Clinical Judgement Analysis: An innovative approach to explore the individual decision-making processes of pharmacists

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Abstract

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Clinical Judgement Analysis: An innovative approach to explore the individual decision-making processes of pharmacists

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This paper describes how CJA potentially uncovers the intuitive clinical decision-making processes of pharmacists. Using an illustrative decision-making example, the application of CJA will be described, including:

- Scenario and associated task development around a defined judgement
- Capture of pharmacists’ decision-making processes and analysis using appropriate statistical methods

Method
An illustrative study was used, applying an established method for CJA. The decision to initiate anticoagulation, alongside appropriate risk judgements, was chosen as the context. Expert anticoagulation pharmacists were interviewed to define and then refine variables (cues) involved in this decision. Decision tasks with sixty scenarios were developed to explore the effect of these cues on pharmacists’ decision-making processes and distributed to participants for completion. Descriptive statistical and regression analyses were conducted for each participant.

Results
The method produced individual judgement models for each participant, for example, demonstrating that when judging stroke risk each participant’s judgements could be accurately predicted using only 3 or 4 out of the possible 11 cues given. The method also demonstrated that participants appeared to consider multiple cues when making risk judgements but used an algorithmic approach based on one or two cues when making the clinical decision.

Conclusion
CJA generates insights into the clinical decision-making processes of pharmacists not uncovered by the current literature. This provides a springboard for more in-depth explorations; explorations that are vital to the understanding and ongoing development of the role of pharmacists.

Key words:
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Clinical decision-making in pharmacy: A Brief Overview

Pharmacy is a profession increasingly on the frontline of patient care, stepping out of the backroom. For example, the UK National Health Service (NHS) Long Term Plan states that pharmacists have an important role in improving population health-related outcomes.\(^1\) With rising numbers of pharmacists becoming prescribers, the expanded role of pharmacists in General Practice as well as a more clinical shift in the role of the community pharmacist, pharmacists initiating treatment plans is becoming part of common practice in the UK. The more traditional role of correcting prescribers and making recommendations is shifting to the role of decision-maker. It is therefore necessary to determine whether the initial education and training of pharmacists is still appropriate. A fuller picture of the decision-making processes of pharmacists is required.

Research into clinical decision-making in pharmacy

Dufful et al propose that pharmacists make decisions primarily based on the bioethical principle of non-maleficence rather than beneficence.\(^2\) This subtle but important distinction suggests decision-making is motivated by avoiding harm rather than doing good, leading to an unbalanced emphasis on risk-aversion. Pharmacists may be more concerned with their role in any potential harm than maximising benefit for the patient. This is supported by the earlier work of Campagna, who proposes a hierarchical model for pharmacists’ decision-making consisting of four levels: submissive, corrective, consultative and prescriptive (Figure 1).\(^3\) Campagna states pharmacists mainly work at a submissive or corrective level, despite being competent to work at the higher levels. As pharmacists assume roles that require prescriptive decision-making, they need to actively seek to “do good”, as well as preventing harm.
Previously defined as a “drug-controller”, the progression of the pharmacist’s role suggests that the term “therapeutic decision-making” should describe clinical decision-making in pharmacy practice. In comparison to diagnostic decision-making, often associated with physicians, pharmacists’ clinical decision-making tends to focus on medicines-management. This poses a difficulty for training and research: while diagnostic decisions could be said to be binary (the patient either has the condition or not), management decisions are not. Most conditions have more than one potential treatment, with varying doses, formulations, administration routes and monitoring requirements.

Existing studies investigating clinical decision-making in pharmacy have been in community pharmacy and employ methods, such as think-aloud techniques, designed to capture approaches that are readily articulated. Whilst these studies provide useful insights into the

**Figure 1** The hierarchical levels of pharmacists’ decision-making, where prevalence has been estimated from published surveys of pharmacy practice reviewed by Campagna (3)
The psychology of decision-making, and implications for research

Dual-process theories, such as the one popularised by Kahneman, suggest that decision-making can be characterised via two pathways: System 1 (intuitive), and System 2 (deliberate). Cognitive continuum theory, a variant of these dual-process theories, states that these two systems are not distinct routes employed independently of one another, but rather two ends of a spectrum. Where decision-making falls on this spectrum is determined by task factors such as complexity. Importantly, task complexity is relative to the experience of the clinician; clinicians will find frequently encountered tasks less complex. The less complex a task, the more likely the clinician is to use more of System 1 than System 2.

Consider the case of a pharmacy student, whose patient presents with a skin complaint. A slow, deliberate process is applied, considering all possible diagnoses and treatment options, using all available resources. An experienced pharmacist, after seeing multiple cases, may not only diagnose ringworm but recommend anti-fungal cream seemingly without a second thought. The student uses more of System 2; the experienced pharmacist more of System 1. If asked, the student would be able to verbalise each step of their thought process. The pharmacist might say, “it was just obvious”.

This poses a problem for research into the decision-making of clinicians: if experts make their decisions intuitively (System 1) rather than deliberately (System 2), can the information used, and the way it has been used in making the decision, be identified? Can an individual clinician’s system for decision-making be described?

The evolution of decision-making research methods in the context of Pharmacy.

Judgement Analysis, developed by Hammond, explores how individuals make decisions. Analysis of a set of judgements or decisions where the possible inputs (“cues”) are known, allows a model describing an individual’s decisions to be created, without having to elicit self-reports from the decision-maker. For example, when a pharmacist assesses stroke risk, multiple cues are presented. The values of these cues are then observed and utilised by the pharmacist to form a judgement. Figure 2 shows the apparent scattering and filtering of these variables through the lens of the “judge” (in this case the pharmacist) before being recombinated. Often referred to as the “Lens Model”, it is regarded by many decision psychologists as a valuable framework.
Formal analyses based on the Judgement Analysis approach (or Lens Model framework) have been used to model the decisions of individuals in a range of domains and settings. When used in clinical practice, it is often referred to as Clinical Judgement Analysis (CJA). These models take the form of input-output mappings (usually derived via multiple or logistic regression) and can be thought to represent the individuals’ personal or idiosyncratic judgement model for making a specific class of decision. Relying on objective observation of the inputs and outputs for a decision, Judgement Analysis does not depend on people’s opportunity (e.g., sufficient time) or ability (e.g., self-insight) to describe their own decision-making. It therefore overcomes certain limitations of self-report or think-aloud methods, providing a quantitative measure of what an individual does with information. CJA is therefore a valuable tool for describing and predicting decisions, so that individual’s decisions can be understood and compared. Application of such a method to pharmacists may allow further investigation into implicit decision-making process, the findings of which will inform future training and educational needs to support the evolving profession. At the time of publishing there is no record of this method being explored in pharmacy, although it has been successfully employed in other domains. For example, it has been used to show how physicians optimise their use of clinical information according to their location in the diagnosis in pneumonia, providing a better understanding of why clinical practice may vary across different regions.

