

Original Article

Feasibility of digital application-based information and follow-up in day-care surgery

Bitten Dybdal¹, Anette Lykke Hindhede² & Tom Møller³

1) Department of Anaesthesia and Operation and the Trauma Centre, HovedOrtoCentre, Copenhagen University Hospital – Rigshospitalet, 2) Centre of Health Research, Copenhagen University Hospital – Rigshospitalet, 3) Centre of Health Research, Københavns Universitetshospital – Bispebjerg and Frederiksberg Hospital, Denmark

Dan Med J 2025;72(11):A11240772. doi: 10.61409/A11240772

ABSTRACT

INTRODUCTION. The rapid adoption of digital health solutions highlights the potential benefits of mobile-based follow-up care. This study examines the feasibility of implementing a digital pain management app for post-operative follow-up in a Danish surgical department.

METHODS. A feasibility study was conducted based on the framework by Bowen et al., assessing feasibility domains such as “Population,” “Acceptance,” “Integration” and “Adherence.” Patients aged 15+ years undergoing same-day ear-nose-throat surgery at a tertiary university hospital were included, provided they owned a smartphone with the MinSP app. Patients received both standard care and optional digital follow-up, with outcomes being analysed using simple mathematical processing.

RESULTS. Among 491 eligible patients, 201 (41.9%) accessed the digital solution. Due to an unanticipated technical error in the automated app allocation, several patients did not receive the app, reducing the success in practical implementation. Among participants, 68.1% completed at least one questionnaire within seven days, with 26.9% requesting staff calls. Although usage was selective, patient interest and acceptance were high, suggesting feasibility following technical improvements.

CONCLUSIONS. Digital post-operative pain management follow-up may be feasible within current hospital resources, but requires consistent app allocation. Future implementations should address technical allocation gaps to ensure broader adoption.

FUNDING. None.

TRIAL REGISTRATION. Not relevant.

Globally, a notable surge has been seen in the introduction of digital, electronic and mobile-health solutions over the past decade, with mounting evidence of digital follow-up after hospital treatment being primarily positive. This encompasses patient interest in follow-up through applications [1], satisfaction with digital application-based follow-up [2, 3], technical feasibility [4, 5], staff willingness to engage in digital care [6], cost-effective utilization of hospital resources [7-9], improved personalised pain management [10] and the potential to reduce readmissions [11].

A qualitative study exploring patients' experiences with post-operative recovery after day care surgery emphasised the importance of patients feeling safe, reassured and acknowledged during the post-operative

recovery period [12]. The study found this feasible with sufficient support and information from their healthcare organisation. Additionally, the use of a mobile app, both for assessment and to facilitate contact with the day surgery unit during the post-operative recovery period, improved cohesion of care and alleviated feelings of post-operative isolation [12]. Systematic e-assessment can enhance patients' subjective sense of recovery and identify key areas for improvement in perioperative care [13]. Additionally, allowing patients to autonomously decide when and if they need contact and support does not increase the frequency of contacts [14].

Following the implementation of a novel interactive mobile health platform for evaluating functional outcomes and pain, Khanwalkar et al. achieved a response rate of 85.6% from patients who reported outcome measures digitally [15], whereas other studies found response rates in the 35-70% range [16]. Warren-Stomberg et al. found that, despite expressed interest in digital follow-up, the non-response in clinical testing accounted for half of the patients included [1].

Evidence supports the potential of mobile apps to enhance compliance, facilitate more frequent and timely collection of patient-reported outcomes with minimal resource use and seamless integration into daily care routines [17]. Furthermore, these apps have demonstrated improvements in outcome measures compared to standard care discharge, reinforcing their potential to enhance overall patient care [18].

To our knowledge, this is the only integrated post-operative pain assistant developed for use within an already existing charting system, where all data and communication are captured and handled alongside all other charting data. Furthermore, we found no published studies of Danish mobile pain-based follow-up or any formal scientific knowledge on overall patient experience of pain and minor comforts immediately after discharge from day-care surgery in Denmark. Furthermore, if feasible, this solution has the potential to continuously obtain data on patient-reported outcomes and pain experiences.

