DANISH MEDICAL JOURNAL

Original Article

Criteria to determine readiness for discharge after pulmonary surgery

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Dan Med J 2025;72(12):A04250304. doi: 10.61409/A04250304

ABSTRACT

INTRODUCTION. The aim of this study was to establish a consensus on criteria to determine readiness for hospital discharge to the patient's own home after pulmonary surgery in Denmark.

METHODS. All Danish board-certified thoracic surgeons were invited to give their expert opinion on which criteria they use to determine readiness for discharge following pulmonary surgery. Opinions were collected and a consensus was achieved through a three-round Delphi survey. In round 1, experts gave their opinions in free text. In round 2, answers were grouped and rated using a five-point Likert scale. In round 3, group answers from round 2 were presented for re-evaluation, and experts were given the opportunity to change their ranking in accordance with the Delphi methodology. To minimise peer influence, individual responses were anonymised and presented without attribution. Consensus was achieved when at least 75% of the experts in round 3 rated discharge criteria and endpoints four or more on a Likert scale.

RESULTS. Among 31 experts, 30 (97%) participated in all three rounds. Consensus was achieved on 23 specific endpoints covering chest drain removal, respiratory function, pain management, mobilisation, arrhythmia, infection, oral intake and self-care.

CONCLUSIONS. A consensus was reached on discharge criteria after pulmonary surgery based on opinions from specialist thoracic surgeons across all institutions performing thoracic surgery in Denmark. These results may facilitate future research in enhanced recovery after surgery and enable differentiation between readiness for discharge and actual discharge.

FUNDING. None.

TRIAL REGISTRATION. Not relevant.

Length of in-hospital stay (LOS) is a surrogate marker of recovery after surgery and a measure of treatment quality. Since the introduction of enhanced recovery after surgery (ERAS) in thoracic surgery, a reduction in perioperative complications and LOS has been shown [1]. A key element of ERAS is the use of minimally invasive surgery to reduce the surgical trauma [2]. In Denmark, the rate of lobectomies performed using video-assisted thoracoscopic surgery (VATS) increased from 30.1% in 2005 to 93.5% in 2022 in the highest performing centre [3, 4]. In parallel with the evolution of ERAS in thoracic surgery, LOS after pulmonary lobectomies has been reduced from six days to two days over a 20-year period [5-8].

However, measuring quality only using a surrogate such as LOS may lead to inaccurate conclusions. Early discharge before full recovery to the preoperative state may be common practice in some countries because patients with complications are discharged to a nursing facility, or patients with air leakage lasting longer than a

week are discharged with a chest drain for planned ambulatory management [9, 10]. In other countries, delayed discharge may occur because of favourable insurance agreements, although patients have recovered and could have been discharged earlier [11]. Furthermore, patients may have recovered somatically but remain admitted for social reasons, due to long distances, transportation issues or simply because they live alone [12]. The aim of this study was to establish a consensus on the criteria used to determine readiness for hospital discharge to own home after pulmonary surgery in Denmark.

METHODS

A three-round web-based Delphi process was used to systematically survey experts in thoracic surgery in Denmark. Experts were defined as board-certified cardiothoracic surgeons in Denmark, with daily subspecialty function in general thoracic surgery. All 31 board-certified cardiothoracic surgeons with a sub-speciality in thoracic surgery at the four Danish cardiothoracic surgery institutions (Copenhagen University Hospital Rigshospitalet, Odense University Hospital, Aarhus University Hospital and Aalborg University Hospital) were invited to participate.

Questionnaires were sent directly to each participant using an online survey platform via a secure website [13]. In accordance with the Delphi methodology, all responses were anonymous to respondents and research individuals to ensure a consensus based on opinion rather than divergence towards any official or unofficial leader [14, 15]. At each institution, a research collaborator acted as a facilitator to ensure a high questionnaire completion rate. The primary investigator (IJI) collected all answers. To enhance the robustness of the findings, achieving a higher response rate was prioritised over shortening the data collection period [15].

In round 1 (August 2023), the open-ended questions “Which criteria best indicate that a patient has achieved sufficient recovery from pulmonary surgery to be considered ready for hospital discharge?” and “How would you determine that this criterion has been achieved?” were posed to our experts. After round 1, the responses were summarised, rewritten into common language and formatted into a rating questionnaire. Thereafter, a qualitative thematic analysis was conducted (by IJI and BLH). Themes were discussed openly and drafted between IJI and BLH. All answers were listed and grouped together into themes. Answers that were similar or partially overlapping were merged into criteria with greater specificity. Other statements were divided into several criteria when they contained multiple components that were important to evaluate. This allowed participants to agree or disagree on more specific criteria. No disagreements occurred during the analysis.