This paper aims to demonstrate how Clinical Judgement Analysis may be adapted to understand pharmacy decisions. With the aid of an illustrative study, this paper outlines how to apply CJA to pharmacists’ decision-making; and to aid other researchers in this area, it describes what was learnt during the design, implementation and analysis of this study. The objectives are to:

- exploit CJA to capture how multiple variables (e.g., patient age, alcohol use) affect a judgement (e.g., assessing bleed risk) or decision (in this case to initiate anticoagulation in patients with atrial fibrillation (AF)).
- demonstrate how participating pharmacists were individually analysed to determine their unique decision-making judgement models.
This study was registered with the King’s College London Research Ethics Office, reference number MRS-17/18-6666.

**Adapting Clinical Judgement Analysis (CJA) for use in pharmacy – an illustrative study**

The development of the method involved a research team of four academic pharmacists and one psychologist specialising in decision-making. Cooksey’s established method for CJA was followed (Figure 3). A glossary of terms has been included below (Figure 4) to aid the reader in this section.

| 1. Define the judgement. |
| 2. Become familiar with the context of the judgement. |
| 3. Draw out the potential cues and their levels (values) involved in making the judgement. |
| 4. Create scenarios that are realistic. |
| 5. Decide on a sample of judges. |
| 6. Collect judgements. |
| 7. Analyse collected judgements to obtain models of individual judgement. |

**Figure 3 Suggested method for Clinical Judgement Analysis (22)**

| Judgement model – mathematical description defining how a set of cues are weighted and utilised by an individual when making a specific judgement or decision. |
| Holdout case – a scenario/ task where the data captured is not used in the regression modelling but used later to test the predictive power of the judgement model generated. |
| Cue – a piece of information or a factor that may be used by an individual when making a specific judgement or decision (e.g. age of patient). A cue can either be fixed (i.e. the age of the patient is kept the same for all scenarios) or varied across difference levels for each scenario. |
| Cue Level – The value of a varied cue defined as a level for the purposes of coding for statistical analysis (e.g. 75-years old = level 1, 80-years old = level 2). |

**Figure 4 Glossary of terms used in CJA**
1. Define the judgement

It is important to clearly define the judgement under investigation, as this will set the scene for the design of the study. In this example, oral anticoagulation initiation in patients with non-valvular atrial fibrillation (NVAF) was chosen as the area of decision-making due to the well documented risk-benefit assessments, notably the validated scoring systems CHA²DS²-VASc and HASBLED.²⁴ The NHS Long Term Plan identifies early detection and treatment of AF as a priority,¹ with pharmacists increasingly expected to support the clinical management of anticoagulation. Whilst there are recognised guidelines which outline several variables to consider, it is not known what variables influence individuals’ judgements; CJA provides a way for this information to be captured, and uncover an individual’s decision-making judgement model.

2. Become familiar with the context of the judgement

Once the judgement has been defined, the context of the judgement should be explored. This allows the researcher to make informed decisions during the study design (steps 3 to 5, Figure 3).

In the illustrative study, a review of literature by the research team followed by expert interviews and observations by the first author were employed as outlined below.

**Review of the relevant literature**

CHA²DS²-VASc is a validated method for AF patients endorsed by NICE.²⁵ Variables are weighted to create a score for a patient (Table 1) that are used to predict their 1-year stroke risk.²³ Similarly, HASBLED (Table 2) predicts the patient’s risk of experiencing a major bleed. These scores guide clinicians on the decision to initiate anticoagulation.²⁵

<table>
<thead>
<tr>
<th>CHA²DS²-VASc variable</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥ 75 years</td>
<td>2</td>
</tr>
<tr>
<td>Age 65 to 74 years</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/TE</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease (prior MI, PAD or aortic plaque)</td>
<td>1</td>
</tr>
<tr>
<td>Sex categorised as female</td>
<td>1</td>
</tr>
</tbody>
</table>

**Maximum score** 9

<table>
<thead>
<tr>
<th>HASBLED variable</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Renal disease</td>
<td>1</td>
</tr>
<tr>
<td>Liver disease</td>
<td>1</td>
</tr>
<tr>
<td>Stroke history</td>
<td>1</td>
</tr>
<tr>
<td>Prior major bleed/ predisposition to bleeding</td>
<td>1</td>
</tr>
<tr>
<td>Labile INR</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥ 65 years</td>
<td>1</td>
</tr>
<tr>
<td>Antiplatelet or NSAID usage</td>
<td>1</td>
</tr>
<tr>
<td>Alcohol use ≥ 8 drinks per week</td>
<td>1</td>
</tr>
</tbody>
</table>

**Maximum score** 9

*Table 2 HASBLED Scoring system used to predict the risk of major bleed in patients with NVAF (24)*
Interview experts

Semi-structured one-to-one interviews were conducted by the first author with an Honorary Consultant Pharmacist in anticoagulation and a Lead Pharmacist for anticoagulation, both based at large London teaching hospitals. Interview questions (Appendix 1) were created following a review of the literature and recorded with permission. Summary reports generated were approved by participants.

Observation of practice

Two pharmacists’ practice was observed in an anticoagulation clinic at a large London teaching hospital for two hours. Information retrieved from the patient’s medical record, referral letter or from the patient themselves by the pharmacists was noted. Factors discussed between the two pharmacists present, during or after each appointment, were also noted. No patient identifiable data was recorded.

3. Draw out the potential cues and their levels involved in making the judgement

Now with an understanding of the judgement context, the study design can begin starting with the identification of potential cues. Judgement Analysis literature suggests that more than 10 varied cues when formulating a task risks overburdening the participants’ cognitive capabilities. This needs to be balanced against ensuring the realism of the scenarios, as often in practice there is no limit to the number of variables. Participants need enough information to be able to make a judgement, without creating an information overload. This difficulty can be ameliorated by having both fixed and varied cues; some factors are kept the same in all scenarios (fixed), giving the participant the information they need to be able to make a judgement without needing to consider how the variation of this factor affects any outcomes.

In this example, information identified as a factor in decision-making through the interviews (n=39) and any additional factors identified through observations (n=3) were listed as potential cues. As patients with NVAF were the focus, the variables used in the CHA2DS2-VASc (n=7) and HASBLED (n=9) scoring systems were also listed as potential cues, giving a total of 58 potential cues (Appendix 2).

