

# Design Guidance

## Terminology – Matching

Thursday, 5 July 2007  
Version 1.0.0.0

*Prepared by*  
**Microsoft**

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# 1 INTRODUCTION

This document provides guidance and recommendations with rationale for aspects of Terminology user interfaces related to searching for clinical codes.

This document should be read in conjunction with the following Design Guidance documentation:

- *Design Guidance – Terminology – Display Standards for Coded Information {R1}*
- *Design Guidance – Terminology – Elaboration {R2}*

## 1.1 Overview

This document is for anyone whose role includes screen design, implementation or assessment of a clinical application and who is involved in creating or evaluating terminology user interfaces.

Terminology user interfaces operate within a note-taking environment. These environments fall into three categories, (as illustrated in Figure 1 and described below), each of which requires different guidance:

- **Forms**
  - The user makes notes by selecting options, not by entering text
  - An encoding interface is not needed; the clinical codes should be embedded within the form itself
- **Single concept matching**
  - The user makes notes by typing the note for a single concept (such as 'asthma'), and the system returns SNOMED-CT<sup>®1</sup> {R3} matches. The user can then choose an appropriate match, refine the concept, then elaborate it with a combination of free text, qualifying SNOMED-CT attributes (such as 'severe') and numerical values.
  - Encoding interfaces require components to match and elaborate SNOMED-CT concepts.
- **Text parser matching**
  - The user makes notes by writing unconstrained text, while the system matches words and phrases against the SNOMED-CT database, or a constrained subset of the database, and displays the matches. The user then has the option to do one of the following:
    - Confirm that they want to encode these SNOMED-CT expressions
    - Browse alternative matches
    - Refine a selected match
    - Leave the note unencoded, in which case it will be saved as unstructured text rather than as a SNOMED-CT expression
  - Encoding interfaces require components to identify and match SNOMED-CT concepts, as well as build post-coordinated SNOMED-CT expressions, based upon sanctioned attribute relationships, from within the text. The interface must also be able to identify terms and relationships from additional informational models in order to support accurate and comprehensive clinical noting.

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<sup>1</sup> SNOMED-CT: <http://www.snomed.org/>

Figure 1 illustrates forms (left), single concept matching (centre) and text parser matching (right).

The figure shows a screenshot of a medical software interface with three main panels. The left panel is a form titled 'Have you ever had any of the following?' with a list of symptoms and checkboxes. The center panel shows a search for 'fever' with a list of relevant matches. The right panel shows a 'New consultation' form with a text input field and a list of suggested SNOMED-CT matches.

**Left Panel (Form):** A list of symptoms with checkboxes. The 'Rheumatic fever' checkbox is checked. A yellow callout box points to the list with the text: 'The user enters key words and the system returns matches, which the user can elaborate.'

**Center Panel (Single concept matching):** A search for 'fever' with a list of relevant matches. The 'Fever' match is selected. A yellow callout box points to the list with the text: 'The user enters key words and the system returns matches, which the user can elaborate.'

**Right Panel (Text parser matching):** A 'New consultation' form with a text input field. The text 'referred by gp' is entered. A yellow callout box points to the text with the text: 'As the user types in notes, the system suggests SNOMED-CT matches.'

Figure 1: Styles of Encoding

Medical language is full of abbreviations and jargon, some of which have more than one meaning. By coding clinical statements, they can be shared unambiguously. This should improve patient safety by reducing confusion or errors, due to ambiguity in clinical notes.

Encoding also opens up important opportunities, such as:

- Unambiguously sharing clinical statements between clinicians in different disciplines or institutions
- Using decision support mechanisms, based on codes within clinical statements, to enhance patient safety
- Auditing clinical activity by using codes to locate and report on specific types of information within patient records
- Researching clinical practice or outcomes by extracting codes from electronic patient records

SNOMED-CT is used in this Design Guidance as the terminology for encoding clinical statements. The clinician can determine what and how much of the information is encoded.

## 1.2 Area of Focus

This document describes Terminology matching, covering the following areas:

- Set context
- Enter text
- Display expression matches
- Browse alternative/Refine selected match(es)
- Leave as unstructured text
- Confirm match(es)
- Offer opportunity to request improvement

These areas of matching are highlighted in the User Interaction Model in Figure 2.

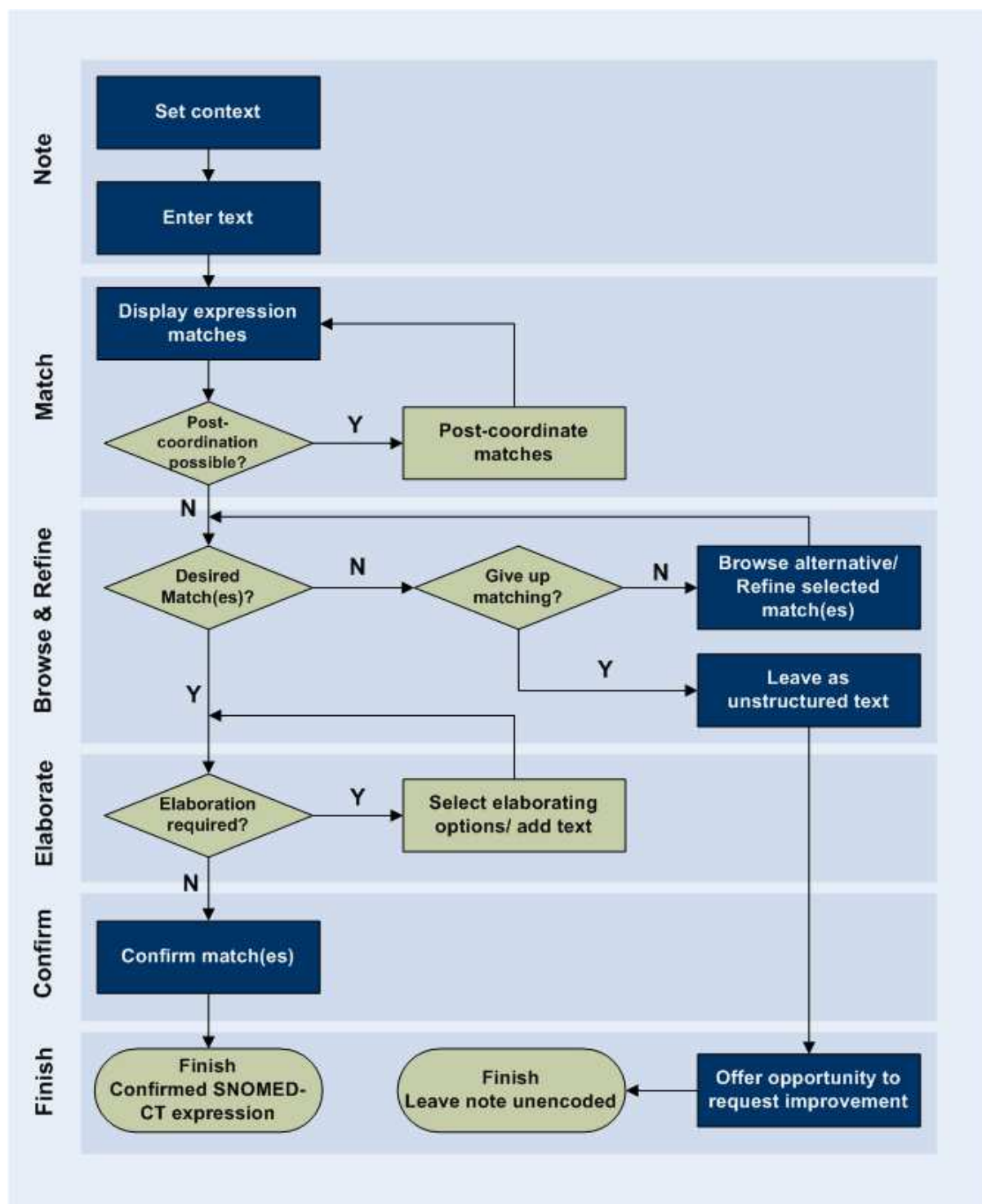


Figure 2: User Interaction Model

Please note that this guidance covers mechanisms for encoding in a single interaction and at the point of care. It does not cater for 'post-hoc' encoding, either by the clinician who first entered the note or by another person, such as a dedicated 'coder'. In the future the design solution implied by the guidance could be adapted to allow post-hoc encoding. Further consideration would need to be given to this guidance, especially given the potential safety risks involved with moving the noting activity away from the patient interaction that it describes.

Also, this guidance does not cover mechanisms for storing clinical noting data (including SNOMED-CT data); it only shows how to build interfaces into which the user may enter the notes.

Please note that the latest guidance outlined in this document has not been subject to a formal patient safety assessment. Such an assessment is expected and potential updates to the guidance may occur following its completion.

## 2 RECOMMENDATION AND GUIDANCE

### 2.1 Approaches to Matching SNOMED-CT Concepts to Clinicians' Notes

The usability of entering or inputting notes into the interface, against which the system can match SNOMED-CT concepts, is essential. Clinicians spend a large proportion of their working day writing notes, and the effects of miswriting the notes or failing to include an important detail could impact on patient care and safety. This risk could be increased using encoded noting as encoding automatically lends a greater legitimacy to a note; one is more likely to assume that an encoded term is accurate and appropriate than a handwritten note. In addition, it could be more difficult to see where the clinician went wrong in an encoded note, rather than in a handwritten note, because the latter expresses nuances relating to the meaning, and this could be lost in encoded notes (for example, the location of words in relation to one another).

In addition to its accuracy, the success of an encoding system will hinge on the levels of flexibility and efficiency experienced by clinicians. For example, if noting interferes too much with the clinician's interaction with their patient, which is often the primary task at hand, or it takes so much time as to delay their already busy workflow, the system will be rejected by clinicians.

