

B. Sc. Thesis

**Assisting the Forecast of Postoperative Delirium by
Creating a User Interface for Decision Trees**

Freie Universität Berlin

Institute of Computer Science

Human-Centered Computing (HCC) Research Group

Alfred Thomas Jäckel

alfredjacket@zedat.fu-berlin.de

Date of Thesis Submission: 03 July 2024

Supervisor:

Prof. Dr. Claudia Müller-Birn* Freie Universität Berlin, Germany

Examiner:

Prof. Dr. Claudia Müller-Birn† Freie Universität Berlin, Germany

Prof. Dr.-Ing. Volker Roth‡ Freie Universität Berlin, Germany

*Department of Mathematics and Computer Science, Human-Centered Computing Research Group

†Department of Mathematics and Computer Science, Human-Centered Computing Research Group

‡Department of Mathematics and Computer Science, Secure Identity Research Group

Summary

After undergoing operation, postoperative delirium (POD), can occur in patients after waking up from anaesthesia or in the days following. Patients with POD are often confused and lack awareness of their surroundings [7]. Health professionals need to assess the risk of POD to prevent putting patients at risk. Current models are fairly complex, which is why Heinrich et al. [7] proposed Fast and Frugal Trees (FFTrees) for this purpose. These FFTrees offer the advantage of simplicity, requiring the input of at most four values, each of which could lead to a direct decision. Requiring only four intuitive inputs, the models are simple to use and easier to communicate. Although a lot simpler they offer a similar level of accuracy compared to unconstrained decision trees or multiple regression on a lot more data. In this thesis a user interface design, more specifically a digital checklist, for one of these FFTrees will be proposed. Its purpose is to further simplify their use, ensure proper application and to support health professionals in their decision, whether further screening or other interventions are necessary or not.

Zusammenfassung

Nach einer Operation mit Narkose und in den Tagen danach, kann bei Patienten Postoperatives Delir (POD) auftreten. Patienten mit POD sind oft verwirrt und haben eine eingeschränkte Wahrnehmung ihrer Umgebung [7]. Medizinisches Personal muss das Risiko von POD einschätzen um Risiken für Patienten zu vermeiden. Bestehende Modelle sind oft sehr komplex, weshalb Heinrich et al. [7] Fast and Frugal Trees FFTrees entwickelt haben. Diese haben den Vorteil, dass sie einfacher sind und höchstens vier Abfragen benötigen, während gleichzeitig jede Abfrage zu einer Entscheidung führen kann. Da nur vier Abfragen von bekannten Risikofaktoren nötig sind, sind FFTrees leichter zu benutzen und zu kommunizieren. Trotz der Simplizität bieten sie ähnliche Genauigkeit wie Unconstrained Decision Trees oder Multiple Regression. In dieser Arbeit wird ein Design für eine Benutzeroberfläche, beziehungsweise für eine digitale Checkliste für eines dieser FFTrees, vorgeschlagen. Ihr Ziel ist es, die Nutzung zu vereinfachen, eine ordnungsgemäße Anwendung sicherzustellen und medizinisches Personal bei ihrer Entscheidung zu stützen, ob weitere Untersuchungen oder andere Schritte notwendig sind oder nicht.

Contents

1. Introduction	2
1.1. Motivation	2
1.2. Goal	2
2. Background	4
2.1. Context of the Project and Problem Description	4
2.2. Related Work	6
2.3. Research Questions	6
3. Iteration I	7
3.1. Understanding the Context	7
3.2. Understanding the Requirements	9
3.2.1. User Focus	9
3.2.2. Context Focus	10
3.2.3. Task Focus	11
3.2.4. Deduced Requirements	11
3.3. Design	12
3.4. Heuristic Evaluation	17
4. Iteration II	18
4.1. Design Improvements	18
4.2. Usability Testing I	20
5. Iteration III	23
5.1. Requirement Updates and Design Changes	23
5.2. Implementation	23
5.3. Final Usability Testing	24
6. Discussion and Conclusion	27
Bibliography	28
A. Appendix	30
A.1. Screenshots of the First Figma Prototype	30
A.2. Post Test and Post Task Satisfaction	35
A.3. Consent Form for Interview	36
A.4. Consent Form for Usability Test	40

List of Figures

1. Use Case Diagram	10
-------------------------------	----

2.	Task Flow Diagram using BPMN	11
3.	Paper Prototypes for Progress Communication	13
4.	Paper Prototypes for CCI input	14
5.	Paper Prototypes for Surgery Site input	14
6.	Paper Prototypes for ASA PS input	15
7.	Revision of the Sidebar	18
8.	Revision of the Page Header	19
9.	Revision of Severity Selection	19
10.	Revision of the Frailty Page	20

1. Introduction

After operations, patients might develop postoperative delirium (POD), a change in mental state, that puts patients at risk. Heinrich et al. [7] propose Fast and Frugal Decision Trees (FFTrees) to improve the screening process, as current guidelines are often poorly implemented. This thesis will propose a user interface (UI) for one of these FFTrees, in form of a digital checklist.

The context is Fast and Frugal Trees, the subject area is digital checklists, the domain of application is medicine and the field of research is Human Computer Interaction.

1.1. Motivation

Current screening guidelines for delirium are not consistently implemented and the facilities for documenting delirium scores are lacking, putting patients with delirium at risk [13]. Existing prediction models are complex and require many parameters to function. Guideline conform screening is extensive [1], and patients at risk required a high frequency of screening. Simplifying the screening process to be more efficient, could help securing quality of patient care, and ensure every patient is subjected to some form of screening or risk assessment. Heinrich et al. [7] propose FFTrees to predict the need for more thorough screening. FFTrees have the advantage of being simple and easy to memorise. However the high workload and time pressure health professionals are under, might make the application from memory unfeasible. A simple UI, in form of a digital checklist, could reduce physician error, improve task completion and improve documentation[9]. Integration of existing data could permit partial automation, decreasing the extent of manual input required. This could make integration into health professionals workflows more attainable. Widespread screening could result in higher recognition of POD reducing risks to patients, as well as possibly saving time and cost because avoidance measures for POD can be cheaper, than treating POD[2].

1.2. Goal

This thesis aims to resolve the lack of a UI design for one of the proposed FFTrees. The goal is to design digital checklists for their use. The proposed design should be adapted to existing workflows as well as possible, integrating existing patient data and documenting new data efficiently, to support the medical practitioner in their decision, whether further screening or other steps are necessary. The design will be evaluated in simulations to gain an indication, of how well it meets the prior mentioned criteria. Evaluation of the contributed design will be anecdotal due to time and scope constraints of this project, requiring further research and validation before real world implementation. The methodology is Human Centred Design.

Research Question Is the proposed interface design sufficiently adapted to existing workflows and does it efficiently support health professionals in their decision, whether further screening or other steps are necessary?

2. Background

This section gives an overview of the current problem as well as summarizing current research and related work.

2.1. Context of the Project and Problem Description

Post operative delirium (POD) is an altered mental state in which patients are confused and have less awareness of their surroundings. It occurs after operations with anaesthesia mainly in older patients. Health professionals need to screen for POD in patients before operations and twice a day for five days after, to avoid putting patients at risk [1, 14, 7]. Recognising those at risk of POD and taking measures to lower the risk can result in a decrease of POD cases, saving time and cost, as patients with POD require more extensive care and have longer hospital stays, as well as leading to lower patient mortality rates[2].

Existing guidelines are often poorly implemented [13, 15] and many current detection models require extensive assessment [7].

Heinrich et al. developed Fast and Frugal Trees (FFTrees) for forecasting POD, assisting health professionals in identifying patients in need of further screening [7]. FFTrees are advantageous in situations with limited data. They are simpler to apply, communicate and require less information whilst remaining competitive. FFTrees are based on models of bounded rationality, that model the limited capacity of the human mind, using only a few significant cues for inductive inferences. They are fast and frugal whilst maintaining most inferential accuracy by exploiting the structure of the environment. Especially when knowledge is limited, models of bounded rationality can match or outperform more complex algorithms in both time and accuracy. The more data there is the better the case for using more complex models with better prediction capabilities, but using models with a lot of variables, in situations with high uncertainty, can also lead to over fitting and models that generalise poorly [5, 7]. In an FFTree each cue either leads to an answer or to the next cue.

The FFTrees developed by Heinrich et al. have four cues for the preoperative setting and three cues for the postoperative setting.

The preoperative cues are:

1. Charlson Comorbidity Index(CCI) > 1. The CCI predicts mortality based on the number of co-morbidities i.e. conditions a patient has, zero meaning a patient has no co-morbidities.
2. Site of surgery is intracranial, intrathoracic, intra-abdominal or pelvic, not peripheral.

3. ASA Physical Status (ASA PS) > 2. The ASA PS is a system to assess a patients pre-anaesthesia co-morbidities based on various factors.
4. Patient is pre-frail or frail.