An iterative process involving an Honorary Consultant Pharmacist in anticoagulation and the research team produced 17 cues to be included in the scenarios (Figure 5).
For 11 of these cues, the level varied across the scenarios (e.g. age of patient was either 70 or 85 years). The value of the other 6 cues were fixed. That is, the cue was mentioned in each scenario, but the value of that cue did not vary across the 60 scenarios (e.g. liver function was always normal). Table 3 provides the rationale for this process; although not all information possible was presented to the participating pharmacists, the design is ecologically valid as in practice not all information is available to the pharmacist.
4. Create scenarios that are realistic

Once the cues have been identified the scenarios can be created. Often in CJA, hypothetical scenarios are designed rather than using existing patient records. Designing the scenarios allows the researcher to ensure that there is no intercorrelation between the cues. This creates an efficient design, making statistical analysis possible with fewer cases because reducing the correlation between cues increases the statistical power to detect the independent effect that one cue has upon the judgement being made. For example, there could be a correlation between age and renal function, making it difficult to identify the relative importance of each cue to the decision-maker. Eliminating the correlation between age and renal function in the scenarios makes it easier to identify the effect that either cue has on judgement. However, a balance needs to be struck between designing scenarios that are realistic enough to produce ecologically valid results, and scenarios that provide a pragmatic way to collect data.

For this study, the cues and variations in their levels were input into SPSS® to create scenarios with no intercorrelation between the cues using a program (macro) available with this software (SPSS ORTHOPLAN). The different combinations of cues were checked by the research team to ensure that no “impossible patients” were created, i.e. a combination of patient factors that could not feasibly co-occur.

A feasibility study was conducted where 16 scenarios were given to 4 anticoagulation pharmacists to critique. Judgements made were not statistically analysed at this stage. Three of the 4 pharmacists recruited to take part in this feasibility study fulfilled the request. Debriefs with these 3 pharmacists were conducted to assess:

- How realistic the scenarios were

<table>
<thead>
<tr>
<th>CUE CATEGORY</th>
<th>RATIONALE</th>
</tr>
</thead>
</table>
| EXCLUDED CUES | Cues were excluded from this illustrative study by the Honorary Consultant Pharmacist and research team if:  
  - the cue was not felt to have significant impact on decision-making in this area  
  - the cue made the task too complex, requiring specialist knowledge and potentially affecting participation  
  - the cue was unlikely to present in regular practice |
| VARIED CUES | Cues were included in this illustrative study by the Honorary Consultant Pharmacist and research team and varied if:  
  - the cue commonly presented in regular practice in this context  
  - varying the cue would create a need for judgement  
  - varying the cue did not create a need for specialist knowledge |
| FIXED CUES | Cues were included in this illustrative study by the Honorary Consultant Pharmacist and research team and fixed if:  
  - The cue was deemed necessary to make a decision, but was outside the scope of the study or met some of the exclusion criteria |

Table 3 Rationale for the categorisation of cues, including exclusion criteria
The varied cues and their levels were then finalised to those shown in Table 4. These 11 varied cues, along with the 6 fixed cues deemed necessary for participants to make a decision, were then used to produce the final 60 scenarios. Using SPSS ORTHPLAN, scenarios were created with no intercorrelation between the cues. Correlations were examined to confirm orthogonal design, i.e. all cues were uncorrelated. For each of the 60 scenarios, an email from a fictional junior doctor was created, asking the pharmacist to advise on anticoagulation initiation (Figure 6). These included 8 “holdout cases”. A holdout case in this study was a scenario that was given to participants to capture data but was exempt from the initial statistical analysis. Holdout cases are then later used to test the predictive power of any models generated. All scenarios were checked by the research team to ensure that each scenario was realistic.

<table>
<thead>
<tr>
<th>Cue</th>
<th>Level 1=</th>
<th>Level 2=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>Bleed Information</td>
<td>Detailed</td>
<td>Lacks detail</td>
</tr>
<tr>
<td>Presence of diabetes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Presence of Chronic Heart Failure</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hypertension</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Renal function</td>
<td>Normal</td>
<td>Impaired</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Physical appearance</td>
<td>Fit</td>
<td>Frail</td>
</tr>
<tr>
<td>Support system</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Responsibility for health</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Patient preference</td>
<td>Wants anticoagulation</td>
<td>Doesn’t want anticoagulation</td>
</tr>
</tbody>
</table>

Table 4 Coding for each cue level, used in the statistical analysis of each participant.
I am looking after a 70-year-old female patient admitted after a suspected TIA, with a subsequent diagnosis of non-valvular atrial fibrillation. I am unsure of the best course of action with regards to anticoagulation for this patient, as they had a GI bleed last month caused by a H. pylori induced gastric ulcer (all FBCs are within range and Gastro has given the all clear).

The patient has no history of diabetes and a history of congestive heart failure, which is well controlled with Ramipril 5mg bd and bisoprolol 10mg od. The patient’s blood pressure is 165/95 for which they have been started on amlodipine 5mg od. LFTs (ALT, GGT, ALP, INR, bilirubin) are all normal. eGFR is 45 ml/min/1.73m². Patient reports taking no other medication.

The patient appears physically healthy to me and seems to rely on others to take responsibility for their health. The patient reports that they have a good family support system in place. I have discussed some possible options with the patient, who has expressed concerns and does not want to take anticoagulants. The patient reports drinking around two large glasses of wine every evening (estimate of 25-30 units per week).

What would your recommendation be with regards to starting anticoagulation?

Many thanks

Charlie (FY1 on cardiology rotation)

Figure 6 Example of scenario with fixed cues highlighted in yellow and variable cues highlighted in blue. “Fixed cues” denote factors that were deemed necessary for the pharmacist to make a risk judgement and final decision but kept the same for all scenarios. “Varied cues” denote the variables that were altered for the scenarios to see how they affect the decision-making judgement model of each individual (Table 4).

TIA: Transient Ischemic Attack; GI: Gastro-intestinal; FBC: Full Blood Count; Gastro: Gastroenterology department; bd: Twice daily; od: Once daily; LFTs: Liver Function Tests; ALT: Alanine transaminase; GGT: Gamma glutamyl transpeptidase; ALP: Alkaline phosphatase; INR: International Normalised Ratio; eGFR: estimated Glomerular Filtration Rate; FY1: Foundation Year 1 Junior Doctor
5. Decide on a sample of judges
Next, with familiarity of the context of the judgement, the participants, or judges, are identified and recruited. In the UK, hospital pharmacists have extensive access to patient data and are often consulted on prescribing decisions, therefore hospital pharmacists were chosen for this study. As any hospital pharmacist could be questioned about anticoagulation in their routine practice, all qualified pharmacists were invited to participate via a link sent to and circulated by clinical services leads at three large London teaching hospitals. Participation was possible without gatekeepers (e.g. line managers) being aware of involvement.