As the international experiences suggest that e-health solutions are highly viable, our primary aim was to evaluate whether the implementation of a digital smartphone application is a feasible follow-up tool after ambulatory surgery. Our secondary aim was to investigate whether it may be implemented within the existing charting system, Sundhedsplatformen (the Danish version of Epic), workplace organisational structures and staff resources.

Methods

Study design

This feasibility study adheres to the framework outlined by Bowen et al. [19], incorporating defined feasibility domains, measures and criteria to determine success. Domains were chosen and adapted to this setting within the areas of "Population", "Acceptance", "Integration", "Practicality", "Critical Adaptation", "Demand", "Adherence" and "Implementation". Furthermore, the success criteria were determined by discussion in the study group before the study was conducted (Table 1).

TABLE 1 Outcome-measures & domains: How to document success.

Domain	Definition	Measure	Criterion for success
Population	Total population for the study period	In- and exclusion criteria	Present
		Causes for exclusion described	Present
Acceptance	Interest and willingness to participate in the study	% of patients who meet the inclusion criteria	> 80%
Integration	The level of system change needed to integrate the new app	Project description and guidelines	Present
		Leadership approval	Present
		Information and teaching of the involved staff	Present
		Appointed key staff	Present
		Staff have viewed the pain app and are familiar with functionality and SP integration	Present
		Written patient information	Present
Practicality	The extent to which a programme can be carried out with intended participants using the existing means, resources and circumstances	Workflow description for allocation to the individual patient	Present
		Patient has phone with MinSP app activated	≥ 90%
		Each patient has received information about app as part of surgery preparation	Ensured
		Each eligible patient has the solution allocated in the system	100%
Critical adaption	Programme contents or new procedures to be appropriate	System for control and manual allocation	Present
		Threshold set for acceptable pain score	Present
		Staff workflow for management of inbox messages described	Present
		Intervention in terms of patient contact described	Present
		Patient requests phone call → call	> 95%
Demand	The extent the intervention is likely to be used 72 h after discharge	Patient cannot cope with pain → call	> 95%
		Patients use of selected intervention activities: post-operative daily questionnaire	> 80%
Attrition	Participants who left study before completion	Percentage of patients who provides no pain data post-operatively	< 25%
Adherence	Patients who meet intervention completion 72 h after discharge	Providing ≥ 1 days of pain score	> 75%
		Patients who receive phone call or communication from staff upon request during follow-up period of 7 days following discharge	> 95%
Implementation		The patients who fulfill the requirements of the domains of Practicality, Demand, Critical adaption and Adherence	> 66%

MinSP = app for SP; SP = Sundhedsplatformen (a patient charting system).

Participants

Inclusion: Patients 15 years or older, scheduled for ear-nose-throat same-day procedures at an outpatient surgery ward at a tertiary university hospital in Eastern Denmark. Inclusion required possession of a private smartphone with an activated MinSP app.

Procedures: Three primary categories: sinus, otologic and auditory implantation surgery.

Exclusion: Patients who did not wish to or were unable to participate (non-Danish speaking, surgery cancelled).

Intervention

A digital pain application was automatically allocated to all eligible patients in the charting system (Sundhedsplatformen), including an application (MinSP) allowing patients to access their own chart and communicate with staff. The intervention ([see Appendix A](#)) was developed by a pain unit and offered video-based patient information, post-operative inquiries on pain, analgesics, nausea, whether the patient could handle the pain and whether the patient required a phone call from staff within seven post-operative days after discharge.

All patients received standard follow-up care. Digital follow-up was offered as an additional option.

Data collection

Data were drawn anonymously and in aggregated form from the reporting system in Sundhedsplatformen, so individual patient charts were not accessed. As formal hospital leadership approval of the project was obtained, hospital policy allows for the analysis and presentation of data. Informed consent was not required.

Statistical analysis

Simple, transparent mathematical processing with numbers and percentages for meeting set the criteria. Demographic descriptions of age (average and range) were recorded, as were binary judicial gender.

Practical execution of the study

The study was executed following a detailed plan, involving leadership meetings, workflow adaptation, educational sessions and comprehensive information dissemination through accessible channels. Patient and staff manuals were developed and tested for electronic designated workflows. On-site and tele-support were provided, and quick access to building teams was ensured for the correction of flaws and errors. Execution was overseen and driven by the Pain Unit.