The issue of flexibility also extends to the fact that noting styles and requirements vary greatly across the clinician audience, at speciality level, context, practice and at individual levels. An obvious distinction exists between general practice, hospital and acute care, and mental health care; the General Practice clinician typically writing terse, efficient notes, the Mental Health clinician writing expansive, highly descriptive notes, and the Hospital and Acute Care clinician's noting style falling somewhere in between. Again, failure to accommodate one or more of these noting styles, or, worse, compromising on all three, would also lead to charges that the system is not fit for purpose and ultimately to a lack of adoption.

It is essential that the interface provides:

- Accuracy
- Efficiency
- Flexibility

#### 2.1.1 Single Concept Approach to Matching

As a minimum requirement, the system should allow users to find a single SNOMED-CT concept by typing in the word, or words that comprise this concept. The system will then present the user with a list of matches from which the user is to select the most appropriate. The user then has the opportunity to refine this concept by (i) browsing related concepts, (ii) adding additional 'free' supporting text, and (iii) selecting any mandatory qualifiers.



Figure 3 illustrates a single concept matching dialog.

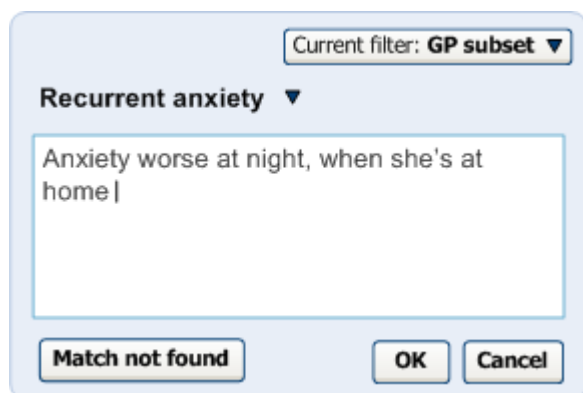


Figure 3: Example of a Single Concept Matching Dialog

The system then records this concept (both its Concept ID and the specific Description ID that the user has chosen, for example, 'Preferred term'), and the additional elaboration.

### 2.1.1.1 Guidance

The system:

- Must allow the user to search for a single concept and immediately view the possible matches ('single concept matching')
  - This function should be available as a standalone process; or
  - As part of matching refinement in a text parser approach
- Must allow the user to add some additional 'free' text (that is, unencoded text)
  - This function must be available as part of a single concept matching process

### 2.1.1.2 How to Use the Design Guidance

Usage	Format	Example	Comments
✓	Ensure that the user encodes at least one SNOMED-CT concept	n/a	The user should not be allowed to record elaboration only with this approach

Table 1: How to Use the Design Guidance

### 2.1.1.3 *How Not to Use the Design Guidance*

Usage	Format	Example	Comments
✗	Offer the single concept matching approach if the clinician is expected to enter a large and rich set of notes	n/a	The process of matching concepts and their elaboration one by one, is not conducive to typing multiple notes which have a lot of elaboration, especially when the elaboration could apply to multiple concepts. The flexible text parser matching approach would be better suited for such as situation
✗	Offer the single concept matching approach if the clinician may wish to enter notes that will require post-coordinated SNOMED-CT expressions	n/a	Although the single concept matching approach may allow post-coordination, users will find it easier to perform such a process using the alternative text parser approach. The single concept matching approach forces the user to match the 'base concept' before inputting and matching attributes. However, it may not always be apparent to the user what is the base and what is the attribute

Table 2: How Not to Use the Design Guidance

### 2.1.1.4 *Benefits and Rationale*

Offering a single concept matching process provides a great deal of benefit, where:

- The range of possible concepts that can be coded is limited. The data may be heavily filtered owing to the narrow range of appropriate selections
- The user is only expected to record a single concept

This approach to matching SNOMED-CT concepts may contribute to the clinical noting process.

From a development point of view, it provides a simple solution that could be implemented in the face of any technical issues with the richer, more flexible text parser matching solution.

User testing with both an interactive demonstrator and wireframes has shown that clinicians understand and respond positively to this approach to matching.

### 2.1.1.5 *Confidence Level*

#### *High*

- Must allow the user to search for a single concept, and immediately view the possible matches ('single concept matching')
  - This function should be available as a standalone process; or
  - As part of matching refinement in a text parser approach
- Must allow the user to add some additional 'free' text (that is, unencoded text).
  - This function must be available as part of a single concept matching process

## 2.1.2 Text Parser Approach to Matching

In addition to the single concept approach to matching, the system will also allow users the flexibility of typing in their notes as a passage of text (rather than sequentially searching for and matching concepts).

The text parser approach to matching is based on the notion that the clinician should be free to type in the notes that they feel best describes the clinical encounter, while, at the same time, the system matches terms and phrases within their notes. As the system identifies what it considers to be the best SNOMED-CT match for a text string within the notes, it presents this for the user to either confirm that the match is correct, or to browse for similarly-worded or semantically-related matches (see Figure 4).

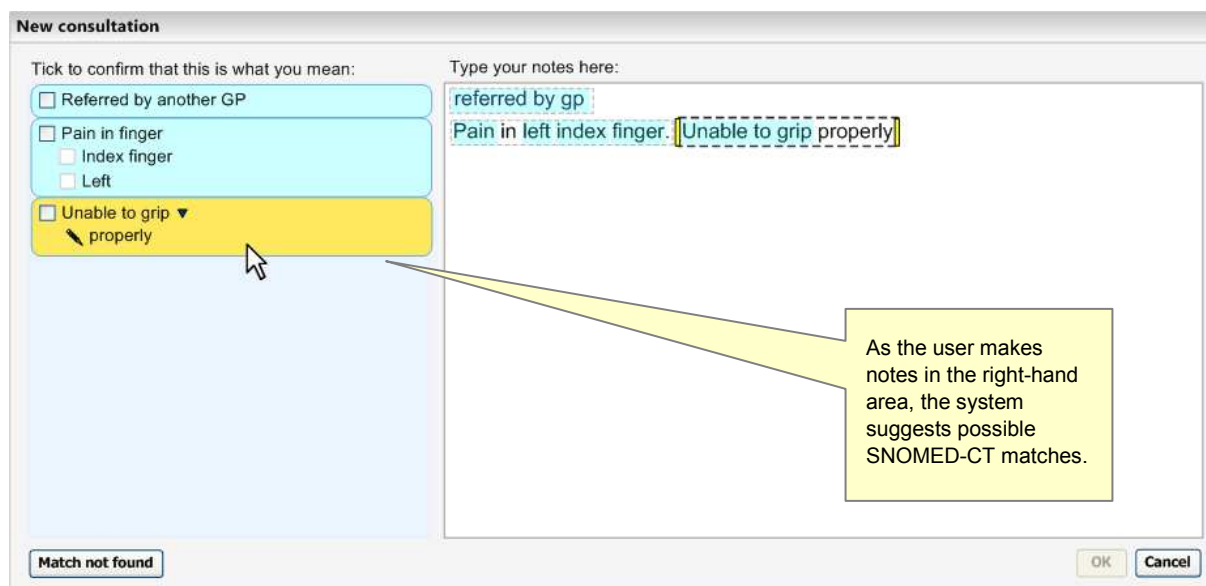


Figure 4: Text Parser Approach to Matching

This approach aims to offer an appropriate balance of letting clinicians type in their notes as they see fit, but, at the same time, encouraging them to encode SNOMED-CT concepts. The matching process should also help the clinician to enter their notes, especially in situations where the clinician is unsure of the best way to articulate a term, or is unsure of its spelling.

If prefix matching or progressive matching are implemented, the system will feed back possible terms to the user, based on a few characters of the word. This would become an especially powerful feature if contextual subset filters are also applied to the matching process. Instead of having to type out their notes in full, the clinician would only need to partially type each term and the system would suggest the full version, which the user can then confirm. In this way, the clinician may be partly guided by the system in their noting. The power of this feature could be increased further with the introduction of decision support, if this support could be triggered by SNOMED-CT matches. This could then influence further matches, in addition to offering informational and decision support.

### 2.1.2.1 Guidance

The system:

- Must allow the user to type in free-text notes without requiring any further actions until the time they decide to save the record
- Must suggest possible SNOMED-CT matches based upon the free-text notes that the user has typed

### 2.1.2.2 How to Use the Design Guidance

Usage	Format	Example	Comments
✓	Allow users to type their notes without constraint	n/a	Clinicians must be able to type in what they want. The system may aim to influence and guide the clinician to achieve clear and consistent noting, but, ultimately, the representation and content of the notes is the responsibility of the individual clinician. The underlying assumption of the current Design Guidance is that the clinician knows what they want to note

Table 3: How to Use the Design Guidance

### 2.1.2.3 How Not to Use the Design Guidance

Usage	Format	Example	Comments
✗	Automatically save SNOMED-CT concepts to the record without the user's confirmation	n/a	No matching process could be sufficiently intelligent as to be able to derive the precise meaning of the clinicians' notes without risk of misinterpretation. Given the potentially dangerous impact of miswriting notes on patient safety, the system must always get the user's explicit confirmation that a SNOMED-CT is a correct representation of their noting before saving it to the record

Table 4: How Not to Use the Design Guidance

### 2.1.2.4 Benefits and Rationale

This approach aims to allow the clinician the most natural approach to noting, that is, unconstrained writing. This may be achieved by typing in via a keyboard or by writing into an electronic pad with handwriting recognition (or a combination of voice recognition and handheld pad), although only the keyboard/mouse interactions are covered in the current design guidance documentation. In addition, it is fulfilling the need to encode the notes according to a common standard terminology, by matching and offering SNOMED-CT concepts and multi-concept expressions, based on the wording of the clinician's noting (plus contextual constraints, for example, based upon workflow). However, by encouraging, but not forcing clinicians to encode in SNOMED-CT, the system should not overly-disrupt the clinician's working pattern.

This approach to noting has been tested with real clinicians in a series of tests that has involved at least three separate wireframe designs. In each case, they understood and responded positively to the designs, even though the designs did differ in terms of specific detail. This overall endorsement of the

text parser matching approach to noting gives us confidence in the potential usability and usefulness of this approach.

This approach to matching SNOMED-CT concepts may contribute to the clinical noting process.

User testing with both an interactive demonstrator and wireframes has shown that clinicians understand and respond positively to this approach to matching.