The postoperative cues are:

1. Duration of anaesthesia > 281 minutes
2. Patient age > 70
3. CCI > 2

If the surgery site is peripheral a low risk is forecasted, for all other cues a high risk is forecasted if they are true if not, the next cue is evaluated. The cues are known individual risk factors for POD, that should be considered in perioperative care according to existing guideline recommendations [2].

The FFTrees were compared to unrestrained classification trees (UDTs) and logistic regression, in two settings, the preoperative models received 18 cues and postoperative models 20, both preoperative and intraoperative cues. They were trained and tested on a randomly split dataset (n=394). The FFTrees outperformed UDTs in the preoperative setting and both logistic regression and UDTs in the postoperative setting with regard to predictive balanced accuracy. A limitation of the study is the small size of the sample set, making UDTs and logistic regression less competitive as they rely on large amounts of data [7].

The FFTrees are not cross-validated, so they cannot both be applied, without losses in accuracy. The postoperative FFTrees has a higher balanced accuracy, and is simpler requiring fewer cues, that are possibly easier to obtain and automate. The preoperative FFTree, while being more complex and less accurate, is more aligned with existing guidelines, that recommend screening before operations [1], to facilitate many of the recommended measures, like avoiding certain medications or monitoring the anaesthesia to avoid it being unnecessarily deep. It also allows communicating a risk to patients [11].

Providing a UI, for the FFTrees might make it easier for health professionals to integrate them into their workflow, circumventing the need for them to be memorised and allowing for quicker adoption. Use of a standardised screening procedure in form of a digital checklist, could reduce physician error, improve task completion as well as documentation and offer integration of existing data and automation [9]. Widespread screening could result in higher recognition of POD reducing risks to patients, as well as possibly saving time and cost because avoidance measures for POD could be cheaper, than treating POD [2].

In a packed workday a health professional uses the proposed UI, that leans on hopefully already existing data, to guide them through a short pre-operative POD risk assessment of a patient before they undergo an operation, to determine if the patient is in need of further, more extensive, screening or possibly perioperative measures.

2.2. Related Work

Electronic Health Records (EHR) can, when implemented well, reduce physician error, improve the quality of documentation and the completeness of data. However, when system design and actual work are misaligned EHR can reduce efficiency and increase workload by decoupling documentation from the workflow and creating the need to use redundant paper documentation [9].

Paper checklists have been shown to improve task completion rates and reduce errors, thus improving patient care, but by nature are static and often incomplete, lacking support for the dynamic nature of medical work [9].

Digital checklists improve on paper checklists by offering the advantages of EHR. They can improve on compliance and integration into workflows, compared to their paper counterparts [9].

If work practice is not reflected by a checklist it can lead to non compliant behaviours: failure to check tasks, falsely checking tasks or checking incomplete tasks [10]. This could be both due to poor checklist design or poor introduction and training, possibly where work practice already deviates from recommended guidelines [10, 3].

Poor design, inadequate introduction and training, duplication of safety checks, poor integration with existing workflows and professional, institutional or national cultural barriers can all lead to complaints of checklist fatigue and rejection [3, 6]. Too many incoherent checklists can lead to high additional workloads, thus they need to be adaptable, smart and well integrated [6]. Checklist items need to earn their right to be on a checklist, their cost (disruption of workflow) needs to be weighed against their benefits (reduced risk) [3, 6].

Burian et al. proposed a framework for checklist development comprised of five steps: conception; determination of content and design; testing and validation; introduction, training and implementation; ongoing evaluation, revision and possible retirement. The goal of the framework is to make sure checklists are tailored to their needs and stay up to date with human performance and cognitive psychology research [3].

2.3. Research Questions

Is the proposed interface design sufficiently adapted to existing workflows and does it efficiently support health professionals in their decision, whether further screening or other steps are necessary?

3. Iteration I

In this iteration the focus is on understanding context and requirements, and to propose a first design, that is evaluated in a heuristic evaluation.

3.1. Understanding the Context

To get a fuller understanding of the context and workflow in pre-operative assessments, further data needs to be collected. A field observation would be great, to gain a better understanding of the workspace, workflow and interaction with tools. Due to the medical context, this is very complicated because of patient involvement and confidentiality of patient data. Thus, interviews with anaesthesiologists, who ordinarily perform pre-operative assessments are a good alternative to gain more understanding of the context and workflow.

Ideally a random selection of anaesthesiologists from different hospitals would be interviewed, to gain a broad picture, not influenced by the protocols of a single hospital. While the information collected for premedication information, and the general tasks are supposedly similar, the extent of POD screening is expected to differ between hospitals, based on varying implementation of the guidelines [15]. Obtaining anaesthesiologists for interviews proves to be harder than expected, and contact forms are partially very slow to respond. Due to time constraints and in the interest of advancing the project only one anaesthesiologist will be interviewed.

The interview is unstructured, asking mainly open questions to provoke detailed answers, and allow for spontaneity. This will help gaining an overview and help uncovering issues, that have not been thought of yet. Also as only one interview is conducted, efficiency and comparability of answers between interview is not an issue.

The interviewee signed a consent form (see appendix A.3), and was informed about the purpose of the interview. The interview, was conducted using a script including the core themes and was recorded and transcribed.

Core themes for the interview:

1. Course of surrounding premedication assessment
2. Extent of digital tools used
3. Current extent of POD risk assessment, tasks, who does what
4. The suggested FFtrees for forecasting POD risk
5. Availability and commonality of required data

The key takeaways are the following:

1. Course of surrounding premedication assessment:

- Patients go to the anaesthesiologist, for their premedication assessment.
- The anaesthesiologist informs patients about the planned procedure, the process and what to expect.
- The anaesthesiologists informs patients about risks involved, including the risk of POD.

2. Extent of digital tools used:

- Generally information is stored in a Hospital Information System (HIS).
- There are no use of checklists, but standardized talking points.
- Occasionally external apps are used to calculate certain risks to aid with informing patient.

3. Current extent of POD risk assessment, surrounding task and who does what:

- For anyone over 65 or with suspected risk recognised in premedication the patient is handed over to specialized team for extensive screening(takes 30 min.)
- Anaesthesiologists know the risk factors for POD and can identify those at risk.
- Age is not causal but correlates highly.
- A POD team accompanies the whole perioperative process. They provide some but not all of the interventions, and provide counselling the care givers.
- The general level of POD training that makes a significant difference is hard to accomplish, thus the co-management strategy is in place and regular staff having heightened awareness is sufficient.
- POD Assessment happens postoperatively for 3-5 days depending on the course of recovery.

4. Concerning the suggested FFTrees for forecasting POD risk:

- The effectiveness of FFTrees, compared to anaesthesiologist assessing risk factors, will vary with anaesthesiologists experience.
- There are many intraoperative factors that could also be impactful for POD, a second risk assessment after operation could be beneficial.

5. Availability and commonality of required data

- CCI needs some guidance, it is not commonly recorded, but illnesses required are known and assessed in premedication assessment.
- ASA PS is a common tool, and intuitive to anaesthesiologists.
- Frailty needs guidance, there are different models with different criteria.

3.2. Understanding the Requirements

To elicit the requirements, from the interview and the literature review, different conceptual models are defined.

3.2.1. User Focus

There are several groups affected by the tool, mainly: patients, anaesthesiologists, hospitals and health insurers. Some presumptions are made about these groups, based on the interview and literature review.

Patients

Patients who are undergoing an operation want the best possible care. They want to know what to expect, what is going on and what is going to happen, as well as the risks they will be exposed to. Depending on the hospital and the wards specialization, they are a more or less homogenous or heterogeneous group.

Anaesthesiologists

Anaesthesiologists need to assess the risk of POD, more or less extensively depending on hospital protocol. They know risk factors and measures to take, and over time develop an intuition for patients risk of POD. They do the screening as extensively as required, either by themselves or might hand it off to someone else. They have many things to do, to assess, and to think about before and during operations, and watch patients wake up from anaesthesia afterwards. These tasks although all done by anaesthesiologists are not necessarily done by the same anaesthesiologist. They work in a time pressured, hectic environment, using, possibly multiple, interfaces for their tasks. On top of all that they strive to provide patients with the best care possible.

Hospitals

The hospitals are interested in good care and good care statistics, as well as being efficient and economical.

Health insurers

They want most cost effective treatment, within the limits of good care. They are interested in treatments if they can lower the cost down the road.

3.2.2. Context Focus

Scenario

A scenario is created to specify what happens when, and motivate choices of use-cases.

Before an operation the anaesthesiologist needs to assess the patient. They assess a variety of things, depending on the planned procedure. All of this has to happen in a limited amount of time, the next patient is waiting. They need to assess the risk of POD quickly using the proposed software. There is information already present in the HIS, that is automatically used, and other information that needs to be entered manually by the anaesthesiologist. On entering all required information the anaesthesiologist receives a result in form of a risk status. They explain the result, and its cause to their patient. The decision is saved. The anaesthesiologist might decide to take further steps or to hand the patient off to someone else.