6. Collect judgements
Following participant recruitment, tasks are completed, and judgements collected. This is potentially the most difficult part of the process, as it requires the input of participants, taking up their time and effort.

In this study, four participants completed the tasks using an online survey link, electronically within the MS Word document or by printing the document to complete the tasks on paper. For each scenario, participants were asked for their judgement on stroke risk, bleed risk and confidence in the patient’s ability to manage their condition. A recommendation on what action should be taken regarding anticoagulation was also requested (Figure 7).

1. The literature suggests that those with the highest risk have a 1% chance of having a stroke in the next year, i.e. 15 out of 100 patients. For this patient, what would you say is the probability of a stroke occurring in the next year?

<table>
<thead>
<tr>
<th>&lt;1%</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
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<th>9%</th>
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<tr>
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<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
</tr>
</tbody>
</table>

2. Regarding anticoagulation, what action would you recommend to the junior doctor? (Select one)
- Do not initiate anticoagulation
- Initiate edoxaban
- Initiate apixaban
- Initiate rivaroxaban
- Refer to consultant
- Initiate warfarin
- Initiate dabigatran

3. The literature suggests similar scale as the one for stroke prediction when look at the chance of a major bleed. If anticoagulation were to be initiated, what would you say is the probability of the patient experiencing a major bleed in the next year?

<table>
<thead>
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4. Considering the risk factors for stroke and major bleed, as well as the patient factors, how confident are you in the patient’s ability to manage their condition?

- Not confident
- Slightly confident
- Moderately confident
- Highly confident

Use the space below to note any explanations for your recommendations, other actions you would recommend, or any other comments you feel are relevant.

Figure 7 Tasks participants were asked to complete for each scenario in the final study. These tasks were the same for all scenarios.

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7. Analyse collected judgements to obtain models of individual judgement

Once the judgements are completed, analysis of the data is undertaken to obtain models of each participant's judgement. Collecting a large amount of data from each participant allows for in-depth analysis of an individual's judgement model, which can be used to produce personalised reports providing feedback for developing practice. Additionally, further analysis can subsequently be undertaken if enough participants contribute data to draw conclusions about a group, or differences between groups. To generate such data, consideration of the time to complete multiple scenario tasks is important as it may impact upon participant recruitment and completion of tasks.

Four participants have completed the study to date, all hospital-based pharmacists with experience in anticoagulation services. Sixty sets of judgements were collected from each participant. Given the small number of participants, detailed demographics were not explored in the interest of confidentiality.

Using multiple regression to model each participant

Three separate multiple regression analyses were conducted on the judgements of each participant. The varied cues (Table 4) were the independent factors and the participant judgements of risk of stroke, risk of bleed, and confidence in the patient's ability to manage their condition were in turn considered as the dependent variables. The coefficients generated were then used to create regression models that can be used to predict each participants' judgement of the risk of stroke, risk of bleed and their confidence for patient self-management. Each model can be applied to any patient for which the values of the 11 varied cues are known. Illustrative examples of the analysis and results are provided below, with full results available by contacting the corresponding author.

For example, multiple regression analysis carried out for Participant 02 produced a model that could predict their judgement of stroke risk with a high level of accuracy (Figure 8). Interestingly, the model showed that only 4 of the 11 cues available to the participant were used to a significant level in their judgement process; the presence of diabetes, CHF and hypertension as well as the reported level of responsibility the patient took for their own health. These are the cues from which this participant's stroke risk judgements can most reliably be predicted.
\[ Y_{\text{Judgement.Stroke.Risk}} = 1.077 + 0.808 \chi_{\text{AGE}} - 0.038 \chi_{\text{BL}} + 0.962 \chi_{\text{DM}*} + 1.038 \chi_{\text{CHF}*} + 0.885 \chi_{\text{HPT}}* - 0.192 \chi_{\text{REN}} - 0.038 \chi_{\text{ALC}} - 0.038 \chi_{\text{PHY}} + 0.038 \chi_{\text{SUP}} - 0.269 \chi_{\text{RES}*} - 0.038 \chi_{\text{PREF}} \]

\( \chi_{\text{AGE}} \): Age, \( \chi_{\text{BL}} \): Bleed Information, \( \chi_{\text{DM}} \): Presence of diabetes, \( \chi_{\text{CHF}} \): Presence of chronic heart failure, \( \chi_{\text{HPT}} \): Hypertension, \( \chi_{\text{REN}} \): Renal function, \( \chi_{\text{ALC}} \): Alcohol use, \( \chi_{\text{PHY}} \): Physical appearance, \( \chi_{\text{SUP}} \): Support system, \( \chi_{\text{RES}} \): Responsibility for health, \( \chi_{\text{PREF}} \): Patient preference

**Figure 10** Regression model for Participant 02 stroke risk (\( R^2=0.86 \), Adjusted \( R^2=0.821 \), \( p<0.01 \))

The higher the coefficient, the more the variation of that cue affected the judgement made. It is proposed that cues with larger coefficients that show significance are the pieces of information the participant gave most importance to when making their judgement. * \( p<0.05 \), 2-tailed

The weight of each cue shows the average difference this cue makes to the judged stroke risk. Participant 02’s judgements of stroke risk are 0.96% higher (in absolute terms) for patients with diabetes when compared with non-diabetics. The presence of CHF also raises judgements of stroke risk by 1%, while the presence of hypertension raises the judged risk by approximately 0.9%.

To test the goodness of fit of the stroke risk regression models generated by the 52 non-holdout cases, using all 11 varied cues, the model was used to predict the stroke risk judgement for the 8 holdout cases. A strong correlation was found between the predicted stroke risk judgement and the actual stroke risk judgement made, indicating a good fit. For example, for Participant 02 there was a correlation of 0.8 between the stroke risk predicted by the regression model and the actual risk judgement given in the 8 holdout cases. Therefore, the model derived could predict judgements made by this participant with a high degree of accuracy. This was the case for all four participant models.

To summarise, stroke risk judgements of the participant could successfully be described in 52 cases knowing only the values of 4 cues. Additionally, analysis generated an arithmetic rule (the regression model) that predicts over 80% of the variance in their stroke risk judgements.
A further finding of note from employing this method was uncovered when the stroke risk judgement of each participant was compared to the stroke risk calculated using the literature (Figure 9). Although all 4 participants had previous or current experience as anticoagulation pharmacists, judgement of stroke risk for each scenario differed between participants. While the stroke risk judgements of Participants 01 and 03 followed those predicted by the CHA\textsubscript{2}DS\textsubscript{2}VASc scoring rule closely, Participant 02 appears to underestimate the risk while Participant 04 overestimates it (relative to the scoring rule). Further research is required into the area of judgement and decision-making within the pharmacy sector, so that differences like the one demonstrated here can be further understood to optimise patient care.