### 2.1.2.5 *Confidence Level*

#### *High*

- Must allow the user to type in free-text notes without requiring any further actions until the time they decide to save the record
- Must suggest possible SNOMED-CT matches based upon the free-text notes that the user has typed

## 2.2 Inputting Notes

In this section, we will explore five areas of guidance:

- Input using the 'text parser' approach to matching
- Input using the 'single concept' approach to matching
- Input of 'additional text' in the single concept approach
- Dealing with clinicians' shorthand
- Spell-checking input

### 2.2.1 Input in the Text Parser Approach

The text parser approach allows the user to type in unconstrained textual notes from which the system matches SNOMED-CT expressions. As shown in Figure 5 and Figure 6, the user types their notes into a clearly defined and labelled text field. This field has a background of white (or just off-white) in order to indicate that it is editable. It also has a well-contrasted dark grey border to help it stand out. In contrast, the left-hand 'Suggested matches area' has a light blue background, in order to indicate that the user may not type notes into this area. In addition, both fields are clearly labelled 'Type your notes here:' and 'Tick to confirm that this is what you mean:' for the Text input area and the Suggested matches area respectively.

Both areas have sufficient contrast to stand out against the light grey dialog background, so that the user can clearly see them both.

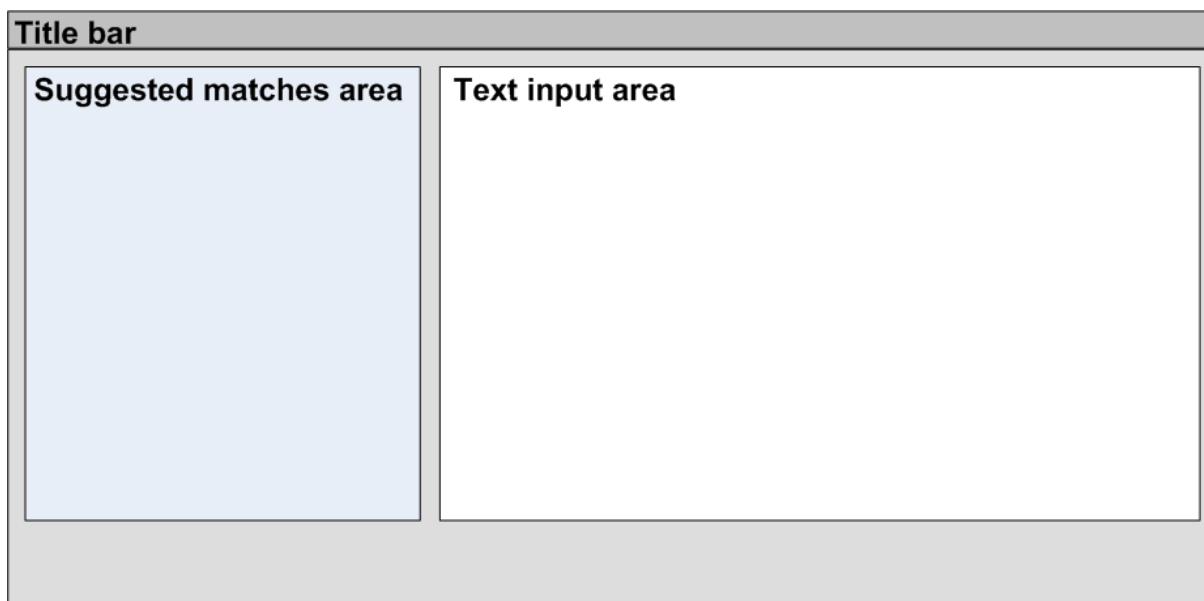


Figure 5: Schematic of User Interface Areas in Text Parser Approach to Matching

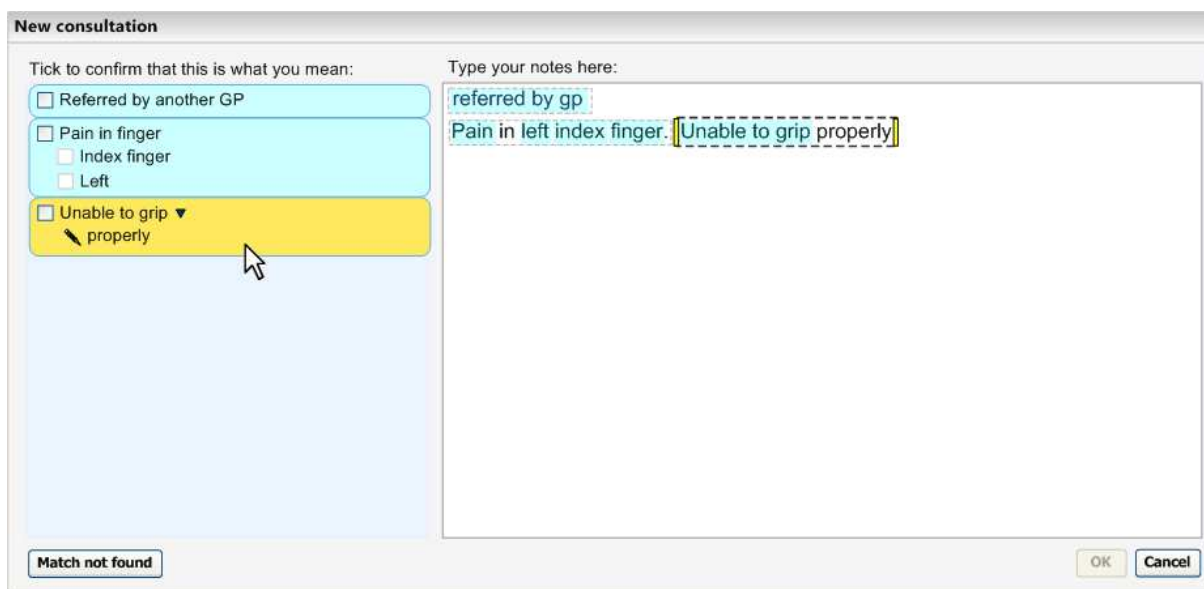


Figure 6: Text Parser Approach to Matching in Detail

As the user types in their notes, the system automatically draws a marquee (a dashed-line perimeter) around the characters. The yellow bars on either side of the characters perform two functions, they, (i) indicate focus and (ii) allow marquee manipulation (which is outlined in more detail in section 2.3.3).

As the user continues to type in characters, the system triggers the matching process and presents the matches in the left-hand column. Further details of concept matching are outlined in section 2.3. The key point to note is that as the text input field is left-justified, the user's typed notes are generally located close to the suggested matches. This is assisted if the user types a carriage return after each phrase (or sentence), which may help them to view their input and the matches together.

Before typing in certain notes, the user may need to insert a 'clerking heading', which will influence the filtering of matches returned, in addition to providing a visual structure to the text. This will appear

within the 'Text input area' and will be visually distinct from the normal text (through a distinct formatting). Further details of the use of clerking headings can be found in section 2.4.

The width of the 'Text input area' should not exceed 60 characters, but there are fewer limits on the depth of the text input area.

### 2.2.1.1 **Guidance**

The system:

- Must provide a clearly-defined area into which the user may type in text
  - Must ensure that this area is separate from an area in which the system presents suggested SNOMED-CT matches (see section 2.3 for details of concept matching)
- Must allow users to types in a full range of alphanumeric characters
  - Should allow users to type in punctuation
  - Should allow users to capitalise letters
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to copy, cut and paste text to and from other areas in the clinical application or external software/electronic documents
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum
- **Must** clearly distinguish the text input field from the area in which suggested SNOMED-CT matches are displayed
  - **Should** feature a white background in the text input field and a very light off-white or pale blue background in the suggested matches area
- Must clearly indicate where the user is to start typing
  - Should feature a cursor in the top left-hand corner of the text input field
    - Could feature a flashing cursor (as per standard word processing software packages)
  - Must feature an appropriate label to communicate to users that they must start typing into the text input field
    - Could feature a label that reads 'Type your notes here:'
  - Must feature a distinct label for the matching area
    - Could feature a label that reads 'Tick to confirm that this is what you mean:'
    - Should grey-out this label until the system has matched at least one SNOMED-CT concept and displayed it in the matching area
  - Should grey-out the matching area until the system has matched at least one SNOMED-CT concept and displayed it in the matching area

### 2.2.1.2 *Benefits and Rationale*

The convention of displaying editable text fields with a white background, and non-editable with a grey/blue background is a fairly universal convention. The left-justification of the text input field, combined with the fact that the suggested matching area is located to the left of the text input field, means that the user's typed notes will appear close to the suggested matches, especially if the user types a carriage return after each phrase (or sentence), which may help them to view their input and the matches together.

The text input field is also located to the right of the suggested matches area for the following reasons: the final output of the noting process will be a combination of user-typed and well-rendered (using matched SNOMED-CT expressions), and the suggested matches are a means of arriving at these final notes. It is a Western convention to read from left-to-right, and this convention also informs other activities; for example, people typically fill in forms from left to right. Essentially, in the current noting process, the user is ending up with output on the right-hand side, which fits with this convention. In fact, it is a right-to-left-to-right action.

This positioning also helps to ensure that the suggested match areas can be expanded from left-to-right (over the top of the text input area) without widening the overall footprint of the noting window (see section 2.3.3 for details on selecting matches).

User testing with both an interactive demonstrator and multiple iterations of wireframes has shown that clinicians respond positively to this input design. For example, in recent testing, a large proportion of users commented that this method of encoding was either 'easy' or, at least, 'attractive'. Less than a quarter of the clinicians had any negative comments about the overall encoding process.