In a variation of this scenario the anaesthesiologist after assessing some of the things, may already be sure the patient needs further screening and overrides the algorithm, taking a note on why.

Use-Cases

Based on the scenario the following use-cases can be defined:

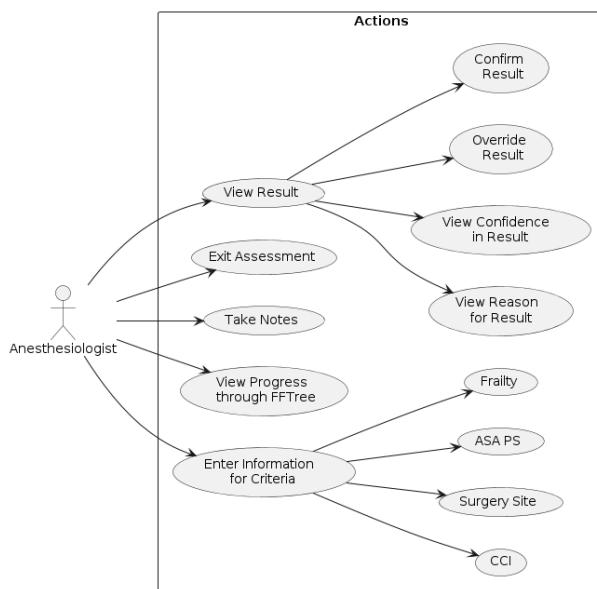


Figure 1: Use Case Diagram

3.2.3. Task Focus

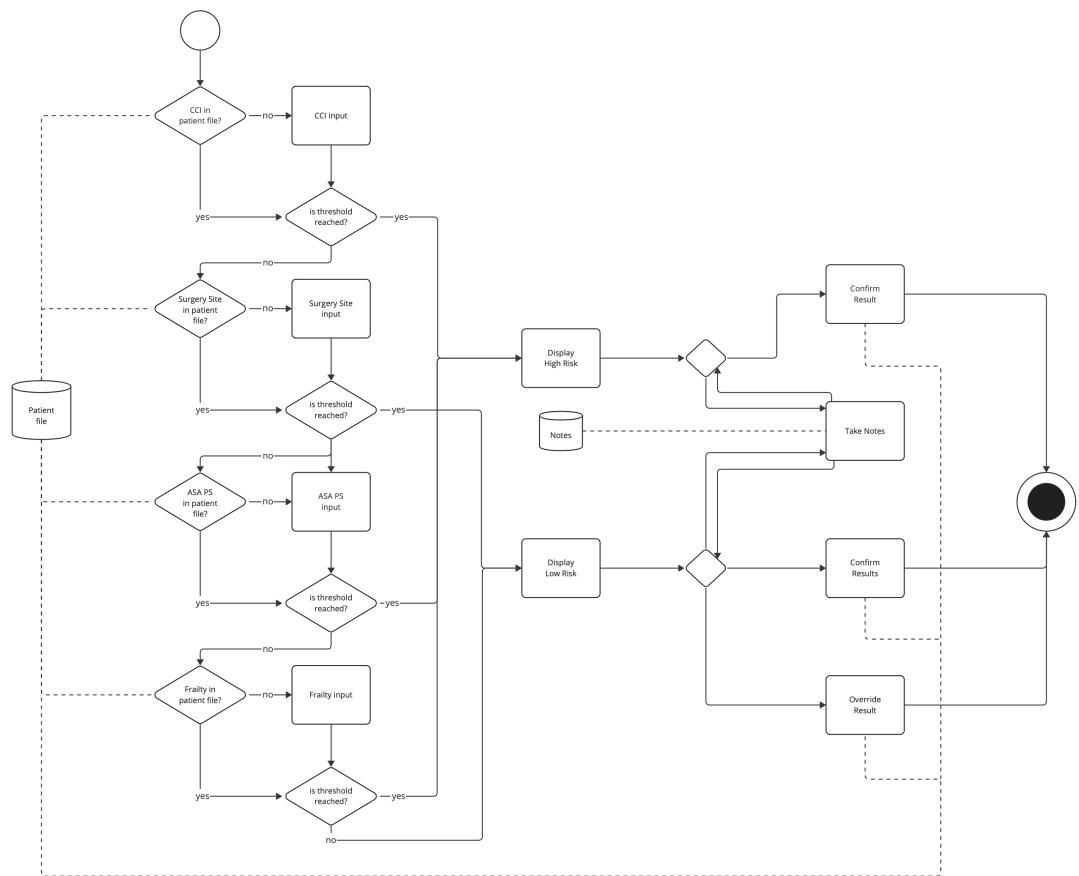


Figure 2: Task Flow Diagram using BPMN

3.2.4. Deduced Requirements

Based on these conceptual models the following requirements can be deduced.

Functional Requirements

- Possibility to enter information for criteria
- ASA PS and surgery site, can be input directly
- Frailty needs criteria to assist assessment
- CCI needs assistance with calculation, only knowledge of individual illnesses can be assumed

- Display progress through the FFTree
- Show the cues and if their threshold has been met
- Display result, and allow for confirmation or override in favour of screening
- Take notes on result
- Exit the assessment (Set override in favour of screening, to avoid non compliant behaviour. Do not allow overriding against screening, because not assessing the risk could put the patient at risk.)

Data Requirements

- Load available illness information from HIS and calculate CCI
- Recognize if cue value reaches the threshold
- Save result to HIS
- Determine risk status from the inputs, returning reason and certainty
- Save and retrieve notes

Environmental Requirements

- High efficiency in a high workload
- Allow anaesthesiologist to make their own decisions
- Integrate into workflow with other interfaces
- Minimal with little clutter
- Clear and simple (attention may be divided, distracted)

3.3. Design

The interactions in this interface will all be instruction, as they allow for being quick and efficient with actions that are repeated a lot.

Design Questions

To help answering some of the questions, paper prototypes are created, to get a better feeling for the individual options.

1. How to communicate progress through the interface?
 - a) A bar at the top with tabs for each step marking those completed with colour, and highlighting the current tab
 - b) A sidebar with ticks for the completed and bold-font for the currently selected.

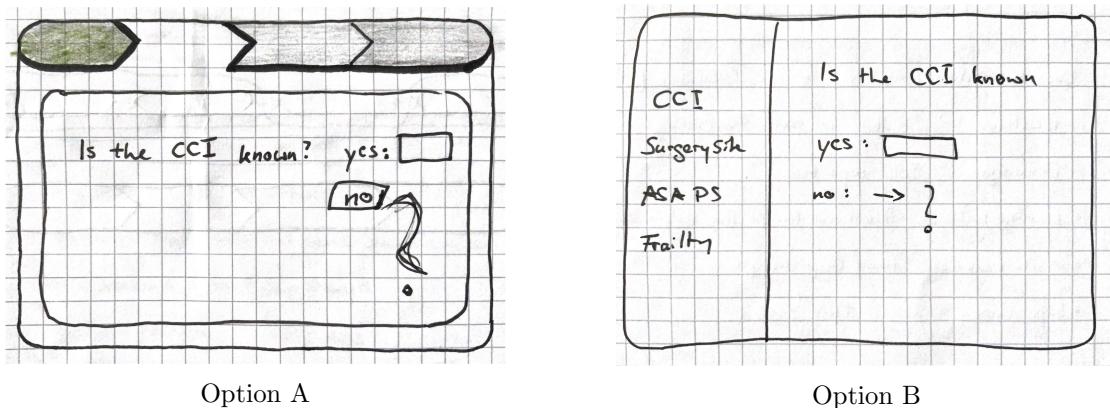


Figure 3: Paper Prototypes for Progress Communication

- Option A shows progress very clearly, tabs can be stylised as arrows to suggest progression.
- Option B has a better use of screen space, and has space for other information that needs to be present at all times if needed.
- Ultimately having a sidebar for progressing items, feels more natural than tabs. Often tabs rather suggest various parallel task instead of a sequence.
-> Option B will be used.

2. How to assess CCI?

- a) Directly input CCI value or if threshold has been reached and display a list of illnesses with their point values as aid.
 - b) Provide the list and select "one or more" / "two or more".
 - c) Provide a list with conditions and a checkbox for each, the interface can forward to the next step when the threshold is reached.
- While option A is very simple if the CCI value is known, it requires reading or knowing all required point values, and calculating the CCI value, if not. The amount of work connected to this disqualifies option A.