![Figure 14 Stroke risk judgement of each participant by scenario, compared to the risk derived from the CHA\textsubscript{2}DS\textsubscript{2}VASc validated scoring rule.](image)

Similar regression analysis was conducted for the second task (Figure 7), a judgement of each patient’s risk of experiencing a major bleed in the next year. Analysis revealed that for each participant 2 or 3 cues explained most of the variance in this judgement, with moderate agreement between participants on which cues predict the level of risk (notably hypertension and alcohol use). Although a model of good fit was produced for this judgement for 3 of the 4 participants (p<0.01), comparison with the holdout cases only showed a significant correlation for participant 01 and 04. The regression models adequately describe and predict judgements of bleed risk; however, they are less successful compared with corresponding models for stroke risk. One possibility is that judgements of bleed risk are simply ‘noisier’. A bleed is more manageable than a stroke, so clinicians may have well-defined mapping between cues and risk for stroke risk, but less so for bleed risk. An alternative possibility is that the participants’ judgements followed a regular pattern, but the pattern was too complex to be represented well by the linear model generated by regression analysis.
The judgement of bleed risk for each scenario made by each participant was compared to the literature (Figure 10). As with stroke risk, Participant 02 underestimates the risk when compared to that predicted by the literature.

Figure 18 Bleed risk judgement of each participant by scenario, compared to risk assessed by the HASBLED validated scoring rule
Although the models generated through multiple regression for the judgement “confidence in patient’s ability to manage condition” were significant for Participants 01, 02 and 04, only the model for Participant 04 produced a strong and significant correlation between the predicted and actual judgements for the 8 holdout cases. It may be that as the participants did not see the patients themselves, relying on the impressions of the junior doctor (Figure 6), they did not have enough information to make this judgement.

Exploratory Statistical Analysis
Using the decision to initiate anticoagulation as the dependent factor, logistic regression was initially carried out, followed by other exploratory statistical analyses.

Simple frequency analysis was conducted for each participant to identify decisions made, and to explore how further to analyse the results. Participant 02 and 04 always recommended initiation, therefore it was not possible to analyse which cues influenced the decision to initiate (Figure 11). However, there was a split in which anticoagulant was chosen, so it could be possible to analyse the effect of the cues on this decision. In contrast, Participant 01 did show a clear split in the decision to initiate therefore this decision could be further analysed.

![Figure 19 Number of times each participant chose to initiate anticoagulation or refer to the consultant. No participants recommended not initiating anticoagulation in any of the scenarios. Participant 01 and 03 recommended referring the patient to the consultant in some of the scenarios. No participants recommended anticoagulants other than edoxaban or apixaban. Participant 02 and 04 recommended anticoagulation to be initiated in every scenario.](image-url)
The decision for each participant was recoded for regression analysis as follows:

- Participant 01: decision to initiate anticoagulation vs decision to refer to consultant
- Participant 02, 03 and 04: decision to initiate edoxaban vs decision to initiate apixaban

Logistic regression (using the 52 non-holdout cases) carried out for all participants did not produce clear findings. However, correlation analysis carried out for each decision as described above against each individual cue revealed some significant relationships.

Participant 01 demonstrated a strong association (phi correlation of 0.89, p<0.01, 2-tailed) between the patient’s preference for treatment and the decision to initiate anticoagulation. Where the patient expressed a preference not to start anticoagulation, Participant 01 typically chose to refer the patient to the consultant.

Participants 02 and 04 showed a strong association (phi correlation of 0.89, p<0.01, 2-tailed) between the presence of CHF and choice of drug chosen. If the patient had CHF, the participants typically recommended apixaban. If the patient did not have CHF, the participants typically recommended edoxaban.

This may be due to the dosing regimen set for patients with CHF. The patients with CHF were on a twice daily dosing regimen, the recommended frequency for taking apixaban. Participants 02 and 04 appear to decide on which anticoagulation to recommend based on which anticoagulant’s dosing regimen most closely matched that of the patient’s current medication.

It was hypothesised that participants would combine the cues within the scenarios to a varying degree to come to their final decision regarding anticoagulation initiation. However, the strong correlation between the final decision made and one particular cue for Participants 01, 02 and 04 suggests a more stepwise approach as shown in Figures 12 and 13.

![Decision Flowchart](image)

*Figure 23 The decisions of participant 01 to start anticoagulation were strongly correlated with one cue (patient preference) suggesting a stepwise decision-making process depending on one variable rather than a weighing up of multiple factors.*
This appears consistent with the way pharmacists are trained. Standard operating procedures (SOPs) are a legal requirement in UK pharmacies, promoting a stepwise approach for technical pharmacy tasks (e.g. dispensing). Perhaps this training for the more technical aspects of pharmacy, something that physicians would not encounter, has inadvertently influenced how clinical decision-making is applied. The superiority or inferiority of this approach to decision-making is beyond the scope of this paper.

**Summary of key findings from the illustrative study**
- Clinical Judgement Analysis produced models of good fit for the prediction of stroke risk judgement and bleed risk judgement made by individual pharmacists.
- The varied cues chosen did not appear to influence the participants’ judgement of how well the patient would manage their condition.
- Participants varied in their judgement of risk (both stroke and bleed). This difference is seen not only when comparing the participants but also in how much their judgement agreed with the risk predicted by the literature.
- The decision-making judgement model for 3 participants appeared to be a stepwise approach, where the presence of one factor dictates the decision-making, rather than based on a model where many variables are considered.

**Figure 13** The decisions of participants 02 and 04 to initiate edoxaban or apixaban were strongly correlated with one cue (presence of CHF) suggesting a stepwise decision-making process depending on one variable rather than a weighing up of multiple factors.

**Figure 14** Summary of the key findings of the illustrative study.
Strengths and Limitations of using CJA in this way

Limitations
The number of scenarios needed to achieve adequate statistical power required a substantial time commitment from participants. This may explain the small sample of participants recruited (n=4) to the illustrative study. No group analysis was therefore possible.