### 2.2.1.3 *Confidence Level*

#### *High*

- Must provide a clearly defined area into which the user may type in text
  - Must ensure that this area is separate from an area in which the system presents suggested SNOMED-CT matches
- Must allow users to type in a full range of alphanumeric characters
  - Should allow users to type in punctuation
  - Should allow users to capitalise letters
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Must clearly distinguish the text input field from the area in which suggested SNOMED-CT matches are displayed
  - Should feature a white background in the text input field and a very light off-white or pale blue background in the suggested matches area
- Must clearly indicate where the user is to start typing
  - Should feature a cursor in the top left-hand corner of the text input field
    - Could feature a flashing cursor (as per standard word processing software packages)



- Must feature an appropriate label to communicate to users that they must start typing into the text input field
  - Could feature a label that reads 'Type your notes here:'
- Must feature a distinct label for the matching area
  - Could feature a label that reads 'Tick to confirm that this is what you mean:'
  - Should grey-out this label until the system has matched at least one SNOMED-CT concept and displayed it in the matching area
- Should grey-out the matching area until the system has matched at least one SNOMED-CT concept and displayed it in the matching area
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum

### **Medium**

- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to cut, copy and paste text to and from other areas in the clinical application or external software/electronic documents

## **2.2.2 Input in the Single Concept Approach**

The single concept matching approach demands a slightly different input process. In contrast to the text parser approach, the input only requires words or partial words that will be matched against a single word or phrase. Therefore, the input area is limited in size. In the example below, the input field can accommodate 32 visible characters, and up to 255 characters in total. If the user types beyond the 32 character visible limit, the field scrolls from left-to-right (but without a scroll bar), in order to ensure that the last character that the user has typed is visible. The user may scroll back to the first letters in the phrase, which may have been pushed out of the visible area.



Figure 7: Blank Input Field in Single Concept Approach to Matching

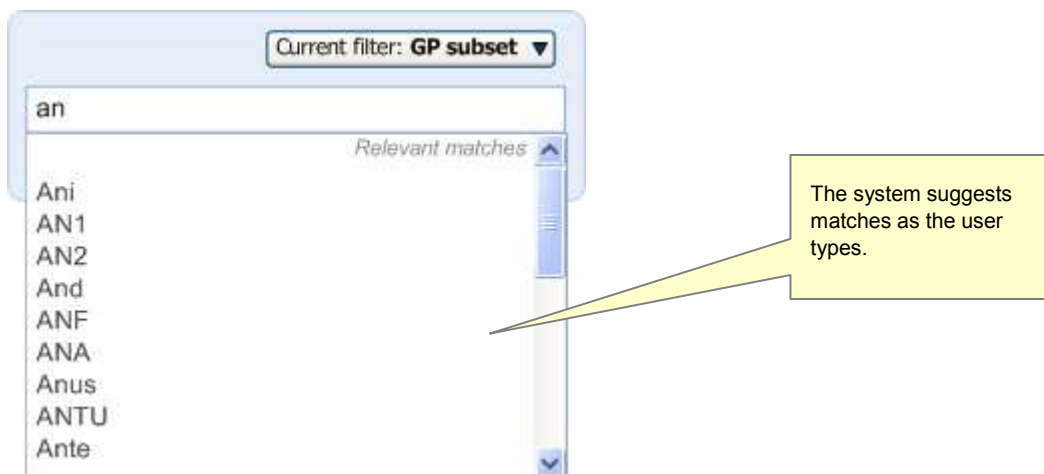


Figure 8: User Types in Characters

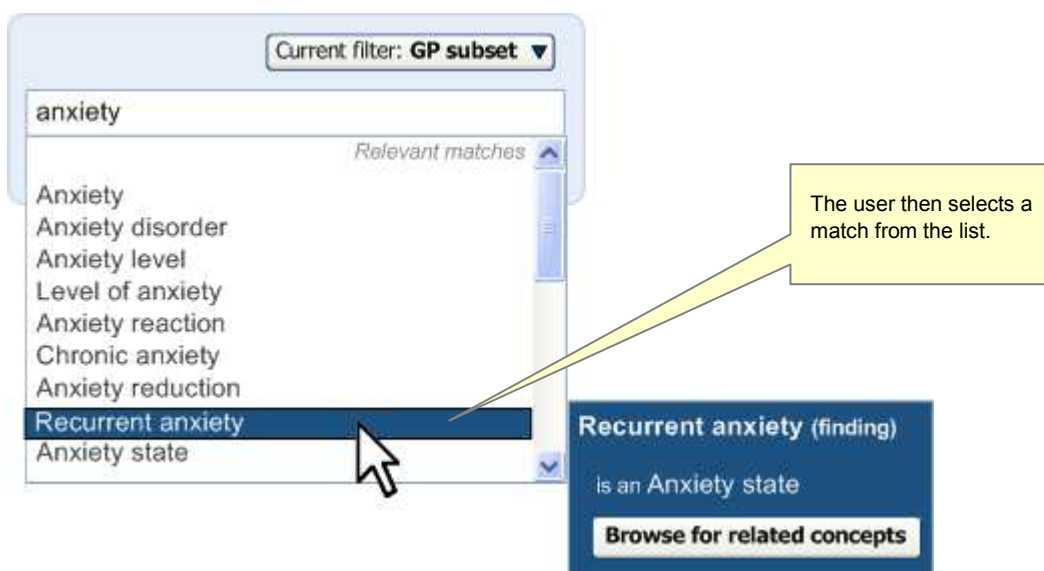


Figure 9: User Selects an Item From the List

The input in the single concept approach to matching will adopt a 'progressive' matching process, that is, matching on each successive character typed in (or deleted), with a slight delay, of approximately 200 milliseconds, to reduce the number of server requests.

The progressive matching will also adopt a 'prefix' matching approach, which allows the system to match the first few letters of multiple words. For example, it could match 'Nec fem' with 'Neck of femur'. The system should also be able to do this irrespective of order; for example, matching 'Fem nec'.

Once the user has selected a match from the list, the input field disappears and is replaced by the match's label with a small black 'down' arrow (▼). In addition, the focus automatically moves to the 'OK' button, to assist keyboard entry of a single concept without additional text. The 'Additional text' field also appears, as shown in Figure 10.

Special provision is made to ensure that the user can move the mouse from the list item to the 'fly-out' dialog, without the fly-out disappearing if the user accidentally moves just outside of the highlight area. For example, movement over the scroll bar and just outside the fly-out area will not close it.

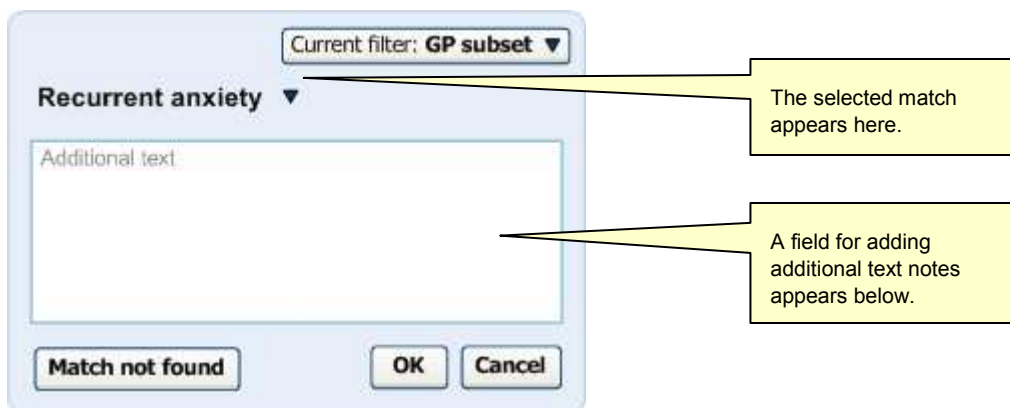


Figure 10: User has Selected an Item and the Additional Text Field Appears

The user can open the input field again by clicking on the label. As the user moves the mouse over the label, the area surrounding the label turns orange and appears 'clickable' (that is, slightly 'embossed'), as shown in Figure 11.

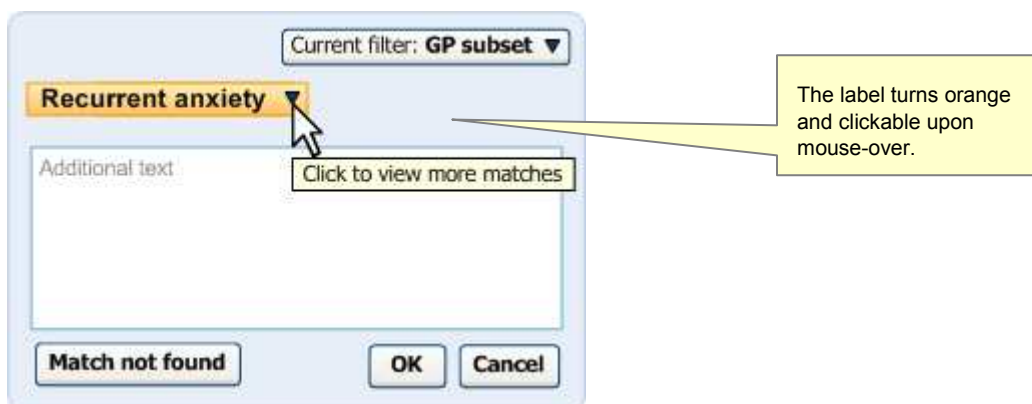


Figure 11: User Moves Mouse onto the Label

Clicking on the label displays the input field, pre-populated with the last set of input text entered by the user before selecting the label. For example, if the user had typed in 'anxiet' and had selected the SNOMED-CT concept 'Recurrent anxiety', the text 'anxiet' would appear in the input field. In the returned matches list, the concept 'Recurrent anxiety' would appear selected at the top of the list (with the appropriate scroll position) as shown in Figure 12.