Staff workflow

Ambulatory office nursing staff played a pivotal role in patient information and follow-up on post-operative days 2-7 ([see Appendix B](#)). Access to the charting system was used only for follow-up and to document actions.

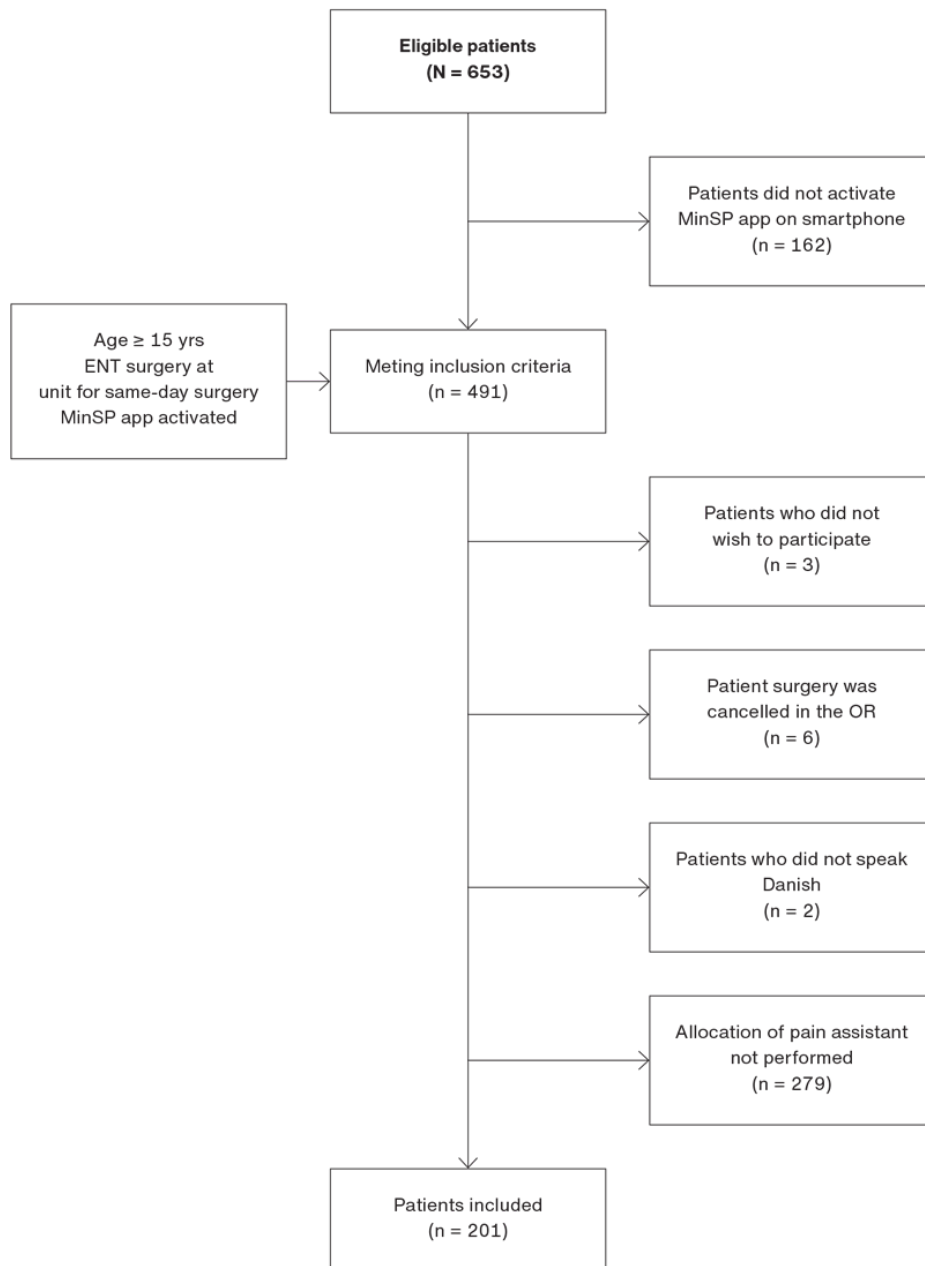
Daycare nursing staff were designated to remind patients of the digital follow-up upon arrival and discharge from the hospital on the day of surgery and to handle follow-up on the first post-operative day.