In round 2 (October 2023), our experts were invited to rank their agreement on each discharge criterion and corresponding endpoints using a five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree). Experts were also presented with the opportunity to comment on the question or their answer to optimise the questionnaire.

Finally, in round 3 (December 2023), responses and comments were incorporated into a third and final questionnaire, where experts were presented with the opportunity to review the results and change their own ranks considering the responses and arguments provided by the group as a whole (but with individual responses blinded).

A consensus was achieved when the discharge criteria and end points were rated as 4 or 5 on a Likert scale by at least 75% of the experts in round 3 [14].

Statistical analysis

Descriptive statistics were used to summarise the results. Distributions and scores for all parameters were measured with calculated medians. Categorical data were reported as frequency, number and percentage. All

statistical analyses were performed using STATA MP 16 (StataCorp LLC). Written consent was obtained from all participants at the onset of the study via the Delphi platform as part of the first questionnaire round [15]. Approval from an ethics committee was not required for this study.

Trial registration: not relevant.

RESULTS

Among 31 board-certified cardiothoracic surgeons with a subspecialty in general thoracic surgery, 30 completed all three rounds and one declined our invitation. Most specialists were experienced surgeons with an annual case load of 50 or more pulmonary procedures (n = 27, 87%) and more than ten years of experience as a specialist thoracic surgeon (n = 21, 68%). Among respondents, 19% (n = 6) had been specialists for 5-10 years, and 13% (n = 4) for up to five years; 45% (n = 14) reported having an established ERAS programme, but 90% reported to not have or not know of a set of written standardised discharge criteria at their institution. Affiliations with each of the four thoracic surgical institutions was not part of the baseline characteristics, as the anonymity of the respondents was prioritised in alignment with the Delphi methodology. Data collection for the study was completed in six months. During the data collection period, one resident became board-certified but was not included in this study. Another expert retired after completing the final round. This expert's answers were not excluded as they were completed during active duty.

Thematic analyses of the responses in the first round identified several discharge criteria related to recovery from pulmonary surgery. In round 3, consensus was achieved on the topics: chest drain removal (≥ 83.3%), respiratory function (≥ 83.3%), pain management (≥ 76.6%), mobilisation (≥ 80%), arrhythmia (≥ 80%), infection (≥ 80%), oral intake (≥ 80%) and self-care (≥ 76.6%). In total, a consensus was achieved on 23 specific endpoints. There were no changes between rounds 2 and 3. **Table 1** summarises the results from round 3. **Table 2** summarises a proposed set of discharge criteria after pulmonary surgery based on the results from Table 1, indicating short-term post-operative recovery. **Figure 1** illustrates the results from round 3, visualised as a Likert Bar Chart.

TABLE 1 Results from round three with percentage agreement and median Likert scale scores. A consensus was reached on the 23 endpoints marked with a note[a].