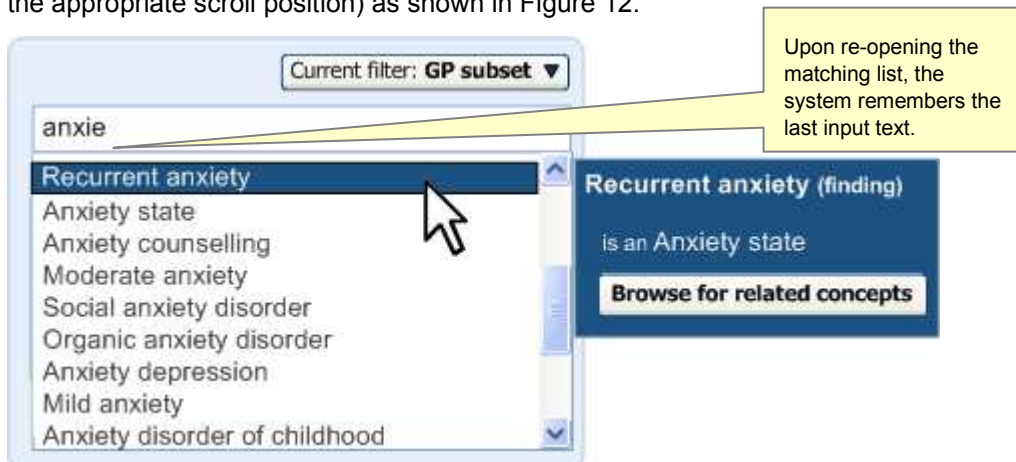


Figure 12: Clicking on the Label Opens up the List Again

### 2.2.2.1 *Guidance*

The system:

- Must provide a clearly defined text field into which the user can type the note
  - Must be distinct from the area that displays the resulting SNOMED-CT matches
- Must allow users to be able to type multiple words into the input field
- Must allow users to type in a full range of alphanumeric characters
  - Could allow users to type in punctuation
  - Could allow users to capitalise letters
- Must provide a visible space in the input field that can accommodate a text string of 32 characters long
- Must allow users to delete text within the search input field
  - Must allow a 'Backspace' deletion
  - Could allow a select and 'Delete' deletion
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to cut, copy and paste text to and from other areas in the clinical application or external software/electronic documents
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum
- Should provide a progressive matching algorithm
- Should allow the user to move just outside of the list item or fly-out area without the fly-out disappearing
- Must provide an 'OK' button to close the dialog and save the matches
- Should also allow the user to close the dialog and save the matches by double-clicking on the list item
- Must provide a 'Cancel' button to close the dialog without saving the matches

### 2.2.2.2 *Benefits and Rationale*

The visible number of characters recommended in the input field (that is, 32 characters) means that the user may type in the full text of over 65% of SNOMED-CT labels. This length also ties in with the recommended width of the list box containing the matched SNOMED-CT labels returned by the system and which need to accommodate up to 62 characters. This covers 95% of label lengths in SNOMED-CT, which are wrapped (see section 2.3.2), with the second line indented by two characters, thus leaving a width of 32 characters. Also, the maximum length of SNOMED-CT labels is 255 characters and this is reflected in the maximum length of text that can be typed into the input field.

Horizontal scrolling of the nature described above is a standard feature of many text input fields throughout a range of popular software applications.

The 'progressive' matching process has been shown to work well when the data is stored at the client end. However, some questions remain about how feasible this solution could be when the system is sending requests to the server each time the user types in a successive character (even with a slight delay), especially if the user has a slow internet connection.

Providing an 'OK' button in the main dialog rather than in the fly-out has been implemented, as tests indicated that users could not find an 'OK' button in the fly-out. Some users tried to double-click on the item to select it and this feature has been implemented in the current design.

If the progressive solution is not feasible, we recommend that a 'Go' button is featured immediately to the right of the field (see Figure 13). This could be an icon with a tooltip communicating that it is a button that triggers the matching process. The matching could also be activated by pressing the ENTER key.

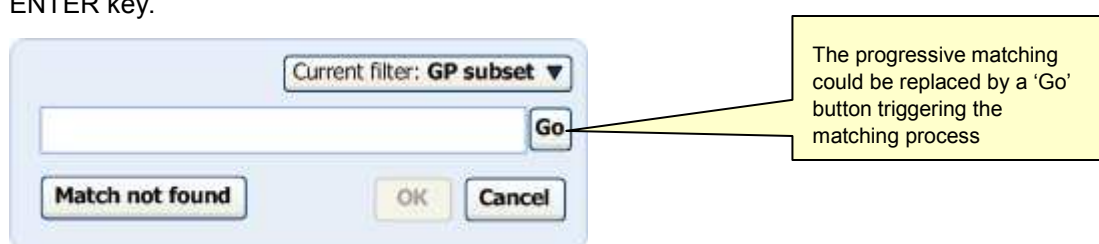


Figure 13: Example of the Design that Features a 'User-Triggered' Rather Than 'Progressive' Matching Process

The 'progressive matching' process has not been tested with clinicians. However, this method of matching is used in a number of popular software designs, including the Google Toolbar™. For this reason, we are confident that users will understand this process.

The basic design, irrespective of progressive matching, has been successfully user tested, both with interactive demonstrator prototypes and with wireframes. In these tests, there were no instances where users did not understand how to enter their notes. Indeed, in a recent test, overall feedback indicated that 80% users indicated that the encoding process was 'fine', 'ok', 'easy' or 'straightforward'.

### 2.2.2.3 Confidence Level

#### High

- Must provide a clearly defined text field into which the user can type the note
  - Must be distinct from the area that displays the resulting SNOMED-CT matches
- Must allow users to be able to type multiple words into the input field
- Must allow users to type in a full range of alphanumeric characters
  - Could allow users to type in punctuation
  - Could allow users to capitalise letters
- Must provide a visible space in the input field that can accommodate a text string of 32 characters long
- Must allow the user to type up to 255 characters in the input field
- Must allow users to delete text within the search input field
  - Must allow a 'Backspace' deletion

- Could allow a select and 'Delete' deletion
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Should allow the user to move just outside of the list item or fly-out area without the fly-out disappearing
- Must provide an 'OK' button to close the dialog and save the matches
- Should also allow the user to close the dialog and save the matches by double-clicking on the list item
- Must provide a 'Cancel' button to close the dialog without saving the matches

### Medium

- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to cut, copy and paste text to and from other areas in the clinical application or external software/electronic documents
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum
- Should provide a progressive searching algorithm

## 2.2.3 Additional Text Input

In the single concept approach to matching, the user is presented with a text field, labelled 'Additional text', in order to elaborate on the matched concept. This additional text input field should be located below the search input box to indicate to the user that it is for information that further relates to the selected match. Once selected, the match also acts as heading.

The label 'Additional text' is displayed inside the additional text input field, in grey, as shown in Figure 14.

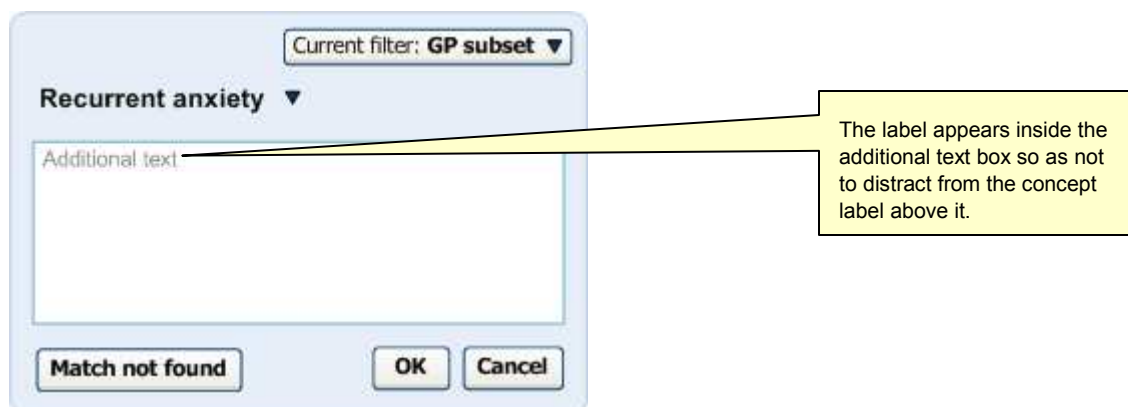


Figure 14: Additional Text Field

Once the user clicks on the field, or tabs to it, the label disappears and a cursor appears, as shown in Figure 15.

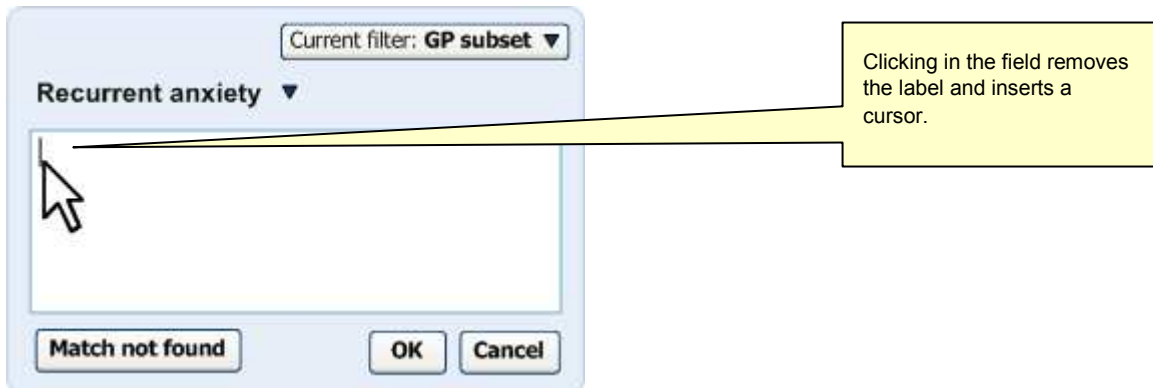


Figure 15: Cursor Appears When User Clicks the Field

At this point, the user can type elaborating text into the field, as shown in Figure 16.