<p>How many of the following conditions does the patient have?</p> <ul style="list-style-type: none"> * condition 1 point explanation * 1 point answer of multiple step questions <p><input type="checkbox"/> none <input type="checkbox"/> one <input checked="" type="checkbox"/> two or more</p>	<p>Is the CCI > 1 Please select the applying</p> <p><input type="checkbox"/> Myocardial infarction + 1 <small>a history of problems with ST/ECG changes or elevation of creatine kinase or troponin</small></p> <p><input type="checkbox"/> CHF + 1</p> <p><input type="checkbox"/> Peripheral vascular disease + 1</p> <p><input type="checkbox"/> CVA or TIA + 1</p> <p><input checked="" type="checkbox"/> Dementia + 1</p> <p><input type="checkbox"/> Hemiplegia + 2</p>
---	--

Option B

Option C

Figure 4: Paper Prototypes for CCI input

- For option B only few clicks needed, but still the whole list needs to be read, making it mentally more complex, and it might still require multiple clicks.
- In option C even though each illness needs to be selected individually, two will be enough before the threshold is reached and it can forward to the next cue.
- Overall option C is more direct, the selection is more intuitive and requires less thought on what to do.

3. How to assess surgery site?

- Ask: Is surgery site Peripheral? Select Yes or No
- Select between Peripheral or Non-Peripheral

<p>Is the site of surgery Peripheral?</p> <p><input type="checkbox"/> no <input type="checkbox"/> yes</p>	<p>Peripheral <input checked="" type="radio"/></p> <p>Non Peripheral - Cardio... <input type="radio"/></p>
--	--

Option A

Option B

Figure 5: Paper Prototypes for Surgery Site input

- Both simple requiring only one click
- Option B allows explicit examples for non-Peripheral, improving recognition.

4. How to assess ASA PS?

- Select explicitly on a scale between 1 and 5
- Selection of 1-2 or 3-5

Please select the patient's ASA score	
<input type="radio"/> ASA I	a normal healthy patient
<input checked="" type="radio"/> ASA II	a patient with mild systemic disease
<input type="radio"/> ASA III	a patient with severe systemic disease
<input type="radio"/> ASA IV	a patient with severe systemic disease that is a constant threat to life
<input type="radio"/> ASA V	a moribund patient who is not expected to survive without the operation

<input type="radio"/> ASA I or ASA II	a patient with at most mild systemic disease
<input checked="" type="radio"/> ASA III, IV or V	a patient with at least severe systemic disease

Option A

Option B

Figure 6: Paper Prototypes for ASA PS input

- Option A is more intuitive and more direct compared to B grouping items
- B requires less specific categorization, and through its categories it implicitly communicates the threshold.

5. How to assess frailty?

- a) Only threshold is relevant, use a tick-box like for CCI illnesses, giving the interface some continuity.
- b) show frailty criteria for guidance and show hand grip strength cut-off values.

6. How to organize these criteria selections?

- a) Separate pages
- b) Large scroll-view
 - Separate pages allow for better orientation if pages are skipped when data is loaded from a database
 - A large scroll-view can show more at once, avoiding having to change pages
 - Ultimately separate pages are more intuitive and allow for better orientation, and are thus chosen.

Further considerations:

1. How to navigate through cues?
 - Next button on bottom right corner of each cue-screen
 - Back button on bottom left corner of each cue-screen
 - Automatically forward when a threshold is reached, do this only the first time to avoid frustration and confusion when going back to correct items.
2. How to convey functioning of algorithm?

- Put threshold definition in question box on top of screen for each cue
 - Order cues in sidebar
 - With the result, also convey the reason for the result, i.e. which cue is true
3. How to convey result?
 - On separate result page, with simple text, highlight emphasizing risk status
 - Show the relevant cue and POD percentage for a given group
 4. How to override result?
 - Have a checkbox on the results page, do not auto-continue to allow correction after possible slip.
 5. How to exit assessment and manually override?
 - Add "skip and override" button to bottom of sidebar.
 6. How do show steps and measures following risk assessment?
 - Following steps vary strongly depending on hospital protocol
 - Only navigate back to a start page displaying the risk (leaving open what follows it)
 7. How to take notes?
 - At this stage the notes page could be navigated to from the results page but need no further function.
 - For now it might be interesting to see how notes are used, but full functionality will be implemented at a later point.
 8. How is the interface accessed and how is the patient selected?
 - It will be assumed the interface is accessed from a larger premedication assessment tool, eliminating the need for selecting the patient, as they have already been selected at a higher level in the workflow.

At this point in the process many design considerations and decisions have been made, to test them before going further a Figma prototype can be made. Figma has the advantage of being reasonably easy to modify, while already allowing for modelling of some functionality and navigation flows, making testing with users possible.

See appendix A.1 for screenshots of the first Figma prototype.

3.4. Heuristic Evaluation

As a first formative evaluation of the interface a heuristic evaluation will be conducted. The purpose of this evaluation is to find general issues and usability problems. The advantage of doing a heuristic evaluation, is that no user participation is required, because anaesthesiologists are harder to get hold of. The evaluation is conducted by four evaluators from different fields (medicine, computer science and design), with different perspectives, aiding in finding a broad range of issues. Having four evaluators is a good balance between the potential for finding issues and effort [12]. In preparation of the evaluation the Nielsen Heuristics [12] are explained to the evaluators using examples. After the evaluation the results were discussed together, resulting in the following key takeaways:

- There are multiple limitations to the prototype due to using Figma that cannot be addressed while using Figma for prototyping like:
 - Ticks on the CCI page cannot be undone
 - The logic for determining the CCI threshold is wonky
 - The automatic forwarding is always on
- Issues related to the sidebar:
 - Progress is not obvious enough
 - No information on values of completed items
 - Expected clicking on sections to navigate through interface, it does not
- Automatic forwarding is disorienting, there is no delay and it is not clear whether the last input was accepted correctly or not
- The layout and hitboxes of question buttons are inconsistent
- The skip button is ugly and not minimalist
- Font boldness is inconsistent
- There is no escaping the interface without either completing it or setting the risk to high
- All question buttons on the CCI page look the same, making it hard to distinguish between the threshold explanation and explanations for illnesses.
- It is not obvious the severity selection is clickable
- Purpose of CCI points is not clear
- Negating frailty, by just not ticking it, feels unintuitive after prior pages

4. Iteration II

In this iteration the design will be improved based on the findings of the heuristic evaluation, and a usability test will be conducted to validate the design decisions made.

4.1. Design Improvements

The heuristic evaluation identified several issues, the following revisions were made to address them:

- Modified the sidebar to include a progress bar, show the value of a cue after it's completion and make the sections clickable. See figure 7
 - This addresses the issues found with the sidebar.

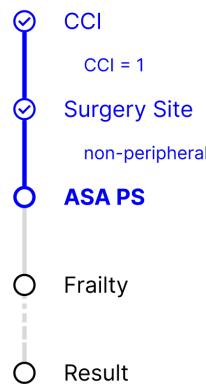


Figure 7: Revision of the Sidebar

- Replace the question mark in the page header with the description of the threshold. See figure 8
 - Together with the revised sidebar, this improves the visibility and facilitates understanding the cues' thresholds, as well as the tree structure.
 - It avoids the problem of having a question button with different types of content on the CCI page.
 - When the threshold is stated at the top of the page it should help making the point values on the CCI page clearer.
- Only forward after a short delay and show a popup.
 - This should improve orientation,
 - Together with showing the value in the sidebar, this provides feedback whether the correct value was entered.

Please select the patients conditions

High risk of developing POD if CCI > 1

Myocardial infarction +1 ⓘ

CUE +1 ⓘ

Figure 8: Revision of the Page Header

- Replace "skip and override" button with an exit button that opens a popup with override or exit as options.
 - This makes the skip button more minimalist, as it has only one word instead of a sentence
 - It adds a way to exit the tool.
- Use iOS setting style selectors for the severity selection. See figure 9
 - This should make the clickability of the severity selection more obvious, by using a familiar layout.

Liver disease Mild +1 Moderate to severe +3 ⓘ

Figure 9: Revision of Severity Selection

- Use a selection of "frail / pre-frail" or "stable" on frailty page. See figure 10
 - This makes the selection more intuitive as it is now in line with the other selectors in the tool.

POD Risk Forecast

Please select the patients frailty status

Low risk of developing POD if stable
High risk of developing POD if pre-frail or frail

<input checked="" type="radio"/> Stable	patient exhibits non of the criteria
<input type="radio"/> Frail or pre-frail	patient exhibits one or more of the criteria

Fried Frailty Criteria

Exhaustion	self-reported
Weightloss	>3kg in the past 3 months
Low Physical Activity	Patient can't transfer from bed to chair without at least minor help (verbal or physical)
Impairment of Gait Speed	slowness in Timed-Up and Go test (≥ 10 seconds)
Muscle Weakness	Hand Grip Strength Cutoff Values

Exit Back Next

Figure 10: Revision of the Frailty Page

- Improve font boldness consistent throughout the tool.
- Unify question button hit-box with the layout of the question button.