To keep the number of cues within the scenarios around the recommended number of 10, the complexity and level of detail and therefore potentially the realism of the scenarios was impaired. The repetitive nature of the tasks set may have impacted the answers given by participants. By designing the scenarios to avoid intercorrelation, the representative design may be affected as clinical features in practice are often correlated. This could potentially be overcome by using cases from practice with a large enough sample size to overcome the effects of intercorrelation on the statistical analysis. Using data already recorded would also negate the time commitment required from participants. A handful of judgment analysis investigations have employed both representative and non-representative design. Some of these point to subtle differences between the two designs in how cues are used. Therefore, to gain a fuller picture of pharmacists’ decision making for anticoagulation prescription, and potentially in other areas, future studies may wish to conduct CJA retrospectively on a large number of existing cases, for example from an anticoagulation clinic’s patient records.

Strengths
Despite the concerns described above, designing the scenarios to avoid intercorrelation provides models of statistical relevance and extensive information about the individual participants’ judgements for a large range of patients. Although the design of the illustrative study did not generate sufficient data to make definitive statements about the pharmacists’ decision-making processes in general, it has shown that CJA is a useful tool for uncovering the decision-making and judgement models of individuals. With a bigger data set and more in-depth analysis, comparisons between levels of experience could be carried out. CJA could also be a useful evaluation and training tool. For example, it could be used to evaluate an intervention designed to change clinical decision-making or help pharmacists to uncover unconscious or intuitive bias in their clinical judgement.

Conclusion
This paper set out to demonstrate how CJA could be used in the context of pharmacy practice to uncover both the explicit and implicit decision-making processes that occur when a pharmacist is called on to make a clinical judgement or decision.

The statistical analysis of the decisions made by the participants suggests that employing CJA generates insights into the clinical decision-making processes of pharmacists not uncovered by methods that rely on participants being explicit about their decision-making processes. More in-depth explorations, essential to the ongoing development of the role of pharmacists, could now be made.

Comparing the risk judgements of the participants to the relevant risk literature suggest that even in this well documented area, pharmacists use approaches to decision-making that vary notably between individuals. This has implications for practice and requires further investigation.
The decision-making process of pharmacists demonstrated by this paper appeared to follow a more stepwise approach, in comparison to the processes shown by other clinicians.\(^{18,21}\) This may be explained by the way pharmacists are trained, compared to physicians. An emphasis on non-maleficence during training may instil this more stepwise approach. An emphasis on beneficence may encourage clinicians to consider numerous factors to produce an optimal solution. Further research in this area will enable greater understanding and facilitate the personal development of pharmacists and influence the way clinical decision-making is taught to pharmacists.

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Declaration of competing interest

The authors have no conflict of interest to declare.

Acknowledgements

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References


Title of Study: An exploration into how pharmacists make clinical decisions in uncertainty (working title)

King’s College Research Ethics Committee Ref: MRS – 17/18 - 6666

Stage 1: Interview of specialist pharmacist

“I’m carrying out a study exploring the variables pharmacists consider when making a clinical decision. The study should also give an indication of how much pharmacists consider these variables when making judgments. I’m hoping that through this interview and interviews with other expert pharmacists, I will be able to construct scenarios with a range of variables which I can use to determine how pharmacists use these variables to make clinical decisions. The study is not about finding out if pharmacists make the right or best clinical decisions, but rather finding out how they use the given information to come to their decision. I’ll be audio recording this session so that I am free to converse with you freely and to ensure that I have an accurate record of what we’ve discussed. I will generate a report of my findings from our conversation today and send you a copy to make sure that I have understood and interpreted everything as you meant it.

The interview has 14 questions, some capture contextual information while others relate to elements around decision making. It will take around 45 minutes to complete.”

About you and your practice

1. What would you say is your specialist area within pharmacy?

2. How would you describe the setting(s) you work in as a pharmacist? (ward/clinic etc.)

About clinical decisions in general

3. How would you define the term “clinical decision”?

4. With a typical workday in mind, what percentage of time do you spend making clinical decisions?

[For the following questions, it would be useful to make notes in a way that the participant can see, e.g. perhaps on a white board?]

5. Can you describe a recent situation where the clinical decision you had to make for the patient wasn’t clear cut?
   a. [if this isn’t part of participants answer] What about when a patient is on interacting medications? How does this affect your decision?

6. Can you describe a recent situation where the risk of harm to the patient was dependent on your clinical decision?
a. [if this isn’t part of participants answer] Can you describe a recent situation where the potential for patient harm was linked to a drug-drug interaction?

7. Can you give examples of drug-drug interactions that causes particular issues within your area of practice?
   a. [if this isn’t part of participants answer] Can you describe a drug-drug interaction involving an anticoagulant that causes particular issues within your area of practice

**About what influences the decisions you make**

I’m hoping to come up with a list of variables that a pharmacist may take into account when making a clinical decision.

8. Keeping in mind the situations you have described, can you tell me what individual pieces of information you need to know about the patient and the medications involved when trying to make a judgment about the risks and benefits involved and to make a decision about the patient’s treatment?
   [write down list of variables]

9. Looking at this list of variables, is there anything you would like to add?

10. Thinking back to a time you worked with a newly qualified pharmacist or pre-registration pharmacist, are there any variables you think they should consider that you would like to add to the list?

11. Thinking back to a time you worked with a pharmacist you haven’t agreed with, are there any variables you think they would consider that they shouldn’t which we could add to the list?

12. Are there circumstances where it would concern you that a patient on citalopram is then prescribed an anticoagulant?
   a. How often do you see these two drugs prescribed for the same patient in your practice?

   b. If you were presented with this scenario, how would you make a judgment of the risk to the patient?

   c. How would you make a judgment of the benefit to the patient?

   d. Are there circumstances where you would not agree with the anticoagulant being prescribed in this scenario?

   e. Is this affected by which specific anticoagulant is prescribed?

13. What if a patient on rifampicin was prescribed an anticoagulant – are there any circumstances where you would have concerns about this situation?
a. How often do you see these two drugs prescribed for the same patient in your practice?

b. If you were presented with this scenario, how would you make a judgment of the risk to the patient?

c. How would you make a judgment of the benefit to the patient?

d. Are there circumstances where you would not agree with the anticoagulant being prescribed in this scenario?

e. Is this affected by which anticoagulant is prescribed?

14. Having talked through those two specific scenarios, are there any variables you would like to add to the list we made earlier?
Appendix 1

Identification of potential cues

Once a defined judgement question had been chosen, interviews and observations were conducted to draw out what cues played a part in the judgement. One to one interviews were carried out with two pharmacists who were identified as the lead anticoagulant specialist pharmacists in their hospital trusts.

