall period, including days without medication use, and divided by the corresponding WHO-defined DDD, accounting for the applicable ATC code and route of administration. For intermittent or as-needed medication use, average daily exposure is calculated from the number of days of use, doses per day, units per dose, and medication strength, divided by the total number of days in the recall period.

$$\text{DDD exposure} = \frac{\text{Average Daily Dose}}{\text{WHO-defined DDD}}$$

Individual medications retain their respective ATC classifications, and the applicable version of the WHO ATC/DDD Index is recorded for all classifications and calculations. Non-opioid analgesic exposure is reported separately for each medication and may be summarized by ATC class; DDD values from different medications are not combined into a single overall exposure score. For example, if the calculated average daily dose of a medication is 1,000 mg and its WHO-defined DDD is 2,000 mg, the exposure corresponds to 0.5 DDD per day.

Opioid exposure is additionally expressed in oral MME, calculated using the conversion factors published in the 2022 CDC Clinical Practice Guideline [7]. For example, 20 mg of oral oxycodone per day corresponds to 30 MME/day (20 × 1.5). The guideline provides conversion factors for commonly used opioids, including oral morphine (1.0), oxycodone (1.5), tramadol (0.2), codeine (0.15), tapentadol (0.4), hydromorphone (5.0), and transdermal fentanyl (2.4 per μg/hour). Buprenorphine is reported separately because it is not included in the CDC conversion table.

For patients using more than one opioid, the MME calculated for each opioid is summed to obtain total daily MME. DDD and MME are reported separately.

If medication strength, dose, frequency, or days of use are missing, DDD or MME exposure cannot be

calculated reliably for the affected medication and is therefore reported as missing rather than assumed to be zero.

Assessment schedule

The SMUQ is intended to be administered concurrently with postoperative PROM assessments to provide information on analgesic medication use during recovery. In its current implementation, assessments are conducted at two days, 14 days, 12 weeks, and six months following surgery. The assessment schedule may be adapted to individual study protocols while maintaining concurrent administration with PROMs and the recommended recall periods. Changes in medication use are assessed against available preoperative medication information at day 2 and against the previous SMUQ assessment at subsequent follow-ups.

In the Danish fast-track arthroplasty setting, many patients are discharged before postoperative day 2, and the SMUQ is administered through patient self-report at this assessment. In settings with longer hospital stays, medication administration records may serve as a supplementary data source but should be reported separately from patient-reported medication use.

The SMUQ is currently being implemented prospectively alongside established PROMs as part of an ongoing longitudinal surgical cohort at the author's institution.

Discussion

The SMUQ is proposed as a structured approach to recording analgesic medication use alongside patient-reported outcomes following surgery. Its intended purpose is not to replace established PROMs or measures of pain intensity, but to provide complementary information on the pharmacological treatment present when these outcomes are assessed. This distinction is relevant when evaluating postoperative recovery, as similar patient-reported levels of pain may occur in patients receiving substantially different analgesic treatment.

The concept of assessing medication use alongside pain outcomes is not new [2,3,8,9]. Analgesic consumption is frequently included as an outcome in postoperative pain studies, although considerable heterogeneity exists in how it is defined and reported. In a systematic review of 295 studies following total knee arthroplasty, pain intensity was assessed in 98.3% of studies and analgesic consumption in 88.8%, with substantial variation in the combinations and definitions of reported outcome domains [8]. Analgesic consumption has also been proposed as a core outcome domain in postoperative pain research [9]. These observations support the relevance of recording medication exposure but also illustrate the need for consistent methods when analgesic use is incorporated into postoperative outcome assessment.