Trial registration: not relevant.

Results

A total of 491 patients met the inclusion criteria. Among these, 201 wished to participate and were given access to the solution (**Figure 1**). Due to an unknown error in the SP workflows, 279 patients were not automatically given access to the solution as expected. This unfortunately had a negative impact on our overall allocation results. Looking into the proposed domains for feasibility, the chosen criteria for success were not met, as illustrated by the result on complete implementation. Thus, the proportion of patients meeting the domains of Practicality, Demand, Critical adaption and Adherence was as low as 7.7% (**Table 2**).

FIGURE 1 Patient inclusion flow chart.



ENT = ear-nose-throat; MinSP = app for Sundhedsplatformen (a patient charting system);
OR = operating room.

TABLE 2 Overview of feasibility domains related to pain management in day surgery: criteria & results.

Domain	Definition	Measure	Criterion for success	Results	
				eligible patients ^a	allocated patients ^b
Population	Total population for the study period	In- and exclusion criteria	Present	Yes	Yes
		Causes for exclusion described	Present	No	No
Acceptance	Interest and willingness to participate in the study	Patients who meet the inclusion criteria	> 80%	75.2%	80%
Integration	The level of system change needed to integrate the new app	Project description and guidelines	Present	Yes	Yes
		Leadership approval	Present	Yes	Yes
		Information and teaching of involved staff	Present	Yes	Yes
		Appointed key staff	Present	Yes	Yes
		Staff has viewed the pain app and are familiar with functionality and SP integration	Present	Yes	Yes
		Written patient information	Present	Yes	Yes
		Workflow description for allocation to the individual patient	Present	No (automated)	No
Practicality	The extent to which a programme can be carried out with intended participants using the existing means, resources, and circumstances	Patients have a phone with the MinSP app activated	≥ 90%	75.2%	80%
		Each patient has received information about app as part of surgery preparation	Ensured	Not ensured	Not ensured
		Each eligible patient has the solution allocated in the system	100%	41.9%	100%
		System for control and manual allocation	Present	Not present	Not present
Critical adaption	Programme contents or new procedures to be appropriate	Threshold set for acceptable pain score	Present	Yes	Yes
		Staff-workflow for management of inbox messages described	Present	Yes	Yes
		Intervention in terms of patient contact described	Present	Yes	Yes
		Patients request phone call → call	> 95%	100%	100%
		Patients cannot cope with pain → call	> 95%	100%	100%
Demand	The extent the intervention is likely to be used 72 h after discharge	Patients' use of selected intervention activities: post-operative daily questionnaire, post-operative inquiry	> 80%	28.1%	68.2%
Attrition	Participants who left study before completion	Patients who provide no pain data post-operatively	< 25%	71.9%	31.9%
Adherence	Patients who are compliant with the intervention 72 h after discharge	Providing ≥ 1 days of pain score	> 75%	28.1%	63.7%
		Providing all 3 days of pain scores	> 50%	6.9%	22.3%
		Patients who receive phone call or communication from staff upon request during follow-up period of 7 days following discharge	> 95%	100%	100%
Implementation	Patients who meet the requirements of the domains of Practicality, Demand, Critical adaption and Adherence		> 66%	7.7%	34.8%

a) All patients meeting inclusion criteria.

b) Segment of patients who had the solution allocated in the system for use.

When focusing on the included patients who did have access to the solution (n = 201), both men and women were included almost equally, with an average age of 31 years (Table 3); 18.9-27.9% viewed the information videos about digital follow-up, and 29.4-42.8% viewed the health-related videos (Table 3). In all, 137 patients (68.1%) completed at least one inquiry or questionnaire within the seven-day follow-up period (63.8 within the first three post-operative days). Among these patients, 54 (26.9%) requested a phone call and 13 (6.2%) answered that they “could not cope with post-operative pain”, which also elicited a phone call. A total of 67 patients received a phone call. All requests for a phone call from staff were met and documented (Table 3).