Cues identified by interviewee 1

- Indication for therapy
- Investigations:
  - Full blood count (FBC)
  - Urea and electrolytes (U&Es)
  - LFTs
  - Renal function (CrCl)
  - INR
- Observations: how the patient presents physically at clinic (Shortness of breath, pulse, blood pressure, pallor etc)
- Co-morbidities or possible co-morbidities/ underlying causes (e.g. cancer)
- DOAC levels (in participants practice checked if CrCl < 30 ml/min)
- Other meds
- Home situation/ support structure
- Number of previous hospital admissions
- Alcohol if outside of Department of Health guidance
- History of bleeding
- How articulate patient is about their health/ how much responsibility they take for their health

Participant made particular mention of the following variables when they make clinical decisions which may be seen as more aggressive or higher risk:

- Social/ home situation/ support system – is there someone who is easily contactable who can make a sensible decision about the patient’s care e.g. whether they should go to hospital – can perhaps be more aggressive with treatment if this safety net is in place
- Number of previous hospital admissions – this could create a situation with multiple clinicians involved in the care of the patient, which can increase risk
- How articulate the patient is about their health/ do they come across as responsible for their own health – if the patient comes across as being competent, this increase confidence in the clinical decision. The participant stated that it made them nervous when patients did not seem to know much about their condition/ general health, and made the participant feel an increased sense of responsibility when making a clinical decision, which may mean they take a less aggressive or lower risk decision.
- Excessive alcohol – although the participant did not feel that there was a concern with alcohol affecting the treatment of the patient in terms of pharmacokinetic/dynamic interactions, it
could be suggestive of an erratic lifestyle and may also mean the patient is more prone to falls, so this may be a factor which affects decision making.

- The participant did not feel that the patient’s diet and smoking habits were particularly relevant to the decisions they made

Cues identified by interviewee 2

When asked what factors or variables they felt were needed to make a clinical decision in the context of anticoagulation, the participant came up with the following list (not in any order of priority):

- Clot history
  - Provoked (e.g. surgery, contraception) or unprovoked
- Bleeding risk/history
- Indication for anticoagulant
  - Indication for long-term vs short-term therapy
- Lifestyle of patient
- Family history
- Social history
- Observations of patient (e.g. frailty)
- Medicine adherence history
- Beliefs about medication (e.g. if patient has had bleeds before, will they take an anticoagulant)
- Patient choice
- Renal function
- Hepatic function
- Other medication and potential for interactions
- History of adverse drug reactions
- Co-morbidities
- Support structure outside of hospital
- What the evidence/guidelines states
- INR or anti-Xa levels
- HASBLED score
- CHADSVASc score
- Input of cardiology/haematology/gastroenterology

Cues identified through observation

During observation in a pharmacist led anticoagulation clinic, the main factors that seemed to be taken into account when making decisions in this area were:

- HASBLED score
- CHADSVASc score
- Patient choice/beliefs


Refinement of cues

Once the decision was made to focus on non-valvular atrial fibrillation as an indication, it was clear that the variables within the HASBLED and CHADSVASc scoring systems would need to be considered as cues. Even though interviewee one had not made mention of these systems, many of the variables they had listed were variables which feature in these two scoring systems.

Judgement analysis literature suggests that having more than 10 cues when formulating a task is considered an overburdening of the cognitive capabilities of participants (Stewart, 1988). Therefore, it was necessary to decide on which of the variables put forward by the interviewees, the researcher’s observations, and the appropriate scoring systems would form the cues to be used in the scenarios created the study.
Figure Captions

**Figure 1** The hierarchical levels of pharmacists’ decision-making, where prevalence has been estimated from published surveys of pharmacy practice reviewed by Campagna (3)

**Figure 2** Adaptation of the Lens Model in the context of a pharmacist considering a patient’s stroke risk

**Figure 3** Suggested method for Clinical Judgement Analysis (22)

**Figure 4** Glossary of terms used in CIA

**Figure 5** Overview of the process used to refine the cues identified during the interviews, the observations at the anticoagulation clinic and the scoring systems for use in the final scenarios. N=number of cues. “Fixed cues” denote factors that were deemed necessary for the pharmacist to make a decision but kept the same for all scenarios. “Varied cues” denote the variables that were altered for the scenarios to see how they affect the decision-making judgement model of each individual.

**Figure 6** Example of scenario with fixed cues highlighted in yellow and variable cues highlighted in blue. “Fixed cues” denote factors that were deemed necessary for the pharmacist to make a risk judgement and final decision but kept the same for all scenarios. “Varied cues” denote the variables that were altered for the scenarios to see how they affect the decision-making judgement model of each individual (Table 4).

TIA: Transient Ischemic Attack; GI: Gastro-intestinal; FBC: Full Blood Count; Gastro: Gastroenterology department; bd: Twice daily; od: Once daily; LFTs: Liver Function Tests; ALT: Alanine transaminase; GGT: Gamma glutamyl transpeptidase; ALP: Alkaline phosphatase; INR: International Normalised Ratio; eGFR: estimated Glomerular Filtration Rate; FY1: Foundation Year 1 Junior Doctor

**Figure 7** Tasks participants were asked to complete for each scenario in the final study. These tasks were the same for all scenarios.

**Figure 3** Regression model for Participant 02 stroke risk ($R^2=0.86$, Adjusted $R^2=0.821$, $p<0.01$) The higher the coefficient, the more the variation of that cue affected the judgement made. It is proposed that cues with larger coefficients that show significance are the pieces of information the participant gave most importance to when making their judgement. * $p<0.05$, 2-tailed

**Figure 4** Stroke risk judgement of each participant by scenario, compared to the risk derived from the CHA$_2$DS$_2$VASc validated scoring rule.

**Figure 5** Bleed risk judgement of each participant by scenario, compared to risk assessed by the HASBLED validated scoring rule

**Figure 6** Number of times each participant chose to initiate anticoagulation or refer to the consultant. No participants recommended not initiating anticoagulation in any of the scenarios. Participant 01 and 03 recommended referring the patient to the consultant in some of the scenarios. No participants recommended anticoagulants other than edoxaban or apixaban. Participant 02 and 04 recommended anticoagulation to be initiated in every scenario.

**Figure 7** The decisions of participant 01 to start anticoagulation were strongly correlated with one cue (patient preference) suggesting a stepwise decision-making process depending on one variable rather than a weighing up of multiple factors.
Figure 13 The decisions of participants 02 and 04 to initiate edoxaban or apixaban were strongly correlated with one cue (presence of CHF) suggesting a stepwise decision-making process depending on one variable rather than a weighing up of multiple factors.