4.2. Usability Testing I

The purpose of this test is to validate the design decisions made. The goal of the test is to find out how well inputting data for the cues works and how well the cues and the tree structure are understood.

This test needs to be conducted with anaesthesiologists, as they are the target group of the tool. Ideally the test should be conducted with at least ten participants, to be able to find a variety of issues, any more than that would yield diminishing returns [4]. Due to availability of participants and limited time, the test was only conducted with one anaesthesiologist, in favour of rather conducting further tests in a next iteration, doing this process iteratively allows finding more issues with a limited amount of participants, as they can notice different new issues if others have been resolved [8].

The participant will be asked to think aloud and describe what they would say to a patient. Qualitative feedback will be collected in form of observation notes. The participant signed a consent form (see appendix A.4), and was informed about the purpose of the test.

The participant receives the following tasks:

- Get a feeling for the tool by assessing a healthy patient.
 - This allows the participant to get a general overview of the tool and how it works and allows observation of intuitiveness of the tool.
- Assess a patient using the tool (with/without patient data filled in from HIS, this is set by evaluator)
 - This allows a general overview of how well the tool can be used, how intuitive it is and how well externally input data is received.
- Be a patient with low CCI, non peripheral surgery, who requires hand test
 - This will force use of the frailty section.

Key Observations:

- All tasks were completed successfully.
- The popup after automatically forwarding was missed while communicating to patient
- ASA PS was decided quickly and confidently.
- Frailty hand test are common, equipment is available in pre-medication assessment room.
- General magnitude of hand grip strength cut-off values is often known, if assessment does not take place in pre-medication assessment room because a patient is bedridden the frailty test becomes moot, as the patient is at least pre-frail according to the criteria.
- Illnesses on CCI page were all recognized confidently.
- Assessing a healthy patient is rather inefficient, requiring running through all questions and a frailty assessment for a patient that clearly is fine.
- Navigation worked well, but confusion arose using the CCI page with the limitations of a Figma prototype.
- Familiarity with risks for POD, and measures that can be taken, and is able to explain them to patient.
- Illnesses are assessed in pre-medication assessment.

- General satisfaction with the tool is good.

Testing with figma requires a lot of internet to change prototype, which is possible but slow and annoying.

5. Iteration III

In this iteration the design will be improved based on the findings of the first usability test, and a summative usability test will be conducted to help answer the research question.

5.1. Requirement Updates and Design Changes

Anaesthesiologists are not focused on the interface, their attention is split between the interface and the patient.

- To accommodate this, any popup timeout needs to be slow if it is not to be missed.

Cut-off values for hand grip strength test, might only be needed if the test is close.

- Thus the cut-off values can be moved to a popup window, to declutter the frailty page, which still has a lot of other information on it, as it also lists all the criteria.

Assessing a young and healthy patient is quite inefficient, as the result might seem obvious to the anaesthesiologist from the start.

- Exiting must allow setting the risk status in either direction, to ensure compliant use and save time.

Because of limitations of Figma prototypes, the revised design will be implemented in a React Native application, to allow for better testing.

5.2. Implementation

The implementation of the prototype as a full application is necessary to allow for testing not impacted by Figma's limitations. The prototype is implemented in React Native, to allow the codebase to be compiled to both IOS or Android devices, thus increasing code reusability. The Expo framework is used because it lowers the barrier of entry to React Native, and this is the first time I have to implement a full application with a user interface. It also simplifies testing on physical devices, as well as simplifying setup of the required development environment. The primary function of the prototype is to facilitate testing, so only those elements required for testing are implemented to save time.

To allow testing with different scenarios, the prototype loads patient data from two JSON files, that can easily be modified. Contexts, partially initiated from JSON files, are used to store the cue values and the progress through the tool, notes taken on the notes page, and any other values the application needs to function.

Expo uses file based routing and the prototype was implemented with the following page structure:

```
app/
|
|-- drawer/
|   |-- _layout.tsx
|   |-- asa.tsx
|   |-- cci.tsx
|   |-- frailty.tsx
|   |-- result.tsx
|   |-- ss.tsx
|
|-- _layout.tsx
|-- index.tsx
|-- startpage.tsx
```

`app/startpage.tsx` is the entry point of the application, from where the risk assessment can be initiated.

`app/_layout.tsx` wraps all routes in the contexts required for the application and defines a `StackNavigator` containing `startpage` and `drawer`.

`app/drawer/_layout.tsx` defines a `StackNavigator` for the drawer pages, that each represent one of the cues or the result, as well as providing the layout for the sidebar.

Modals were used to display pop-ups, required for hand grip strength cut-off values, the notes page, the exit menu, informing that data has been loaded, informing that the tool has auto-forwarded, showing detailed explanations for some of the illnesses on the CCI page and when trying to select a page that can't be navigated to yet.

The prototype was implemented with assistance from GitHub Copilot, a tool that can provide code suggestions, to speed up the implementation process.

The source code, and instructions for running it, can be found at: https://github.com/alfredjaeckel/BA_Prototype

5.3. Final Usability Testing

The purpose of this evaluation is to find out whether or not the prototype fulfils the research goal. The goal is to find out whether the prototype supports the anaesthesiologists in their risk assessment, whether it does so efficiently and ensuring proper application of the FFTree, and whether it fits into anaesthesiologists workflow. This test is conducted

with the same anaesthesiologists as the previous test. Again due to time constraints there is only one participant. The participant signed a consent form (see appendix A.4), and was informed about the purpose of the test.

The participant will be asked to think aloud, talk freely and to express any thoughts, feelings and opinions. Qualitative feedback will be collected in form of observation notes. As well as a post test questionnaire. Quantitative feedback will be collected in form of a Single Ease Question (SEQ) after each task, and a post test Short User Experience Questionnaire (SUEQ).

The participant receives the following tasks:

1. Explore the interface and explain what you see.
 - Let the participant get a feeling for the tool, and get them talking in preparation for the following tasks.
2. Assess a healthy but frail patient. Explain what you would communicate to them.
 - Let the participant fully assess a patient, and get observe patient communication.
3. Assess a healthy patient.
 - Prefill CCI and surgery site, to observe how the participant reacts to prefilled data.
4. Assess a patient who has End-organ damage Diabetes.
 - Observe the participant using the severity selector
5. Assess a patient you are sure is at high risk, because they are confused, and suffer dementia (and log it), but is otherwise healthy and is having a peripheral surgery.
 - Observe whether the participant is able to override the result, or exit and override.

Key Observations

- Task 1
 - The interface was received as intuitive, clear and easy to use.
 - Selecting the values for the cues was clear and fast.
- Task 2
 - A mistake was made selecting the surgery site, but was recognised and corrected instantly.
 - Communicates POD risk to patient as well as the reason for the heightened risk (the cues that caused it).

- Would not communicate the percentage to avoid unsettling the patient unnecessarily.
- Task 3
 - Prefilled data was not noticed, but also did not cause any confusion, the interface was used as normal from the later entry point.
- Task 4
 - The severity selector was identified promptly.
 - The participant shows understanding of the cue thresholds, and the working of FFTree.
- Task 5
 - Participant used the tool, progressing through all slides, but got stuck when the result was low and they wanted to set the risk to high.
 - They received aid in the form of: "regard the result page carefully please" after which, they found the override setting.

Post Test Questionnaire

- Would you prefer using a checklist tool or memorizing the four conditions ($CC1 > 1$, surgery site peripheral, $ASA \geq 3$, frail/non-frail) and why?
 - The participant prefers the checklist tool.
 - After using the tool, the result could be documented directly and change the work-plan for the patient accordingly.
- How well would this concept integrate into your current workflow?
 - Fairly straightforward
 - Before the end of the premedication assessment, most of the data required is already collected and using the tool would be very quick.
- Would you use a tool like this for predictions, if it were purely voluntary?
 - It depends on the case, if it does not have the advantage of data integration, then only in those cases with large uncertainty.
- How does this prototype compare to the one tested prior?
 - Slight improvements, but those noticed were mostly due to the limitations of the previous Figma prototype and the switch to a React Native prototype.

General satisfaction with the interface was high, for more detailed information see appendix A.2, containing the SEQ and SUEQ answers.

6. Discussion and Conclusion

The final evaluation, shows positive feedback, the proposed interface, can support the anaesthesiologist in making their decision whether or not a patient is at risk of POD. The interface could integrate well into existing workflows with a minimal increase in workload, and with little training required. Overall satisfaction using the interface is high.

While these results are promising, these results and the proposed interface are only anecdotal, due to the limited amount and variety of participants. Further research is needed to validate the design with a larger group of participants.

In the future the design could be improved, by exploring the standardization of common notes and sorting the illnesses checked on the CCI page by frequency of occurrence, these improvements could further improve the efficiency. Issues of finding elements, specifically the override option on the results page need to be explored further. While they might be non-issues if users receive training before use, there might be better options to improve their recognition.