TABLE 3 Demographic description and results, average age 31 (15-76) yrs.

	n (%)	Content in Danish
<i>Legal gender</i>		
Male	100	
Female	101	
<i>Use of videos</i>		
Introduction of app	39 (19.4)	"Brug af MinSP Assistent"
Preparation for surgery	64 (31.8)	"Forberedelse til efter operation"
Post-operative pain	59 (29.4)	"Smerter efter din operation"
Non-pharmacological management	77 (38.3)	"Smertebehandling"
Pharmacological management	86 (42.8)	"Smertestillende midler"
Nausea and vomiting	86 (42.8)	"Kvalme og opkastninger"
End of pain assessments	38 (18.9)	"Forløbet er slut"
Constipation	74 (36.8)	"Hård mave og forstoppelse"
End of app	56 (27.9)	"Smertescoring slut"
<i>Patient questionnaire & inquiries</i>		
Single questionnaires ^a & inquiries ^b	459	
Patients returning ≥ 1 questionnaire or inquiry	137 (68.2)	
Patients returning questionnaires on 1st through 3rd post-operative days	137 (63.2)	
Patients returning all 3 questionnaires on 1st through 3rd post-operative days	45 (22.3)	
Patients returning inquiries on 4th through 7th post-operative days	86 (42.8)	
<i>Phone calls</i>		
Patients requesting a phone call	54 (26.9)	
Patients answering yes to "not being able to cope with pain", which elicits a phone call from staff	13 (6.2)	
Phone calls performed by staff, total	67	

MinSP = app for Sundhedsplatformen (a patient charting system).

a) Full set of questions: 1st, 2nd, 3rd post-operative days.

b) Patients ask for phone call: 4th, 5th, 6th, 7th post-operative days.

Discussion

The conversion of surgical procedures into ambulatory surgery represents a strategic approach to optimising hospital resources, thereby increasing the capacity to accommodate a larger number of patients. Escalation in the complexity of ambulatory procedures underscores the need for effective post-operative follow-up and information, particularly in the immediate post-operative period. During this phase, patients are discharged and expected to assume responsibility for their post-surgery care, diverging from the traditional model of hospitalisation with continuous care of healthcare professionals. Given that direct contact with health professionals is primarily initiated by patients in the immediate post-operative period, executing high-flow,

same-day surgery demands viable means of disseminating patient information, ensuring accessible communication and instilling a sense of security. A digital application, as proposed by this pain assistant, may represent a feasible means to provide patients with easy access to staff and report outcomes when at home, as they appeared able to navigate and utilise the features of the digital solution and content to engage in digital follow-up.

Although 491 patients met the inclusion criteria, only 201 (41.9%) were included. Assuming that automatic allocation based on defined patient- and procedure-specific criteria would secure allocation to all eligible patients proved misleading. The initial edition of the pain assistant in Sundhedsplatformen was built to capture all eligible patients based on set age criteria, booking type and surgical field and validated by the builders in a subtext of the system. However, during the study, automatic allocation was inconsistent and several patients were missed due to an unknown error.

This technical error adversely affected the feasibility outcomes, as detailed in Table 2. Technical feasibility is therefore limited, unless this issue is addressed in future implementations. However, among patients who had access to the solution, feasibility outcomes were more favourable, although the implementation did not fully meet the success criteria defined by the study group. However, patients showed considerable interest in the solution, with a high acceptance rate ($201/212 = 95\%$), although this rate might have been lower had all the patients been allocated the solution. These response rates were broadly consistent with international experiences [16]. Although they were slightly lower than those reported by Khanwalkar et al. [20], our results indicate that patients recognised the application's functionality and opportunities and, to a large extent, were able to utilise its features as needed.

No formal registration of work hours was conducted for analogue patient-initiated follow-up before implementation of the digital solution; staff subjectively reported that digital follow-up was performed without requiring additional resource. Furthermore, they deemed all inquiries for a phone call to be relevant.

Among allocated patients, use of the features varied: some completed one or more health questionnaires or requested phone calls, but they did not systematically watch all videos or complete all questionnaires. We interpret this to mean that the patients only used the possibility and information if they perceived it to be necessary. This corresponds with Stomberg et al. [5] who found that although expressed interest in digital follow-up was high, this was not fully reflected in a clinical study testing a mobile app for post-operative follow-up. In an era of abundant, easily accessible online information, we found the interaction noteworthy, demonstrating the need for interaction with the staff. We therefore argue that the application is a feasible solution. However, to document this, the feasibility criteria must be revised for validity to accommodate user variance and relevance.