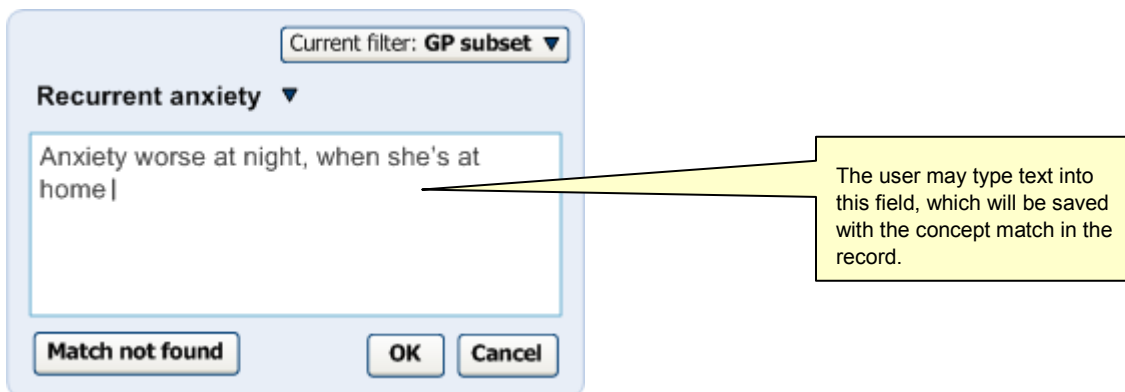


Figure 16: Entering Text in the Additional Text Field

This text will also be parsed for relevant attributes of the main concept (see *Design Guidance – Terminology – Elaboration {R2}* for details).

### 2.2.3.1 Guidance

The system:

- Must allow the user to type in 'additional' text that is associated with a selected concept
  - Must provide a clearly defined text field into which the user may type this additional text
    - Must ensure that this area is clearly distinct from the single concept input field
    - Should clearly label this additional text area
  - Could label this additional text area as 'Additional text'
  - Could feature the label in grey text which disappears when the user clicks on it (or tabs to it). The label will reappear if the user moves the focus out of the text box without typing any text in it
- Must provide a visible space in the input field that can accommodate a passage of text of a minimum of three lines high

- Must provide a vertical scrolling mechanism if the length of the text that the user types in exceeds the visible space
- Must allow users to delete text within the search input field
  - Must allow a 'Backspace' deletion
  - Could allow a select and 'Delete' deletion
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to cut, copy and paste text to and from other areas in the clinical application or external software/electronic documents
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum

### 2.2.3.2 *Benefits and Rationale*

It is extremely important to allow users to add further details about a matched concept, for a couple of reasons. The first is that the range of the SNOMED-CT terminology, although wide, can only account for a fraction of the terms, and relationships between terms, that are used by clinicians in their noting. Not only could the clinician want to express their note with a rich use of English, but also, there will be a large amount of specialist noting that SNOMED-CT will not cover. The second is that there may be a number of occasions when the clinician wants to elaborate a term with free text that they would not want to encode. They may wish to record a suspicion or a 'note-to-self' that is 'weak' and should not be treated as a 'strong' code, even if it is preceded by the qualifying code 'possible'.

Featuring the field label within the field area (box) and displaying it in small grey text prevents this text from distracting the user's view of the matched SNOMED-CT concept label. There is also the potential to add further instructive text in the box, such as 'Add some detail to the matched concept' or even some dynamic text, such as 'Type in additional details about the 'Recurrent anxiety''.

In addition, by featuring it immediately below the matched concept indicates that the field is for information that further relates to the selected match.

### 2.2.3.3 *Confidence Level*

#### *High*

- Must allow the user to type in 'additional' text that is associated with a selected concept
  - Must provide a clearly defined text field into which the user may type this additional text
    - Must ensure that this area is clearly distinct from the single concept input field
    - Should clearly label this additional text area
      - Could label this additional text area, 'Additional text'
- Must provide a vertical scrolling mechanism if the length of the text that the user types in exceeds the visible space



- Must allow users to delete text within the search input field
  - Must allow a 'Backspace' deletion
  - Could allow a select and 'Delete' deletion
- Should **not** allow users to format the text, in particular:
  - Emboldening text
  - Underlining text
  - Highlighting text
- Must display the text in a readable (for on-screen viewing) and sufficiently sized font, for example, Arial 10 point as a minimum

### Medium

- Must provide a visible space in the input field that can accommodate a passage of text of a minimum of three lines high

### Low

- Could feature the label written in grey text that disappears when the user clicks on it (or tabs to it). The label will reappear if the user moves the focus out of the box without typing any text into it.
- Could allow users to cut, copy and paste text in the text entry field
  - Could allow users to cut, copy and paste text to and from other areas in the clinical application or external software/electronic documents

## 2.2.4 Spell Checker Input

Users may mistype or misspell words as they type them. The system should provide a way of managing this human error. However, this will only apply when the system employs a full word rather than partial word (that is, 'prefix') matching approach.

Figure 17 shows how a spelling mistake is highlighted and underlined in red.

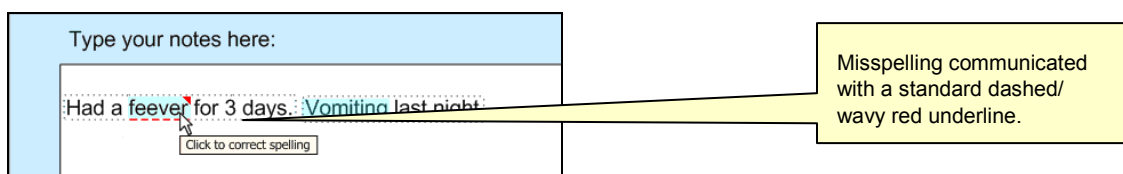


Figure 17: Highlighting Spelling Mistakes

The user then opens the Spell checker dialog by clicking on the word, as shown in Figure 18.

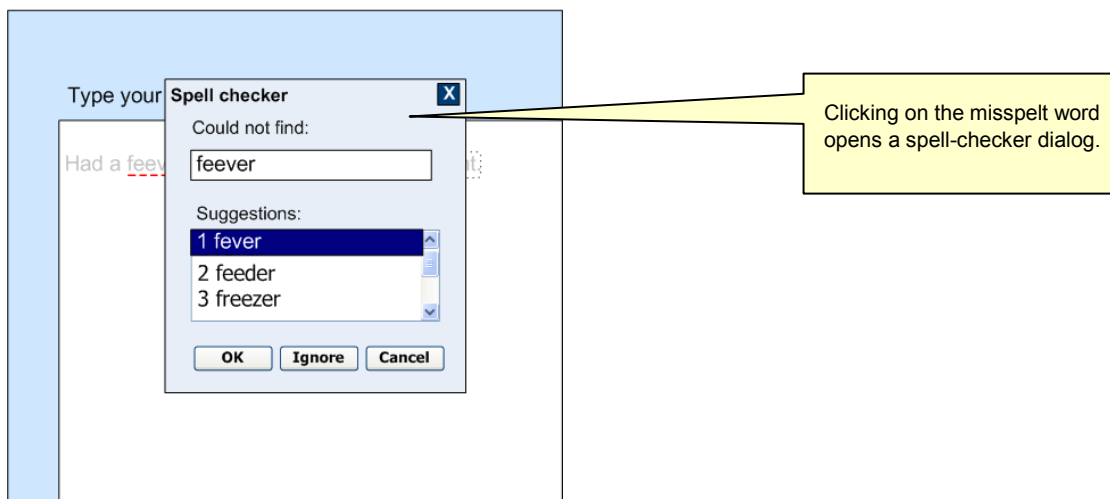


Figure 18: Spell Checker Dialog

Once the user has selected a word, the system should automatically run another post-coordination parse.

Please note that the spell-checker feature only applies to the text parser approach to matching, and not to the single concept matching.

#### 2.2.4.1 Guidance

The system:

- Must identify all words that are not SNOMED-CT matched, and do not match with a standard English dictionary
- Should underline all unmatched words with a red dashed line
- Should remove the red dashed underline once a spelling mistake has been resolved
- Should invoke a spell-checker dialog when the user clicks the unmatched word
- Should offer spell-checked words (drawn from both SNOMED-CT and a standard English dictionary)
  - Should allow the user to select one of the fuzzy-matched words
  - Should allow the user to close the spell checker dialog without selecting any of the matches
- Should replace the unmatched word with a matched word selected by the user
- Must not automatically confirm any matched words selected by the user, in the spell checker dialog
- Could offer these three options (or their equivalents) in the spell-checker dialog:
  - **OK** – change the word to the word that the user has selected
  - **Ignore** – to close the dialog and to remove the red underline
  - **Cancel** – to close the dialog and to keep the red underline

### 2.2.4.2 How to Use the Design Guidance

Usage	Format	Example	Comments
✓	Feature a red underline (similar to the Microsoft® Office spelling checker)	See Figure 17	This is a standard feature in a popular word-processing package
✓	Spell-check against SNOMED-CT database	n/a	n/a

Table 5: How to Use the Design Guidance

### 2.2.4.3 How Not to Use the Design Guidance

Usage	Format	Example	Comments
✗	Where there is a gross error that cannot be resolved by fuzzy matching, do not feature a highlight around the unrecognised word	n/a	Do not indicate that a word is encodable until a match (or fuzzy match) has been recognised

Table 6: How Not to Use the Design Guidance

### 2.2.4.4 Benefits and Rationale

It is important for the user to resolve the spelling of the word prior to encoding it. Simply launching a fuzzy match could lead to incorrect matches, compound the user error and possibly compromise patient safety. Featuring a method of spell-checking that is similar to that found in popular word processing packages will ensure that learning can be transferred easily, and that the tool is intuitive to most users.

The system should not automatically confirm words that have been spell-checked, as the newly matched concept could form part of a post-coordinated expression which should be confirmed as a unit.

This has not been tested with clinicians. However, this method of spell-checking is used in a number of popular word-processing packages. Therefore, we are confident that this will be understood by clinicians.

### 2.2.4.5 Confidence Level

Although this has not been explored in wireframe testing, it follows behaviour that is similar to popular word processing software packages, such as Microsoft Word. It can be recommended with medium confidence.

This guidance is only relevant where the system attempts to match complete rather than partial words.