	Agreement: % of agree or strongly agree	Likert scale score, median (IQR)
The post-operative chest drain(s) has/have been removed[a]	83.3	4 (4-4)
A post-operative chest drain remains in place and connected to a Heimlich valve because of air leak	56.6	4 (3-4)
A chest X-ray after drain removal has been deemed clinically acceptable according to the following[a]	100	5 (4-5)
No pneumothorax requiring drain insertion		
No subcutaneous emphysema requiring drain insertion		
No fluid-requiring drain insertion		
Adequate pain control, measured by VAS, NRS or equivalent, using oral analgesia[a]	86.6	5 (4-5)
The patient is able to mobilise without the need for IV opioids[a]	76.6	4.5 (4-5)
The patient is able to cough[a]	90	4.5 (4-5)
The patient is able to take deep breaths[a]	83.3	4 (4-5)
The patient is able to mobilise sputum/phlegm[a]	83.3	4 (4-5)
The patient is mobilised and able to perform self-care and daily activities, e.g., get dressed, shower, go to the toilet, in accordance with preoperative performance status[a]	80	4 (4-4)
The patient has recovered cognitive function corresponding to the preoperative level	70	4 (3-4)
The patient has passed flatus ≥ 1 ×	70	4 (3-4)
The patient has passed stool ≥ 1 ×	70	4 (2-4)
The patient has resumed oral intake of liquids without nausea or vomiting[a]	80	4 (4-4)
The patient has resumed oral intake of food without nausea or vomiting	70	4 (3-4)
The patient is able to take regular medicine[a]	80	4 (4-4)
The patient is able to pass urine without a catheter	53.5	4 (2-4)
The patient is able to pass urine[a]	76.6	4 (4-5)
Clinical examination and biochemistry without signs of untreated complication or medical condition[a]	76.6	4 (4-5)
Blood pressure is stable and consistent with preoperative levels[a]	80	4 (4-4)
The heart rate and pulse are stable and consistent with preoperative levels, or a benign arrythmia is present and sufficiently treated[a]	86.6	4 (4-4)
There is no arrhythmia	36.6	3 (2-4)
The respiratory rate is stable and consistent with the expected post-operative level for the specific patient[a]	80	4 (4-5)
No or minimal deterioration of pulmonary function compared to preoperative state	40	3 (2-3)
Restored preoperative lung function adjusted for the size of the procedure and the presence of adequate non-oxygen-requiring lung function	53.3	4 (3-4)
The oxygen saturation in blood > 90%	40	3 (3-4)
The oxygen saturation in blood is stable and consistent with the expected post-operative level for the specific patient[a]	90	4 (4-4)
The patient does not depend on supplementary oxygen unless required preoperatively	73.3	4 (3-4)
No sign of infection, clinically or biochemically, requiring IV fluid antibiotics[a]	83.3	4 (4-5)
Normal temperature or decreasing temperature towards 37 °C during antibiotic treatment	70	4 (3-4)
Normal leukocytes or decreasing towards normal[a]	83.3	4 (4-4)
Decreasing CRP concentration during antibiotic treatment for infection[a]	80	4 (4-4)
CRP concentration < 100 mg/l during antibiotic treatment for infection	46.6	3 (3-4)
No need for IV medication[a]	80	4 (4-5)
Absence of anaemia, with haemoglobin concentration > 4.5 mmol/l, except in cases where a chronic condition causing anaemia is present	70	4 (3-4)
The patient is informed of the process/restitution after surgery and plan for follow-up[a]	100	5 (4-5)
The patient is self-reliant or with sufficient support at home: family, friends or home support[a]	86.6	4 (4-5)
The patient feels safe[a]	83.3	4 (4-4)
The patient accepts the recovery plan	73.3	4 (4-4)

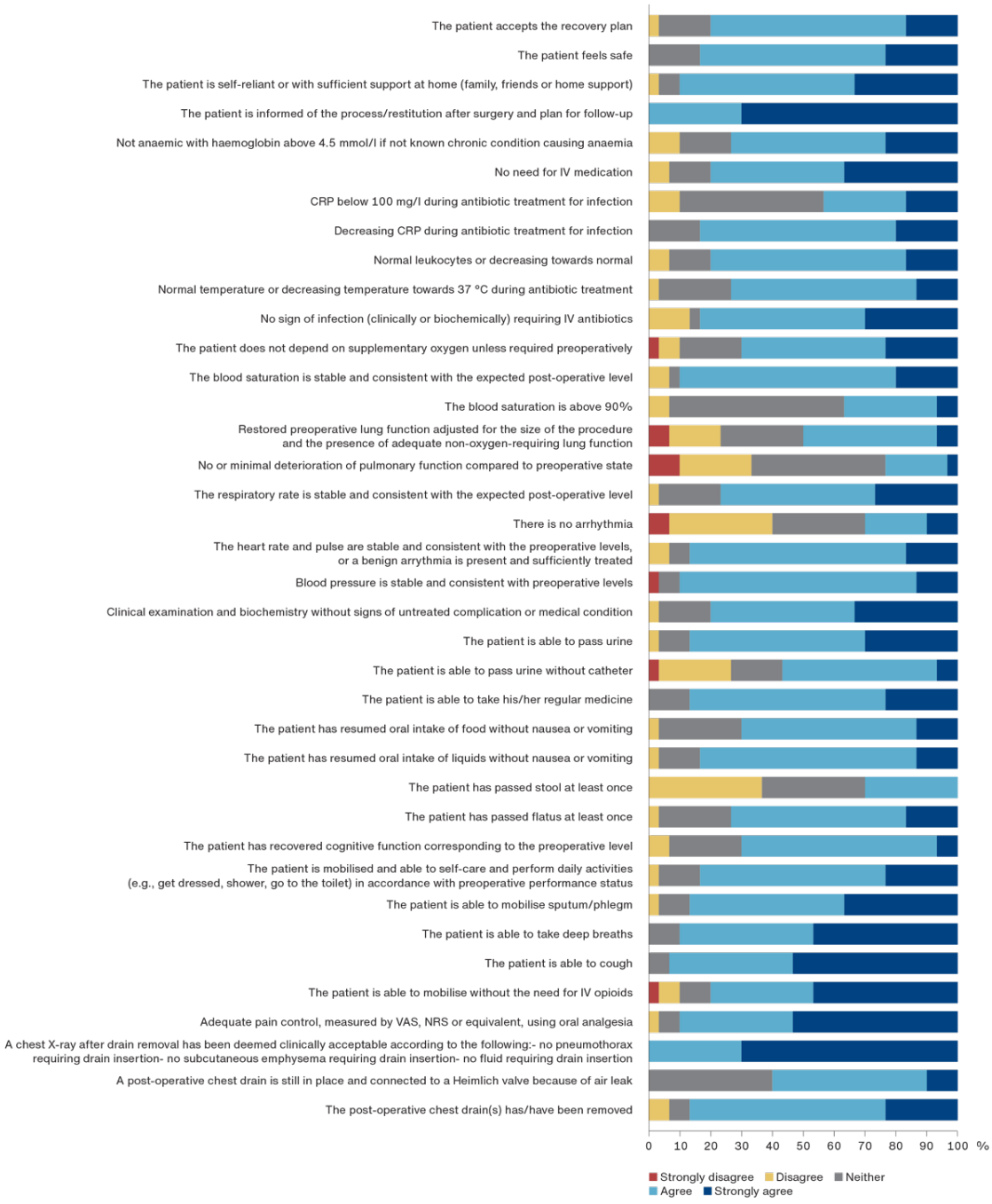
IV = intravenous; NRS = numeric rating scale; VAS = visual analogue scale.
a) Consensus was achieved if > 75% of experts agreed or strongly agreed.