Figure 14 Summary of the key findings of the illustrative study

Table Captions

Table 1 CHA2DS2VASc Scoring system used to predict stroke risk in patients with NVAF (23)

Table 2 HASBLED Scoring system used to predict the risk of major bleed in patients with NVAF (24)

Table 3 Rationale for the categorisation of cues, including exclusion criteria

Table 4 Coding for each cue level, used in the statistical analysis of each participant.
Prescriptive – the pharmacist makes the decision independently e.g. a pharmacist independent prescriber initiating drug treatment in a clinic setting.

Consultative – the pharmacist is involved and makes suggestions at the point the decision is being made e.g. consulted on a dose in the case of renal impairment.

Corrective – the pharmacist intervenes after a decision has been made by pointing out an error e.g. incorrect dose on a prescription.

Submissive – the pharmacist has no input into the decision other than to clarify information.
<table>
<thead>
<tr>
<th>Patient</th>
<th>Variables (cues) as presented in context of environment</th>
<th>Pharmacist perceives and interprets cues</th>
<th>Cues prioritised, weighted and combined by pharmacist to make judgement</th>
<th>Stroke risk judgement made</th>
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<td>Age, Blood Pressure, Drug history, Frailty</td>
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The diagram illustrates the process of identifying stroke risk factors through a series of steps involving a patient and a pharmacist. The patient's medical variables are presented, which the pharmacist perceives and interprets to make a judgement about stroke risk.
1. Define the judgement.
2. Become familiar with the context of the judgement.
3. Draw out the potential cues and their levels (values) involved in making the judgement.
4. Create scenarios that are realistic.
5. Decide on a sample of judges.
6. Collect judgements.
7. Analyse collected judgements to obtain models of individual judgement.
**Judgement model** – mathematical description defining how a set of cues are weighted and utilised by an individual when making a specific judgement or decision.

**Holdout case** – a scenario/ task where the data captured is not used in the regression modelling but used later to test the predictive power of the judgement model generated.

**Cue** – a piece of information or a factor that may be used by an individual when making a specific judgement or decision (e.g. age of patient). A cue can either be **fixed** (i.e. the age of the patient is kept the same for all scenarios) or **varied** across difference levels for each scenario.

**Cue Level** – The value of a varied cue defined as a level for the purposes of coding for statistical analysis (e.g. 75-years old = level 1, 80-years old = level 2)
To: pharmacyteam@hospital.nhs.uk

Dear Pharmacy Team,

I am looking after a 70-year-old female patient admitted after a suspected TIA with a subsequent diagnosis of non-valvular atrial fibrillation. I am unsure of the best course of action with regards to anticoagulation for this patient, as they had a GI bleed last month caused by a Helicobacter pylori-induced gastric ulcer (all FBCs are within range and Gastro has given the all clear).

The patient has no history of diabetes and a history of congestive heart failure which is well controlled with Ramipril 5mg bd and bisoprolol 10mg od. The patient’s blood pressure is 165/95 for which they have been started on amlodipine 5mg od. LFTs (ALT, GGT, ALP, INR, bilirubin) are all normal. eGFR is 45 ml/min/1.73m². Patient reports taking no other medication.

The patient appears physically healthy to me and seems to rely on others to take responsibility for their health. The patient reports that they have a good family support system in place. I have discussed some possible options with the patient, who has expressed concerns and does not want to take anticoagulants. The patient reports drinking around two large glasses of wine every evening (estimate of 25-30 units per week).

What would your recommendation be with regards to starting anticoagulation?

Many thanks,

Charlie (FY1 on cardiology rotation)
1. The literature suggests that those with the highest risk have a 15% chance of having a stroke in the next year, i.e. 15 out of 100 patients. For this patient, what would you say is the probability of a stroke occurring in the next year?

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2. Regarding anticoagulation, what action would you recommend to the junior doctor? (Select one)

- Do not initiate anticoagulation
- Initiate edoxaban
- Initiate apixaban
- Initiate rivaroxaban
- Refer to consultant
- Initiate warfarin
- Initiate dabigatran

3. The literature suggests similar scale as the one for stroke prediction when look at the chance of a major bleed. If anticoagulation were to be initiated, what would you say is the probability of the patient experiencing a major bleed in the next year?

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4. Considering the risk factors for stroke and major bleed, as well as the patient factors, how confident are you in the patient’s ability to manage their condition?

- Not confident
- Slightly confident
- Moderately confident
- Highly confident

Use the space below to note any explanations for your recommendations, other actions you would recommend, or any other comments you feel are relevant.
\( Y_{\text{Judgement,Stroke Risk}} = 1.077 + 0.808X_{\text{AGE}} - 0.038X_{\text{BL}} + 0.962X_{\text{DM}}^* + 1.038X_{\text{CHF}}^* + 0.885X_{\text{HYP}}^* - 0.192X_{\text{REU}}^* - 0.038X_{\text{ALL}}^* - 0.038X_{\text{PHY}} + 0.038X_{\text{SUP}} - 0.269X_{\text{RES}}^* - 0.038X_{\text{RES}} \)

- \( X_{\text{AGE}} \): Age
- \( X_{\text{BL}} \): Bleed after infarction
- \( X_{\text{DM}} \): Presence of diabetes
- \( X_{\text{CHF}} \): Presence of chronic heart failure
- \( X_{\text{HYP}} \): Hypertension
- \( X_{\text{REU}} \): Renal function
- \( X_{\text{ALL}} \): Alcohol use
- \( X_{\text{PHY}} \): Physical appearance
- \( X_{\text{SUP}} \): Support system
- \( X_{\text{RES}} \): Responsibility for health
- \( X_{\text{DM}}^*, X_{\text{CHF}}^*, X_{\text{HYP}}^*, X_{\text{REU}}^*, X_{\text{ALL}}^*, X_{\text{PHY}}^*, X_{\text{SUP}}^*, X_{\text{RES}}^* \): Binary indicators
Is anticoagulation indicated?

Yes

Does the patient want anticoagulation?

No

Refer to consultant

Yes

Initiate anticoagulation
Is anticoagulation indicated? 

Yes 

What are the dosing intervals of the patient’s other medication(s)? 

Twice daily 

Initiate apixaban 

Once daily 

Initiate edoxaban 

No 

?
Summary of key findings from the illustrative study

- Clinical judgement analysis produced models of good fit for the prediction of stroke risk judgement and bleed risk judgement made by individual pharmacists.
- The varied cues chosen did not appear to influence the participants’ judgement of how well the patient would manage their condition.
- Participants varied in their judgement of risk (both stroke and bleed). This difference is seen not only when comparing the participants but also in how much their judgement agreed with the risk predicted by the literature.
- The decision-making judgement model for 3 participants appeared to be a stepwise approach, where the presence of one factor dictates the decision-making, rather than based on a model where many variables are considered.