#### Medium

- Must identify all words that are not SNOMED-CT matched and do not match with a standard English dictionary
- Should underline all words identified as spelling mistakes with a red dashed line
- Should remove the red dashed underline once a spelling mistake has been resolved
- Should invoke a spell-checker dialog when the user clicks the unmatched word
- Should offer spell-checked words (drawn from both SNOMED-CT and a standard English dictionary)

- Should allow the user to select one of the fuzzy-matched words
- Should allow the user to close the spell-checker dialog without selecting any of the matches
- Should replace the unmatched word with a matched word selected by the user
- Must not automatically confirm any matched words selected by the user in the spell-checker dialog

## 2.2.5 Dealing with Clinicians' Shorthand

Clinicians use a large amount of shorthand when noting. In the Design Guidance, although we will not attempt to identify all shorthand terms in order for the system to deal with every possibility, we need to specify a mechanism for the system to deal with this shorthand.

The design shown below in Figure 19 will identify instances of possible shorthand and will underline the shorthand in the same way as the spell-checker (see section 2.2.4 for details on the spell-checker). It will also feature a small red triangle in the top right-hand corner of the marquee around the words.

Meanwhile, a warning message will appear in the corresponding suggested match (when in focus) in the left-hand column, which communicates that there is a possible example of shorthand to resolve. It also displays the shorthand phrase as free text.

Clicking on the phrase will open the list of possible resolutions for the shorthand. Once the user has selected a resolution, such as '3 months', the system will change the words and will automatically run another post-coordination parse.

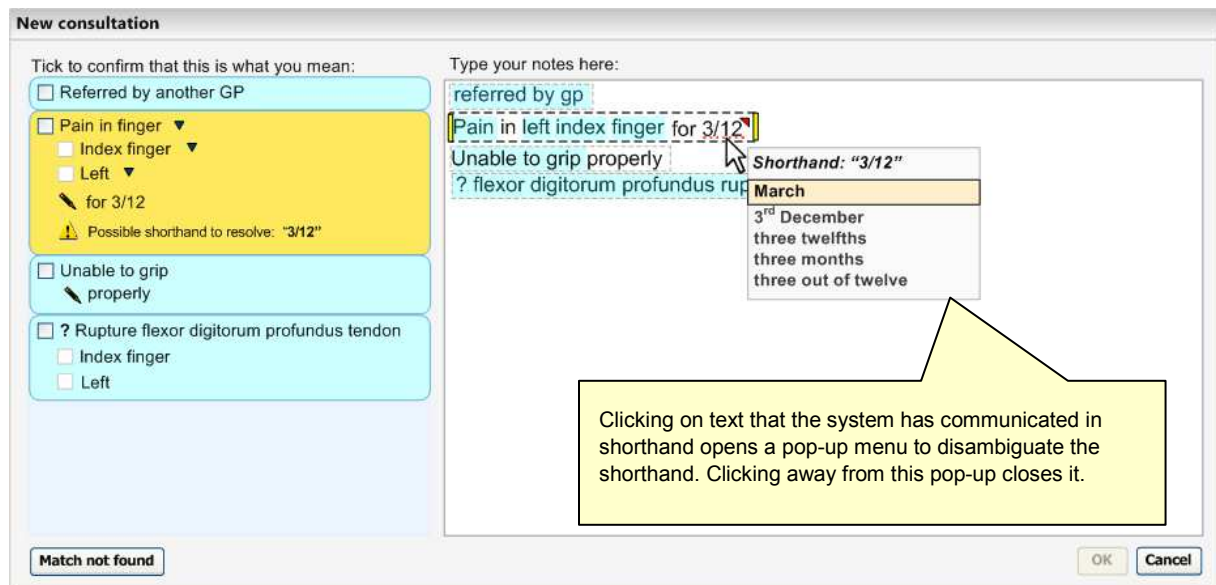


Figure 19: System Underlines Shorthand and Lists Shorthand Options

### 2.2.5.1 Guidance

The system:

- Should recognise a limited set of clinicians' shorthand comprising non-SNOMED-CT synonyms
- Should access these terms from a database of shorthand terms and their corresponding SNOMED-CT or administrative terms (such as dates).

### 2.2.5.2 How to Use the Design Guidance

Usage	Format	Example	Comments
✓	Refer to an external database of approved shorthand terms		

Table 7: How to Use the Design Guidance

### 2.2.5.3 How Not to Use the Design Guidance

Usage	Format	Example	Comments
✗	Automatically translate the shorthand without explicit user actions		

Table 8: How Not to Use the Design Guidance

### 2.2.5.4 Benefits and Rationale

The system allows the user to resolve the shorthand prior to the confirmation process, as the shorthand may influence the post-coordination process. For example, it may post-coordinate with a concept when resolved, therefore, it would be cleaner to resolve the term prior to addressing the post-coordination of the expression in which it sits. Also, it is different from the normal matching process in that for some shorthand, there is a lot of variation in the way it can be written. In addition, as shown in the example above (Figure 19), one particular chunk of shorthand can have many different meanings, but the system does not have any way to discriminate between these different meanings, so displaying a 'top match' will not be possible.

This topic has not undergone rigorous user testing, and so further usability testing is expected, possibly resulting in potential updates.

#### Note

This solution requires additional data to be created and managed.

### 2.2.5.5 Confidence Level

#### Low

- Should recognise a limited set of clinicians' shorthand comprising non-SNOMED-CT synonyms
- Should access these terms from a database of shorthand terms and their corresponding SNOMED-CT or administrative terms (such as dates)

## 2.3 Matching

### 2.3.1 Matching Input Text Against the SNOMED-CT Database

The matching process is the means by which clinicians' notes are translated into SNOMED-CT expressions. An effective and efficient matching process will influence the success of the system. This section outlines:

- The underlying matching process(es)
- Matching interface in the text parser matching approach
- Matching interface in the single concept matching approach
- SNOMED-CT interface features

#### *The Underlying Matching/Searching Algorithms*

The designs feature a similarity measure, which calculates the 'fit' between the input words and the words in the matched SNOMED-CT expression. The benefits of this approach are discussed in the following sections. The design also features partial or 'prefix' matching which allows users to find matches by typing just the first three or four letters of each word in an expression. The solution also allows matching in spite of an inverted ordering of words between the input and the matched expression. This approach is based upon the assumption that clinicians will want to search on prefixes rather than on word endings. There could be an argument for also allowing clinicians to search on word endings (such as '...ectomy'), but this has not been addressed by the current guidance. We could look at this during the development of future guidance (see section 3).

Please note that all the matching behaviour outlined in this guidance assumes a standard and optimal indexing of SNOMED-CT.

#### *Matching in the Text Parser Approach*

The matching event will occur automatically as the user types in their notes. There are a number of ways in which this may be done, some of which may carry greater performance penalties than others, which in the case of a web-based interface could be prohibitive. Further work is being done to understand the practical implementation issues associated with the different matching event triggers. Meanwhile, in the guidance, we will outline the seven main alternatives that we are considering:

- Progressive matching
- Matching upon the completion of each sentence
- Matching upon the completion of each word
- Batch processing
- Line-by-line matching
- Time-based matching (that is, periodical triggering)
- User-triggered matching (such as pushing a button)

The matching event will not interfere with the user's typing of their notes. Instead, the top matches for each text string, (where matching is possible), will be displayed to the user to confirm that this is the correct match (see section 2.3.2 for details).

These will be displayed in the context of the wider 'expressions' to which they belong (although an expression may only comprise a single concept).

The current design also excludes certain common words from the searching, including prepositions, such as 'for' or 'to'. Such an exclusion list would need to be developed and maintained outside of the released SNOMED-CT data. However, there are further issues that need to be resolved with such an exclusion list, and so it is not currently recommended guidance (see section 3).

The matching process will be subject to a number of text parsing rules which may affect which concepts are matched. In particular, in the text parser approach, the system will not match any concepts that are not drawn from the two major SNOMED-CT Upper Level hierarchies: 'Clinical findings' and 'Procedures', or from the supporting hierarchies 'Observable Entities' or 'Situations with explicit context', unless the concept post-coordinates with a concept from one of these hierarchies. In certain contexts, concepts from the category 'Events' may also be base concepts. For example when recording the history of a complaint, the clinician may want to record that the patient has been involved in a 'car accident', which is an event. It is worth noting that, after consideration, we excluded the category, 'Pharmaceutical/biological products', from this list of base concepts. Further work would need to be done to show how concepts from within this category could be disambiguated to determine whether the note refers, for example, to prescription, administration, history of administration or supply (see section 3 for an outline of potential next steps in this area). The rules that determine such 'base' concepts have been devised in light of the October 2006 publication of SNOMED-CT, and would need to be revised in light of any changes made to the database.

Also, the system will only return matches that meet a predefined similarity score threshold. This score, excludes words from the 'exclusion' list (a list which includes very common words, such as prepositions). Further work needs to be devoted to determining this threshold, but currently it could be set at about 70%.

For example, the input text 'leg' could potentially be matched against the concepts 'Leg fracture' or 'Leg injury', but the system would not return these matches because the input text does not meet the similarity threshold, therefore no matches would be returned. In order to get a match, the user must type in more words, for example, 'leg fracture'.

This feature reduces the risk of inappropriate matching, although it cannot guard against the text 'left leg' returning the match 'Pain in left leg' (where the word 'in' is excluded).

The triggering of matching in the text parser approach is still under discussion, but a leading method is to allow 'progressive' matching, whereby a match request is sent upon the insertion or deletion of each character into the text input area, possibly with a slight delay (of 200 milliseconds) in order to reduce the numbers of requests. However, this approach may be fairly performance-intensive and therefore further feasibility studies should be conducted. Other methods of triggering the matching include:

- Matching upon the completion of each sentence
- Matching upon the completion of each word
- Batch processing
- Line-by-line matching
- Time-based matching
- User-triggered matching

Each of these matching processes has its own merits. For example, line-by-line processing would require fewer requests to the server, and thus could reduce problems with performance due to server traffic. Batch processing could also reduce the web service requests, although if the batches were too big, there could be long delays when the matching is triggered.

Matching word-by-word could involve fewer web service requests than progressive matching. However, progressive matching does have the advantage over the other processes in that it allows the user to see the concept building up as they type. In this way, the process could help to guide the user into getting the right match. Obviously the user would not be able to see the alternative matches unless they actually expand the list of matches (see section 2.3.3 for details), but this could give them very useful feedback as they type.