As part of separate studies on patient satisfaction, we concurrently conducted a voluntary, web-based, validated questionnaire survey. The survey assessed satisfaction with digital follow-up, the video-based content of the application and overall satisfaction with the care pathway. While the results will form the basis of a future publication, preliminary findings showed that patients were generally very satisfied with the digital pathway and its content. However, participants reported several technical issues related to functionality and expressed a need for more information about the surgical procedure, specific operative details and guidelines regarding the surgical site and wound care.

Promoting the activation of "MinSP" by all patients remains a continuous focus in both regions. Over time, we expect electronic health literacy in the population to improve, supporting a wider adoption of digital and application-based tools in healthcare. The proposed solution is readily applicable across most surgical fields and patient groups, free of charge and feasible within existing personnel resources.

Further studies are in progress as we aim to validate the solution in a randomised clinical trial, where the

solution will be used by a group of patients undergoing surgery at a secondary spine unit.

Conclusions

Converting standard procedures for post-operative follow-up on pain and minor discomforts in the immediate period after discharge into a digital, systematic application-based solution may be feasible and implemented within the hospital system's existing digital structures and staff resources; however, further research and technical assistance are required to validate the solution.

Staff commonly reported that follow-up did not require more attention than previously, and that the amount and content of patient inquiries were considered relevant. However, ensuring patient access to the solution is fundamental for successful implementation.

Data sharing statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Correspondence *Bitten Dybdal*. E-mail: bitten.dybdal@regionh.dk

Accepted 25 July 2025

Published 15 October 2025

Conflicts of interest BD reports financial support from or interest in Region Hovedstaden, Lundbeck, Novo, Eli Lilly Demant, GN Store Nord, Coloplast, Embla Medical, Bavarian & Ambu. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. These are available together with the article at ugeskriftet.dk/dmj

Acknowledgements Institutions: UCSF - Center for Sundhedsfaglig Forskning, Region Hovedstaden, CPI - Center for Patient Inddragelse, Region Hovedstaden, RegionH E-læring, Center for HR og Uddannelse, Region Hovedstaden, Collaborators, Ragnheiddur Traustadottir Cand.Polyt., Sektion for Værdi og Sammenhæng, Rigshospitalet, Karsten Lomholt Lassen, PhD student, former project nurse in the Unit for Acute Management

References can be found with the article at ugeskriftet.dk/dmj

Cite this as Dan Med J 2025;72(11):A11240772

doi 10.61409/A11240772

Open Access under Creative Commons License [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)

Supplementary material: <https://content.ugeskriftet.dk/sites/default/files/2025-07/a11240772-supplementary.pdf>

REFERENCES

1. Warren-Stomberg M, Jacobsson J, Brattwall M, Jildenstål P. At-home monitoring after surgery/anaesthesia - a challenge. *J Eval Clin Pract*. 2016;22(6):882-886. <https://doi.org/10.1111/jep.12551>
2. Kneuert PJ, Jagadeh N, Perkins A, et al. Improving patient engagement, adherence, and satisfaction in lung cancer surgery with implementation of a mobile device platform for patient reported outcomes. *J Thorac Dis*. 2020;12(11):6883-6891. <https://doi.org/10.21037/jtd.2020.01.23>
3. Thiel B, Godfried MB, van Huizen EC, et al. Patient reported postoperative pain with a smartphone application: a proof of concept. *PLoS One*. 2020;15(5):e0232082. <https://doi.org/10.1371/journal.pone.0232082>
4. Rian T, Sand K, Skogvoll E, et al. A web-based communication tool for postoperative follow-up and pain assessment at home after primary knee arthroplasty: feasibility and usability study. *JMIR Form Res*. 2022;6(4):e34543.