If real world use of the the interface is to be achieved, the underlying study [7] would need to be validated with a larger group of patients, at this point it is only based on a repurposed dataset. The interface could be used to support collecting real world data to aid the validation process.

References

- [1] C. Aldecoa, G. Bettelli, F. Bilotta, R. D. Sanders, R. Audisio, A. Borozdina, A. Cherubini, C. Jones, H. Kehlet, A. MacLullich, F. Radtke, F. Riese, A. J. Slooter, F. Veyckemans, S. Kramer, B. Neuner, B. Weiss, and C. D. Spies. European Society of Anaesthesiology evidence-based and consensus-based guideline on postoperative delirium. *European Journal of Anaesthesiology*, 34(4):192–214, Apr. 2017.
- [2] L. Ansaloni, F. Catena, R. Chattat, D. Fortuna, C. Franceschi, P. Mascitti, and R. M. Melotti. Risk factors and incidence of postoperative delirium in elderly patients after elective and emergency surgery. *British Journal of Surgery*, 97(2):273–280, Jan. 2010.
- [3] B. K. Burian, A. Clebone, K. Dismukes, and K. J. Ruskin. More Than a Tick Box: Medical Checklist Development, Design, and Use. *Anesthesia & Analgesia*, 126(1):223–232, Jan. 2018.
- [4] L. Faulkner. Beyond the five-user assumption: Benefits of increased sample sizes in usability testing. *Behavior Research Methods, Instruments, & Computers*, 35(3):379–383, Aug. 2003.
- [5] G. Gigerenzer and D. G. Goldstein. Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review*, 103(4):650–669, Oct. 1996.
- [6] E. Grigg. Smarter Clinical Checklists: How to Minimize Checklist Fatigue and Maximize Clinician Performance. *Anesthesia & Analgesia*, 121(2):570–573, Aug. 2015.
- [7] M. Heinrich, J. K. Woike, C. D. Spies, and O. Wegwarth. Forecasting Postoperative Delirium in Older Adult Patients with Fast-and-Frugal Decision Trees. *Journal of Clinical Medicine*, 11(19):5629, Sept. 2022.
- [8] S. Krug. *Don't make me think! a common sense approach to Web usability*. Circle.com library. Que, Indianapolis, Ind, 2000.
- [9] L. Kulp, A. Sarcevic, M. Cheng, Y. Zheng, and R. S. Burd. Comparing the Effects of Paper and Digital Checklists on Team Performance in Time-Critical Work. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, pages 1–13, Glasgow Scotland Uk, May 2019. ACM.
- [10] L. Kulp, A. Sarcevic, Y. Zheng, M. Cheng, E. Alberto, and R. Burd. Checklist Design Reconsidered: Understanding Checklist Compliance and Timing of Interactions. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, pages 1–13, Honolulu HI USA, Apr. 2020. ACM.
- [11] B. Neuner, D. Hadzidiakos, and G. Bettelli. Pre- and postoperative management of risk factors for postoperative delirium: who is in charge and what is its essence? *Aging Clinical and Experimental Research*, 30(3):245–248, Mar. 2018.

- [12] J. Nielsen and R. Molich. Heuristic evaluation of user interfaces. In *Proceedings of the SIGCHI conference on Human factors in computing systems Empowering people - CHI '90*, pages 249–256, Seattle, Washington, United States, 1990. ACM Press.
- [13] T. Saller, V. V. Dossow, and K. Hofmann-Kiefer. Kenntnis und Umsetzung der S3-Leitlinie zum Delirmanagement in Deutschland. *Der Anaesthesist*, 65(10):755–762, Oct. 2016.
- [14] F. Yürek, M. Olbert, U. Müller-Werdan, H. Held, C. Knaak, C. Hermes, R. Dubb, A. Kaltwasser, S. Monke, and C. Spies. Wie können postoperativ ein Delir und eine neurokognitive Störung verhindert werden? *AINS - Anästhesiologie · Intensivmedizin · Notfallmedizin · Schmerztherapie*, 54(11/12):669–683, Nov. 2019.
- [15] F. Yürek, J.-D. Zimmermann, E. Weidner, A. Hauß, E. Dähnert, D. Hadzidiakos, J. Kruppa, J. Kiselev, N. Sichinava, O. A. Retana Romero, L. Hoff, R. Mörgeli, L. Junge, K. Scholtz, S. K. Piper, L. Grüner, A. E. M. Harborth, L. Eymold, T. Gürmez, E. Falk, F. Balzer, S. Treskatsch, M. Höft, D. Schmidt, F. Landgraf, U. Marschall, A. Hölscher, M. Rafii, and C. Spies. Quality contract ‘prevention of postoperative delirium in the care of elderly patients’ study protocol: a non-randomised, pre–post, monocentric, prospective trial. *BMJ Open*, 13(3):e066709, Mar. 2023.

A. Appendix

A.1. Screenshots of the First Figma Prototype

POD Risk Forecast

Please select the patients conditions

CCI

Surgery Site

ASA PS

Frailty

Result

Myocardial infarction +1 ⓘ

CHF +1 ⓘ

Peripheral vascular disease +1 ⓘ

CVA or TIA +1 ⓘ

Dementia +1 ⓘ

COPD +1

Connective tissue disease +1

Peptic ulcer disease +1 ⓘ

Liver disease Mild +1 Moderate to severe +3 ⓘ

Diabetes mellitus Uncomplicated +1 End-organ damage +2

Skip Assessment and set high risk

Back Next

CCI page

POD Risk Forecast

CCI

Surgery Site

ASA PS

Frailty

Result

**Skip Assessment and
set high risk**

Please select the patients surgery site



Non-peripheral intracranial, intrathoracic, intra-abdominal or pelvic



Peripheral

Back

Next

Surgery site page

POD Risk Forecast

CCI

Surgery Site

ASA PS

Frailty

Result

Skip Assessment and
set high risk

Please select the patients ASA PS



ASA I / II

a patient with at most mild systemic disease



ASA III / IV / V

a patient with at least severe systemic disease



Back

Next

ASA PS page

POD Risk Forecast

CCI

Surgery Site

ASA PS

Frailty

Result

Skip Assessment and set high risk



The patient exhibits one or more of the following:



Exhaustion self-reported

Weightloss >3kg in the past 3 months

Low Physical Activity Patient can't transfer from bed to chair without at least minor help (verbal or physical)

Impairment of Gait Speed slowness in Timed-Up and Go test (≥ 10 seconds)

Muscle Weakness Hand Grip Strength

Handgrip strength cutoffs

Male:	BMI ≤ 24 :	≤ 29 kg	Female:	BMI ≤ 23 :	≤ 17 kg
	BMI 24.1-26:	≤ 30 kg		BMI 23.1-26:	≤ 17.3 kg
	BMI 26.1-28:	≤ 30 kg		BMI 26.1-29:	≤ 18 kg
	BMI > 28 :	≤ 32 kg		BMI > 29 :	≤ 21 kg

Average three trials from the dominant hand

Back

Next

Frailty page

POD Risk Forecast

CCI

The patient is at **LOW RISK** of developing POD

Surgery Site

Patients with peripheral surgery develop POD in 10% of cases

ASA PS

Patient is not in need of further measures

Frailty

Result

Skip Assessment and set high risk

The patient is in need of further measures anyway

Add Notes 

Back

Confirm

Result page

Premedication Checklist

Start POD Risk Forecast

Start page

Premedication
Checklist

Start POD Risk Forecast

End page

A.2. Post Test and Post Task Satisfaction

Task 1

Overall, how difficult or easy did you find this task?



Task 2

Overall, how difficult or easy did you find this task?



Task 3

Overall, how difficult or easy did you find this task?