TABLE 2 Proposed Danish criteria to determine readiness for hospital discharge following pulmonary surgery.

Topic	Criteria
Chest drain removal	The post-operative chest drain(s) has/have been removed
	The following chest X-ray shows no pneumothorax, subcutaneous emphysema or fluid-requiring drain insertion
Pain management	Adequate pain control, measured by VAS, NRS or equivalent, using oral analgesia
	The patient is able to:
	Mobilise without the need for IV opioids
	Cough
	Take deep breaths
	Mobilise sputum/phlegm
Mobilisation	The patient is mobilised and able to perform self-care and daily activities, e.g., get dressed, shower, go to the toilet, in accordance with preoperative performance status
Oral intake	The patient has resumed oral intake of liquids without nausea or vomiting
	The patient is able to take regular medicine
Urinary function	The patient is able to pass urine
Clinical exam and vitals	Clinical examination and biochemistry without signs of untreated complication or medical condition
	Blood pressure is stable and consistent with preoperative levels for the specific patient
	The heart rate and pulse are stable and consistent with preoperative levels, or a benign arrythmia is present and sufficiently treated
	The respiratory rate is stable and consistent with the expected post-operative level for the specific patient
	The blood saturation is stable and consistent with the expected post-operative level for the specific patient
Infection	No sign of infection: clinically or biochemically, requiring IV antibiotics
	Normal leukocytes or decreasing towards normal
	Decreasing CRP concentration during antibiotic treatment for infection
	No need for IV medication
Self-care	The patient is informed of the process/restitution after surgery and plan for follow-up
	The patient is self-reliant or with sufficient support at home: family, friends or home support
	The patient feels safe

IV = intravenous; NRS = numeric rating scale; VAS = visual analogue scale.

FIGURE 1 Likert Bar Chart of results from round 3.



IV = intravenous; NRS = numeric rating scale; VAS = analogue scale.

DISCUSSION

This study details consensus among 97% (30/31) of thoracic surgeons in Denmark on criteria for discharging patients after pulmonary surgery, where consensus was defined as over 75% of participants supporting the topic on 23 specific endpoints. The high response rate reflects current practice in Denmark and is summarised as a set of discharge criteria to guide clinicians and researchers.

As indicated in Table 1, some of the evaluated topics overlapped, since all topics suggested in round 1 were kept and ultimately rated in rounds 2 and 3. This aligns with the Delphi methodology, as different variations of similar

treatments can be assessed and compared. An example is the two opposing criteria on chest drains (discharge with or without). Importantly, there was agreement on not discharging patients with a chest drain, which differs from other institutions in other countries. A central element in the evolution of ERAS is to continuously assess the reasons for post-operative hospitalisation by asking the question: "Why is the patient still admitted today, and what can we do to improve the situation?" [2]. Despite major improvements in thoracic surgery during past decades, air leak and chest drains remain some of the most important factors keeping patients admitted after pulmonary surgery [5, 16]. This criterion seems important when comparing results across institutions, since discharging patients with a chest drain may reduce LOS but does not seem to reflect complete in-hospital recovery as described in the current consensus criteria.