<https://doi.org/10.2196/34543>

5. Stomberg MW, Platon B, Widén A, et al. Health information: what can mobile phone assessments add? *Perspect Health Inf Manag.* 2012;9(fall):1-10
6. Highland KB, Tran J, Edwards H, et al. Feasibility of app-based postsurgical assessment of pain, pain impact, and regional anesthesia effects: a pilot randomized controlled trial. *Pain Med.* 2019;20(8):1592-1599. <https://doi.org/10.1093/pm/pny288>
7. Armstrong KA, Semple JL, Coyte PC. Replacing ambulatory surgical follow-up visits with mobile app home monitoring: modeling cost-effective scenarios. *J Med Internet Res.* 2014;16(9):e3528. <https://doi.org/10.2196/jmir.3528>
8. Dahlberg K, Philipsson A, Hagberg L, et al. Cost-effectiveness of a systematic e-assessed follow-up of postoperative recovery after day surgery: a multicentre randomized trial. *Br J Anaesth.* 2017;119(5):1039-1046. <https://doi.org/10.1093/bja/aex332>
9. Lizée T, Basch E, Trémolières P, et al. Cost-effectiveness of web-based patient-reported outcome surveillance in patients with lung cancer. *J Thorac Oncol.* 2019;14(6):1012-1020. <https://doi.org/10.1016/j.jtho.2019.02.005>
10. Carlier J, Robin F, Pages N, et al. Pain evaluation after day-surgery using a mobile phone application. *Anaesth Crit Care Pain Med.* 2021;40(3):100879. <https://doi.org/10.1016/j.accpm.2021.100879>
11. Keng CJS, Goriawala A, Rashid S, et al. Home to stay: an integrated monitoring system using a mobile app to support patients at home following colorectal surgery. *J Patient Exp.* 2020;7(6):1241-1246. <https://doi.org/10.1177/2374373520904194>
12. Dahlberg K, Jaensson M, Nilsson U, et al. Holding it together - patients' perspectives on postoperative recovery when using an e-assessed follow-up: qualitative study. *JMIR Mhealth Uhealth.* 2018;6(5):e10387. <https://doi.org/10.2196/10387>
13. Jaensson M, Dahlberg K, Eriksson M, Nilsson U. Evaluation of postoperative recovery in day surgery patients using a mobile phone application: a multicentre randomized trial. *Br J Anaesth.* 2017;119(5):1030-1038. <https://doi.org/10.1093/bja/aex331>
14. Dahlberg K, Jaensson M, Nilsson U. "Let the patient decide" – person-centered postoperative follow-up contacts, initiated via a phone app after day surgery: secondary analysis of a randomized controlled trial. *Int J Surg.* 2019;61:33-37. <https://doi.org/10.1016/j.ijsu.2018.11.022>
15. Khanwalkar AR, Shen J, Kern RC, et al. Utilization of a novel interactive mobile health platform to evaluate functional outcomes and pain following septoplasty and functional endoscopic sinus surgery. *Int Forum Allergy Rhinol.* 2019;9(4):345-351. <https://doi.org/10.1002/alr.22273>
16. Lidder AK, Detwiller KY, Price CPE, et al. Evaluating metrics of responsiveness using patient-reported outcome measures in chronic rhinosinusitis. *Int Forum Allergy Rhinol.* 2017;7(2):128-134. <https://doi.org/10.1002/alr.21866>
17. Belarmino A, Walsh R, Alshak M, et al. Feasibility of a mobile health application to monitor recovery and patient-reported outcomes after robot-assisted radical prostatectomy. *Eur Urol Oncol.* 2019;2(4):425-428. <https://doi.org/10.1016/j.euo.2018.08.016>
18. Pooni A, Brar MS, Anpalagan T, et al. Home to stay: a randomized controlled trial evaluating the effect of a postdischarge mobile app to reduce 30-day readmission following elective colorectal surgery. *Ann Surg.* 2023;277(5):e1056-e1062. <https://doi.org/10.1097/SLA.0000000000005527>
19. Bowen DJ, Kreuter M, Spring B, et al. How we design feasibility studies. *Am J Prev Med.* 2009;36(5):452-457. <https://doi.org/10.1016/j.amepre.2009.02.002>
20. Khanwalkar AR, Shen J, Kern RC, et al. Utilization of a novel interactive mobile health platform to evaluate functional outcomes and pain following septoplasty and functional endoscopic sinus surgery. *Int Forum Allergy Rhinol.* 2019;9(4):345-351