The SMUQ shares several features with the QAQ developed by Robinson-Papp et al. [5]. The QAQ demonstrated that structured patient reporting can provide detailed information on actual analgesic use and identified information that was not available from medical records alone in 94% of a subgroup of participants, including over-the-counter medication use and actual use of medication prescribed on an as-needed basis. The instrument also demonstrated high interrater reliability and was able to quantify changes in medication regimens over time [5]. The principal application of the QAQ was the assessment of chronic pain medication regimens and adherence to prescribed treatment. The SMUQ differs primarily in its intended application: it is designed for repeated assessment of analgesic medication use alongside postoperative PROMs during longitudinal follow-up. Other approaches, including the Medication Quantification Scale (MQS III) [10], quantify analgesic medication use through weighted medication scores. Unlike these approaches, the SMUQ is intended primarily as a pragmatic patient-reported framework for documenting medication use alongside postoperative PROMs, rather than generating a single composite medication score. Future validation may include comparisons with established instruments and prescription registry data, although dispensed prescriptions do not necessarily reflect actual medication consumption.

A further feature of the SMUQ is the separation of data collection from subsequent standardization of medication exposure. Rather than assigning an internally derived weighting to individual medications, reported medication use is classified according to the WHO ATC system and non-opioid exposure is expressed relative to the corresponding DDD [6]. Opioid exposure is additionally expressed as MME using established conversion factors [7]. This approach provides reproducible units for describing medication exposure while retaining information on individual substances and pharmacological classes.

Recording the indication for analgesic use is important, as pain and medication use following arthroplasty may be influenced by conditions unrelated to the operated joint. For example, pain originating outside the operated joint may contribute to analgesic use and complicate the interpretation of postoperative outcomes [11].

DDD and MME should, however, be interpreted according to their respective methodological purposes. The DDD is a technical unit developed for drug-utilization research and does not necessarily correspond to the recommended, prescribed, or therapeutically equivalent dose for an individual patient [6,12]. Similarly, MME conversion factors provide an estimate of opioid exposure and cannot account for individual

pharmacokinetic and pharmacodynamic variability [7]. Accordingly, DDD and MME in the SMUQ are intended to standardize the description of medication exposure rather than estimate individual analgesic potency or treatment efficacy. The two measures are retained separately and are not combined into a single composite score.

Several limitations should be acknowledged. Patient-reported medication use may be affected by recall bias, health literacy, and difficulties reporting medication strengths, particularly among older patients. The SMUQ does not systematically capture adverse effects or non-pharmacological treatments, nor does it independently verify reported medication use against prescriptions. Differences between inpatient and outpatient medication data sources, as well as deviations from recommended recall periods, may affect comparability. Perceived analgesic effect is subjective and does not establish pharmacological effectiveness. The SMUQ has undergone a six-month pilot implementation in a clinical research setting, although formal assessment of content validity according to COSMIN has not yet been performed.

Future studies should evaluate the measurement properties and clinical utility of the SMUQ in prospective surgical populations. Although the SMUQ was initially developed for use in patients undergoing elective hip and knee arthroplasty, the framework is not procedure-specific, and its applicability to other surgical populations should be evaluated. Of particular interest is whether longitudinal assessment of medication exposure alongside PROMs provides information on postoperative recovery that is not captured by PROMs alone. Such evaluation should also determine the most appropriate reporting of changes in DDD and MME over time and whether these measures improve interpretation and comparison of postoperative recovery trajectories.

Conclusions

The SMUQ provides a structured framework for recording analgesic medication use alongside postoperative patient-reported outcomes. By capturing medication type, dose, frequency, indication, perceived analgesic effect, and changes in medication use over time, the framework is intended to provide complementary pharmacological context for the interpretation of pain and recovery following surgery. Standardization of medication exposure using DDD and MME may further facilitate consistent reporting of non-opioid and opioid use across longitudinal assessments.

Prospective implementation in an ongoing longitudinal surgical cohort will enable future evaluation of the feasibility, measurement properties, and clinical utility of the framework. Until its feasibility, measurement properties, and clinical utility have been established through prospective evaluation and formal validation, the SMUQ should be considered a proposed methodological framework rather than a validated measurement instrument.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Chris H. Dreyer

Acquisition, analysis, or interpretation of data: Chris H. Dreyer

Drafting of the manuscript: Chris H. Dreyer

Critical review of the manuscript for important intellectual content: Chris H. Dreyer

Supervision: Chris H. Dreyer

Disclosures

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