Task 4

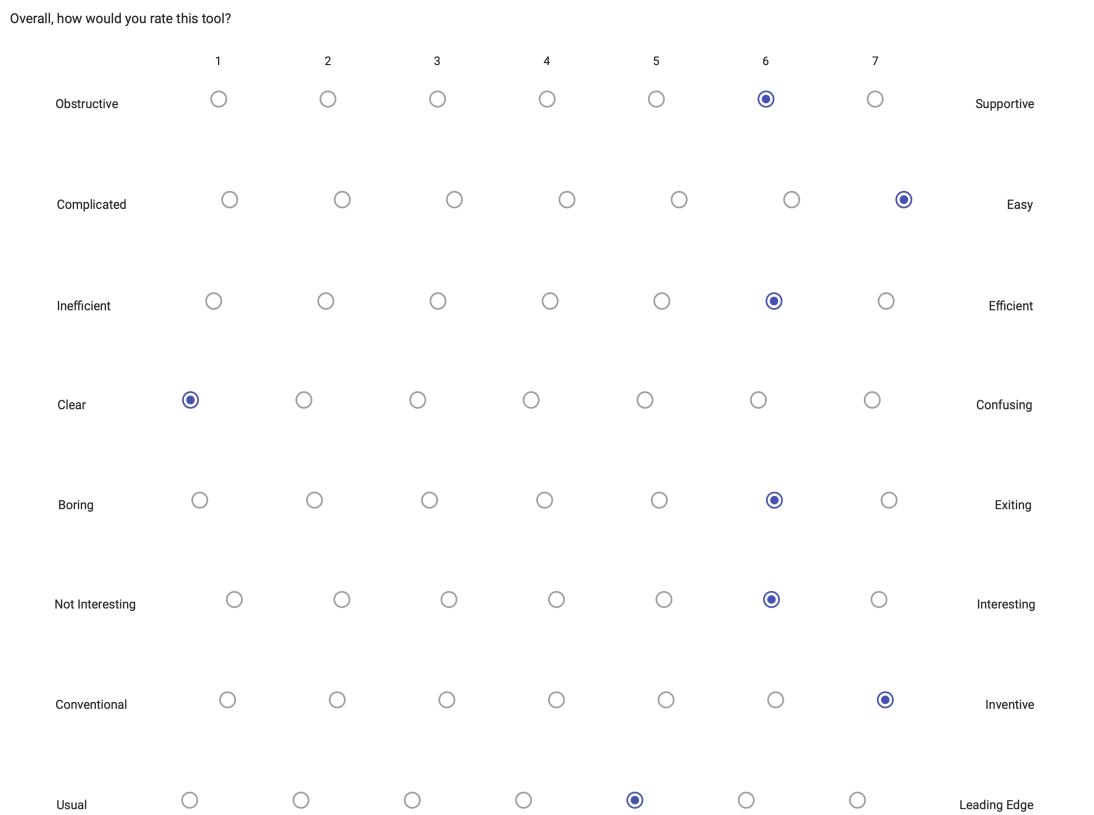
Overall, how difficult or easy did you find this task?



Task 5

Overall, how difficult or easy did you find this task?





A.3. Consent Form for Interview



Information und Einverständniserklärung

Erhebung, Verarbeitung und Übermittlung von personenbezogenen Interviewdaten

1. Grundlegende Informationen

Name der teilnehmenden Person(en):

Datum / Ort der Befragung:

Titel der Bachelorarbeit: Assisting the Forecast of Postoperative Delirium by Creating a User Interface for Decision Trees

Durchführung des Tests: Alfred Jäckel

Vielen Dank, dass Sie zugestimmt haben, im Rahmen der oben genannten Bachelorarbeit interviewt zu werden. Forschungsethik und Datenschutzbestimmungen (d. h. DSGVO¹) erfordern, dass die Befragten ausdrücklich zustimmen, interviewt zu werden und wie die in ihrem Interview enthaltenen Informationen verwendet werden. Diese Informations- und Einwilligungserklärung ist notwendig, damit wir sicherstellen können, dass Sie den Zweck Ihrer Teilnahme verstehen und mit den Bedingungen Ihrer Teilnahme einverstanden sind.

2. Hintergrund der Bachelorarbeit

Der Fokus meiner Bachelorarbeit ist der Entwurf einer Benutzeroberfläche, für einen Algorithmus zur Vorhersage von postoperativem Delir, um seine Anwendung zu erleichtern. Dieses Interview dient in diesem Rahmen dazu den Arbeitsablauf von Anästhesisten im OP Vorgespräch mit dem Patienten und den Ablauf im Aufwachraum besser zu verstehen. Außerdem um einen groben Überblick von der digitalen Infrastruktur im Krankenhaus zu bekommen.

3. Ablauf des Interviews

Es findet ein halbstrukturiertes Interview (ca. 45 Min) statt. Das Gespräch wird aufgenommen (über die Aufnahmefunktion des Video-Konferenztools Webex) und es wird ein Transkript des Interviews oder Auszüge daraus als Textdatei erstellt.

Mit Ihrer Teilnahme sind keine Risiken verbunden, aber Sie haben das Recht, das Interview jederzeit abzubrechen oder von der Mitwirkung an unserer Studie zurückzutreten. Es steht Ihnen frei, die Beantwortung von Fragen abzulehnen, die Sie nicht beantworten möchten, oder das Interview jederzeit abzubrechen. Ich gehe davon aus, dass ich nur ein Interview durchführen werde; es kann jedoch sein, dass Nachfragen zur weiteren Klärung erforderlich sind. Wenn dies der Fall sein sollte, werde ich Sie per E-Mail kontaktieren, um dies zu erbitten.

3. Datenverwertung und -veröffentlichung

Auszüge der Notizen und des Fragebogens dürfen in anonymisierter Form direkt oder indirekt in akademischen Artikeln, Konferenzpräsentationen oder Blog-Beiträgen zitiert und angezeigt werden.

4. Entschädigung

Sie werden für die Teilnahme an dieser Studie nicht entlohnt.

¹ Datenschutz-Grundverordnung <https://dsrgvo-gesetz.de/>

5. Vertraulichkeit

Ihre Studiendaten werden vertraulich behandelt. Die Transkription des Interviews wird manuell vorgenommen. Der Zugang zu den Interview-Transkripten wird auf mich und Kolleg:innen, mit denen ich im Rahmen meiner Forschung zusammenarbeite, beschränkt sein. Ich werde einzelne Namen in allen Versionen der Notizen und Zitate, die mit anderen geteilt werden, anonymisieren.

6. Datensicherheit und -speicherung

Die Aufnahme des Videocalls und das Transkript werden auf meinem Computer gespeichert. Wenn die Bachelorarbeit abgeschlossen ist, werde ich diese Originaldaten löschen (voraussichtliches Löschdatum 07/2024).

9. Rechte der betroffenen Person

Laut DSGVO haben Sie die folgenden Rechte, sobald Ihre personenbezogenen Daten erstellt wurden:

- Recht auf Auskunft über die gespeicherten personenbezogenen Daten (Artikel 15 DSGVO).
- Recht auf Berichtigung, wenn Daten zu Ihrer Person falsch oder unvollständig sind (Artikel 16 DSGVO).
- Recht auf Löschung der Sie betreffenden Daten, sofern eine der gesetzlichen Voraussetzungen vorliegt und keine gesetzliche Ausnahmeregelung dem entgegensteht (Artikel 17 DSGVO).
- Recht auf Einschränkung der Verarbeitung, insbesondere wenn die Richtigkeit der Daten bestritten wird, wenn einer der im Gesetz genannten Gründe eingreift, insbesondere auf Ihren Wunsch auch anstelle der Löschung der Daten (Artikel 18 DSGVO).
- Recht auf Datenübertragbarkeit. Sie haben das Recht, Auskunft über alle personenbezogenen Daten zu verlangen, die über Sie in einem strukturierten, gängigen und maschinenlesbaren Format gespeichert sind, und haben das Recht, diese Daten einem anderen Verantwortlichen ohne Behinderung durch den Verantwortlichen, dem die personenbezogenen Daten bereitgestellt wurden, zu übermitteln (Artikel 20 DSGVO)
- Recht, eine Beschwerde bei einer Aufsichtsbehörde einzureichen. Die zuständige Aufsichtsbehörde kann jede beliebige Datenschutzaufsichtsbehörde sein (Artikel 77 DSGVO).

10. Kontakt

Wenn Sie Fragen zu dieser Studie haben, können Sie gerne mich (Alfred Jäckel) oder Prof. Dr. Claudia Müller-Birn kontaktieren.

Alfred Jäckel
Freie Universität Berlin
Fachbereich Mathematik und Informatik
Institut für Informatik
Human-Centered Computing
Königin-Luise-Str. 24/26
14195 Berlin

alfredjackel@zedat.fu-berlin.de

Prof. Dr. Claudia Müller-Birn
Freie Universität Berlin
Fachbereich Mathematik und Informatik
Institut für Informatik
Human-Centered Computing
Königin-Luise-Str. 24/26
14195 Berlin

clmb@inf.fu-berlin.de
030 - 838 75256

Wenn Sie über diese Forschung beunruhigt sind, oder wenn Sie Bedenken haben, wie sie durchgeführt wird, können Sie sich an den Datenschutzbeauftragten der Freien Universität Berlin wenden:
datenschutz@fu-berlin.de.

Einverständniserklärung

Mit meiner Unterschrift erkläre ich mich freiwillig bereit, an dem Usability-Test gemäß den Bedingungen des Informationsblattes, das ich gründlich gelesen habe (Seiten 1-3 dieses Dokuments), teilzunehmen. Mir ist bekannt, dass ich die Beantwortung von Fragen und Bearbeitung von Aufgaben verweigern kann und jederzeit ohne Angabe von Gründen aus der Studie aussteigen kann.