According to the latest published data from the Danish Lung Cancer Registry 2022, 88% of all segmentectomies and 83% of all lobectomies in Denmark are performed as VATS with corresponding individual institutional rates reaching 100% and 94%, respectively [4]. The median national LOS after pulmonary resection is three days. The proposed discharge criteria may serve as a context for data from the national registries when comparing institutional results.

Patient discharge is not an end in itself, as premature discharge may increase morbidity and mortality due to late detection of complications [15]. However, LOS is a good indication of the recovery level and should not be viewed as a risk factor for readmission [6, 7, 17, 18]. In two recent reports, the 30-day readmission rate was 7.8-8.3%, with pulmonary complications (not described) being the most important readmission cause [17, 18]. Similarly, two recent reports from Copenhagen found 30-day readmission rates of 7.8% after VATS wedge resection and 15.2% after VATS lobectomy. [6, 7]. In both cohorts, pulmonary complications were also the main driver of readmissions, and in the lobectomy cohort with the highest frequency of readmissions on post-operative days three and five. In the lobectomy cohort, pulmonary complications were mostly air leak and pneumonia, whereas in the wedge resection cohort, pulmonary complications were pneumothorax, pneumonia and pleural effusions [6, 16]. Risk factors identified for readmission were chronic obstructive pulmonary disease, alcohol abuse and current smoking, among which the latter two are potentially modifiable. In another study from Copenhagen of reasons for continued post-operative hospital admission, air leak, pneumonia and pain were the main reasons for continued hospitalisation after VATS lobectomy [16].

ERAS pathways are typically linked to specific procedures (e.g. lobectomy) or diseases (e.g. lung cancer). Our survey does not differentiate between types of procedures, as the aim of discharge is not related to the surgery but to the standards that need to be achieved before the surgeon finds that discharge is safe [19]. In our current survey, the potential issue of needing procedure-specific discharge criteria was not raised by the experts, which seems to support that procedure-specific discharge criteria are unnecessary.

The time period of in-hospital recovery, between surgery and discharge, may be highly dependent on both surgery-related and patient-specific factors. The duration of this recovery period is often an important focus in the literature on ERAS, whereas a focus on the actual discharge criteria is rare [19]. In fact, to our knowledge, a consensus on the discharge criteria following pulmonary surgery has not previously been published, although the surgeons' decision on when to discharge their patient is essential to the ERAS pathway [8]. Potentially, improved patient education and early planning of discharge during the preoperative phase may reduce the gap between readiness for discharge and actual discharge [2]. Using a defined set of discharge criteria to determine readiness for discharge may facilitate identification of non-somatic factors limiting discharge [1, 15, 16].

Strengths and limitations

This study has several limitations. Using the validated and well-known Delphi methodology, the aim was to assess the opinions of as many current thoracic surgeons in Denmark as possible. Given the high response and

level of agreement, the findings are likely to reflect current practice in Denmark. However, the high response rate came at the price of prolonged data collection, which may potentially have affected the results.

Since the survey included only thoracic surgeons, the results do not reflect the perspectives of other stakeholders - such as nurses, hospital administrators, relatives and patients - or the influence of broader trends in the healthcare system. Including the opinion of these groups before implementing discharge criteria may be important in future validation studies.

Although nationwide and multicentre, the panel only counted experts from Denmark. The present study was a time-limited cross-sectional survey without validation of the results in a patient cohort. This may restrict the generalisability of the results. These factors may serve as a foundation for future ERAS protocols to distinguish between somatic and non-somatic factors that keep patients hospitalised and investigate how early discharge may place a strain on primary healthcare. Furthermore, future validation studies should aim at improving the discharge protocol to ensure prevention or early detection of post-discharge adverse events.

CONCLUSIONS

The Danish consensus discharge criteria presented may serve as a tool to evaluate patients' readiness for home discharge after pulmonary surgery. Future research in ERAS using these criteria may enable differentiation between readiness for discharge and actual discharge and potentially reduce or prevent post-discharge adverse events. Future validation studies are needed to safely implement this in a clinical setting.

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Accepted 14 August 2025

Published 5 November 2025

Conflicts of interest BLH reports financial support from or interest in Company Medela AG. 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 This study could not have been conducted without the experts' participation, and we are grateful for their time and thoroughness in responding to our survey.

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Cite this as Dan Med J 2025;72(12):A04250304

doi 10.61409/A04250304

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