Zusätzlich erkläre ich:

- Ich möchte die anonymisierten Zitate, die sich auf meine Teilnahme an dem Usability-Test beziehen, überprüfen, bevor sie Teil einer Veröffentlichung werden.

Eine Abweichung von den vorstehenden Bedingungen erfolgt nur mit Ihrer weiteren ausdrücklichen Zustimmung.

Unterschrift der*des Teilnehmer*in/s

Unterschrift der*des Wissenschaftler*in/s

Berlin

Ort, Datum



Dieses Informationsblatt und die Einverständniserklärung stehen unter der Lizenz CC BY-SA 4.0, die eine Weiterverwendung und Anpassung ermöglicht, wobei die Namensnennung „Forschungsgruppe Human-Centered Computing, Freie Universität Berlin“ erforderlich ist. Einige Elemente dieses Textes wurden aus der Einverständniserklärung für das Interview der School of Geosciences der Universität Edinburgh übernommen, zu finden unter <https://www.ed.ac.uk/geosciences/intranet/working-in-school/other-important-information/ethicsinresearch/sampleinfoandconsent> (nur in Englisch).

A.4. Consent Form for Usability Test



Information und Einverständniserklärung

Erhebung, Verarbeitung und Übermittlung von personenbezogenen Usability-Test Daten

1. Grundlegende Informationen

Name der teilnehmenden Person(en):

Datum / Ort der Befragung:

Titel der Bachelorarbeit: Assisting the Forecast of Postoperative Delirium by Creating a User Interface for Decision Trees

Durchführung des Tests: Alfred Jäckel

Vielen Dank, dass Sie zugestimmt haben, im Rahmen der oben genannten Bachelorarbeit an einem Usability-Test teil zu nehmen. Forschungsethik und Datenschutzbestimmungen (d. h. DSGVO¹) erfordern, dass die Befragten ausdrücklich zustimmen, an einem Test teilzunehmen und wie die in ihrem Test erhobenen Daten verwendet werden. Diese Informations- und Einwilligungserklärung ist notwendig, damit wir sicherstellen können, dass Sie den Zweck Ihrer Teilnahme verstehen und mit den Bedingungen Ihrer Teilnahme einverstanden sind.

2. Hintergrund der Bachelorarbeit

Der Fokus meiner Bachelorarbeit ist der Entwurf einer Benutzeroberfläche, für einen Algorithmus zur Vorhersage von postoperativem Delir, um seine Anwendung zu erleichtern. Dieses Interview dient in diesem Rahmen dazu den Arbeitsablauf von Anästhesisten im OP Vorgespräch mit dem Patienten und den Ablauf im Aufwachraum besser zu verstehen. Außerdem um einen groben Überblick von der digitalen Infrastruktur im Krankenhaus zu bekommen.

3. Ablauf des Usability-Test

Es findet ein Usability-Test (ca. 30 min) statt. Es werden Notizen zu Beobachtungen im Test gemacht, sowie Antworten auf einem Fragebogen notiert.

Mit Ihrer Teilnahme sind keine Risiken verbunden, aber Sie haben das Recht, den Test jederzeit abzubrechen oder von der Mitwirkung an unserer Studie zurückzutreten. Es steht Ihnen frei, die Beantwortung von Fragen abzulehnen, die Sie nicht beantworten möchten, oder den Test jederzeit abzubrechen. Ich gehe davon aus, dass ich nur einen Test durchführen werde; es kann jedoch sein, dass Nachfragen zur weiteren Klärung erforderlich sind. Wenn dies der Fall sein sollte, werde ich Sie per E-Mail kontaktieren, um dies zu erbitten.

3. Datenverwertung und -veröffentlichung

Auszüge der Notizen und des Fragebogens dürfen in anonymisierter Form direkt oder indirekt in akademischen Artikeln, Konferenzpräsentationen oder Blog-Beiträgen zitiert und angezeigt werden.

4. Entschädigung

Sie werden für die Teilnahme an dieser Studie nicht entlohnt.

5. Vertraulichkeit

¹ Datenschutz-Grundverordnung <https://dsrgvo-gesetz.de/>

Ihre Studiendaten werden vertraulich behandelt. Die Beobachtungsnotizen werden manuell vorgenommen. Der Zugang zu den Beobachtungsnotizen wird auf mich und Kolleg:innen, mit denen ich im Rahmen meiner Forschung zusammenarbeite, beschränkt sein. Ich werde einzelne Namen in allen Versionen der Notizen und Zitate, die mit anderen geteilt werden, anonymisieren.

6. Datensicherheit und -speicherung

Die Notizen werden auf meinem Computer gespeichert. Wenn die Bachelorarbeit abgeschlossen ist, werde ich diese Originaldaten löschen (voraussichtliches Löschdatum 07/2024).

9. Rechte der betroffenen Person

Laut DSGVO haben Sie die folgenden Rechte, sobald Ihre personenbezogenen Daten erstellt wurden:

- Recht auf Auskunft über die gespeicherten personenbezogenen Daten (Artikel 15 DSGVO).
- Recht auf Berichtigung, wenn Daten zu Ihrer Person falsch oder unvollständig sind (Artikel 16 DSGVO).
- Recht auf Löschung der Sie betreffenden Daten, sofern eine der gesetzlichen Voraussetzungen vorliegt und keine gesetzliche Ausnahmeregelung dem entgegensteht (Artikel 17 DSGVO).
- Recht auf Einschränkung der Verarbeitung, insbesondere wenn die Richtigkeit der Daten bestritten wird, wenn einer der im Gesetz genannten Gründe eingreift, insbesondere auf Ihren Wunsch auch anstelle der Löschung der Daten (Artikel 18 DSGVO).
- Recht auf Datenübertragbarkeit. Sie haben das Recht, Auskunft über alle personenbezogenen Daten zu verlangen, die über Sie in einem strukturierten, gängigen und maschinenlesbaren Format gespeichert sind, und haben das Recht, diese Daten einem anderen Verantwortlichen ohne Behinderung durch den Verantwortlichen, dem die personenbezogenen Daten bereitgestellt wurden, zu übermitteln (Artikel 20 DSGVO)
- Recht, eine Beschwerde bei einer Aufsichtsbehörde einzureichen. Die zuständige Aufsichtsbehörde kann jede beliebige Datenschutzaufsichtsbehörde sein (Artikel 77 DSGVO).

10. Kontakt

Wenn Sie Fragen zu dieser Studie haben, können Sie gerne mich (Alfred Jäckel) oder Prof. Dr. Claudia Müller-Birn kontaktieren.

Alfred Jäckel

Freie Universität Berlin

Fachbereich Mathematik und Informatik

Institut für Informatik

Human-Centered Computing

Königin-Luise-Str. 24/26

14195 Berlin

alfredjackel@zedat.fu-berlin.de

Prof. Dr. Claudia Müller-Birn

Freie Universität Berlin

Fachbereich Mathematik und Informatik

Institut für Informatik

Human-Centered Computing

Königin-Luise-Str. 24/26

14195 Berlin

clmb@inf.fu-berlin.de

030 - 838 75256

Wenn Sie über diese Forschung beunruhigt sind, oder wenn Sie Bedenken haben, wie sie durchgeführt wird, können Sie sich an den Datenschutzbeauftragten der Freien Universität Berlin wenden:
datenschutz@fu-berlin.de.

Einverständniserklärung

Mit meiner Unterschrift erkläre ich mich freiwillig bereit, an dem Usability-Test gemäß den Bedingungen des Informationsblattes, das ich gründlich gelesen habe (Seiten 1-3 dieses Dokuments), teilzunehmen. Mir ist bekannt, dass ich die Beantwortung von Fragen und Bearbeitung von Aufgaben verweigern kann und jederzeit ohne Angabe von Gründen aus der Studie aussteigen kann.

Zusätzlich erkläre ich:

- Ich möchte die anonymisierten Zitate, die sich auf meine Teilnahme an dem Usability-Test beziehen, überprüfen, bevor sie Teil einer Veröffentlichung werden.

Eine Abweichung von den vorstehenden Bedingungen erfolgt nur mit Ihrer weiteren ausdrücklichen Zustimmung.

Unterschrift der*des Teilnehmer*in/s

Unterschrift der*des Wissenschaftler*in/s

Berlin

Ort, Datum



Dieses Informationsblatt und die Einverständniserklärung stehen unter der Lizenz CC BY-SA 4.0, die eine Weiterverwendung und Anpassung ermöglicht, wobei die Namensnennung „Forschungsgruppe Human-Centered Computing, Freie Universität Berlin“ erforderlich ist. Einige Elemente dieses Textes wurden aus der Einverständniserklärung für das Interview der School of Geosciences der Universität Edinburgh übernommen, zu finden unter <https://www.ed.ac.uk/geosciences/intranet/working-in-school/other-important-information/ethicsinresearch/sampleinfoandconsent> (nur in Englisch).