We are not currently in a position to definitively recommend any of these matching processes, as further work needs to be carried out regarding:

- The technical and performance issues surrounding each approach
- The user experience associated with each issue

Details of feasibility analyses conducted so far can be found in section 2.3.1.3.

Figure 20 below shows the system displaying top matches (in the left-hand column) for the text typed in by the user in the right-hand text input area. Each match (or set of matches, where there is possible post-coordination) is displayed within a boundary and has a pale blue background, except where it is 'in focus', in which case the background is yellow.

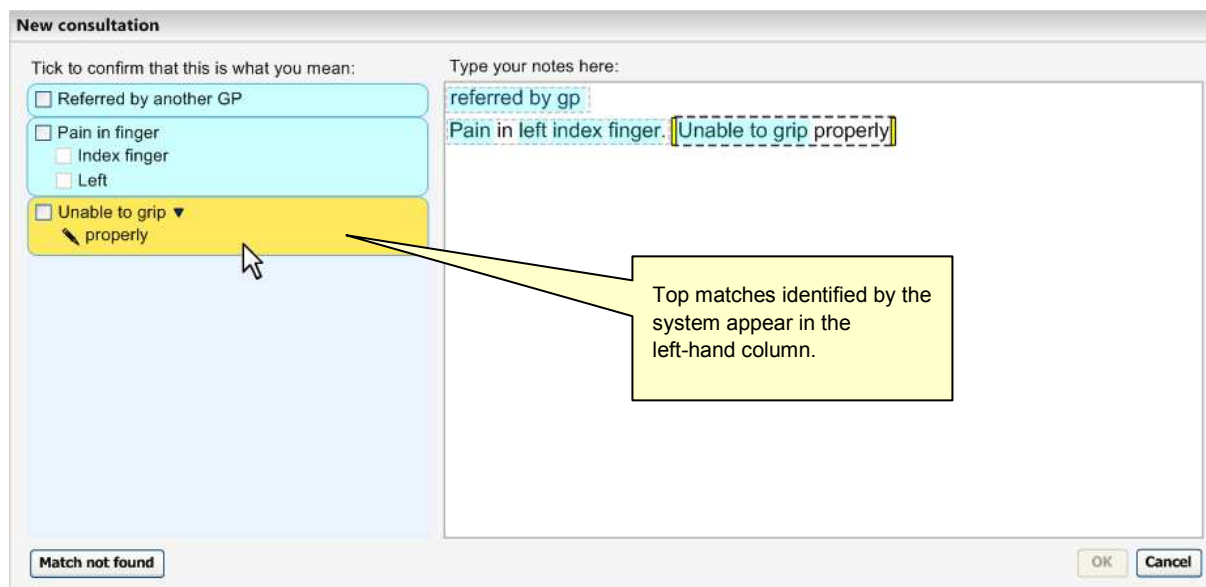


Figure 20: Text Parser Approach to Matching

### ***Matching in the Single Concept Matching Approach***

The single concept matching approach will employ a progressive matching event, in that the matching event is triggered by the user typing in a new character, or deleting a character. It will also feature partial (prefix) matching which can match multiple partial text strings irrespective of the order in which they are typed.

For example, the text 'fem nec' will return the top match of 'neck of femur'.

Certain qualifiers and negation will also be recognised in this matching approach.



Figure 21, Figure 22, Figure 23 and Figure 24 show the matching sequence in the single concept matching approach.

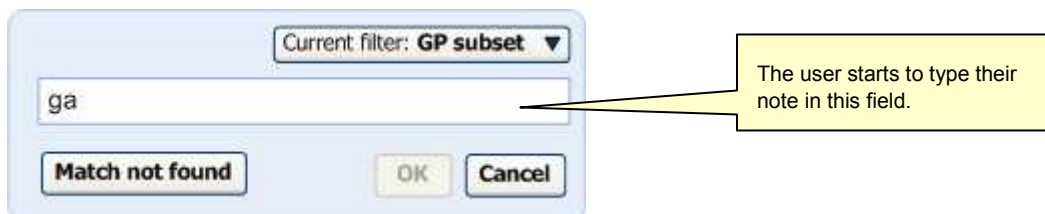


Figure 21: Single Concept Approach to Matching – Step 1

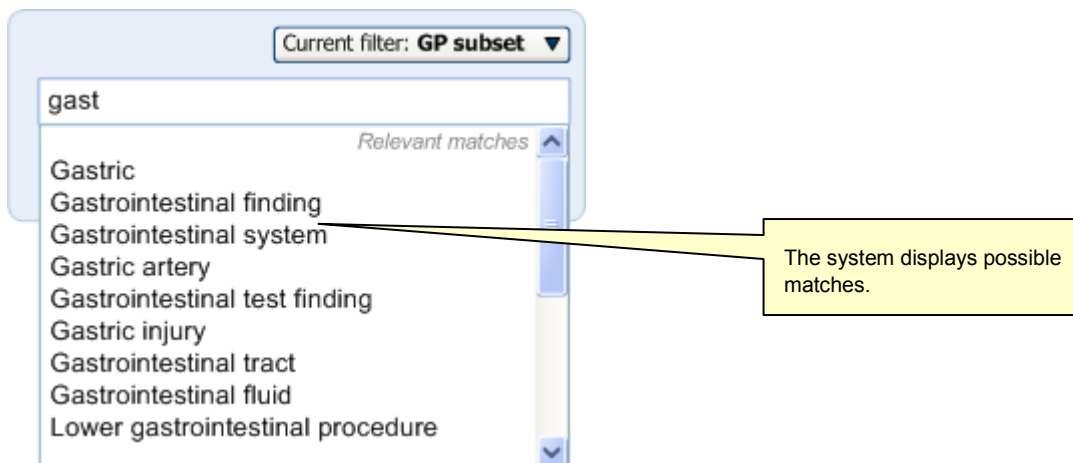


Figure 22: Single Concept Approach to Matching – Step 2

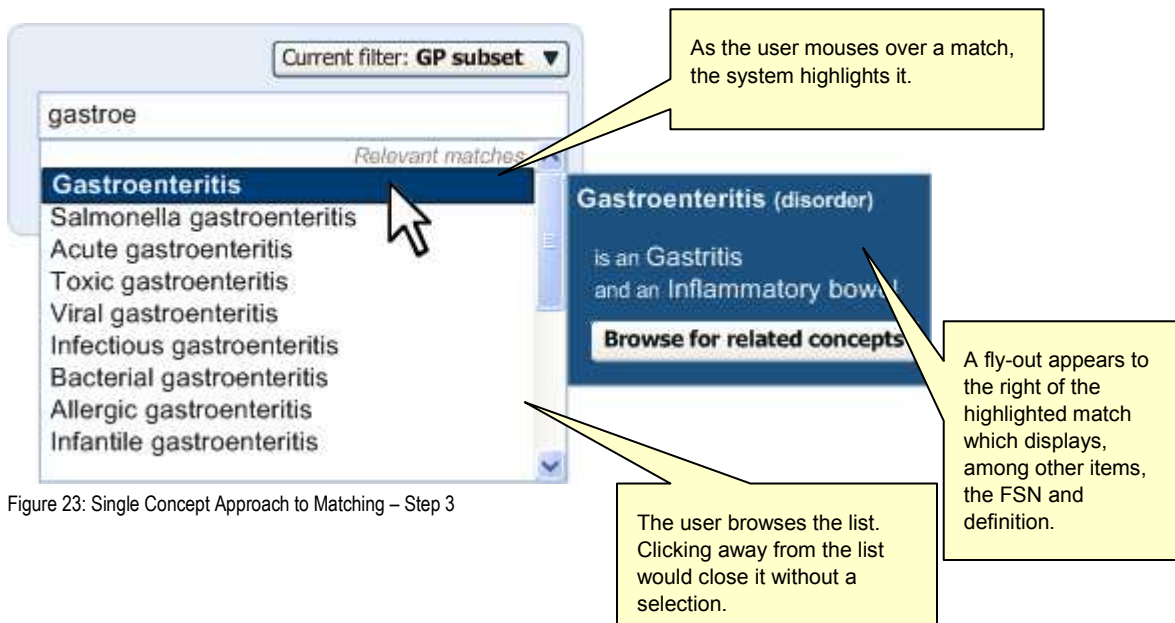


Figure 23: Single Concept Approach to Matching – Step 3

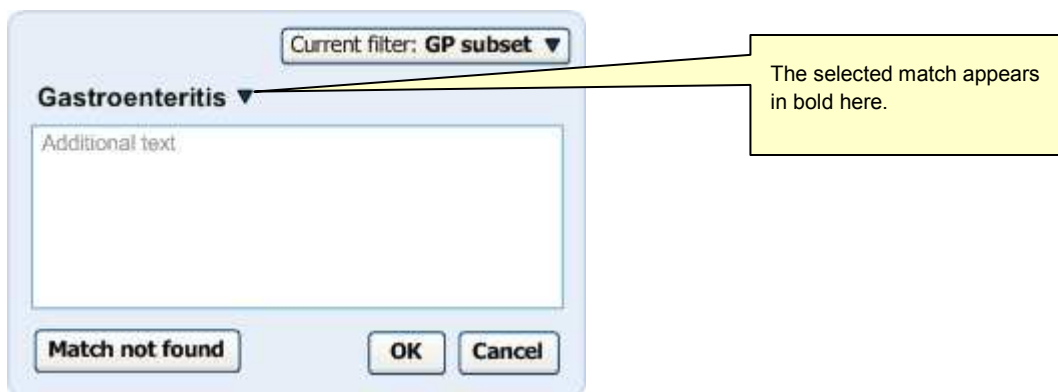


Figure 24: Single Concept Approach to Matching – Step 4

### **SNOMED-CT Interface Features - Synonyms and Word Equivalence**

SNOMED-CT has a number of useful interface features. One of these is the inclusion of synonyms, and the other is the use of 'equivalence' matching.

The terminology features synonym description labels for a vast number of concepts. In addition to the ConceptID, a concept also has a DescriptionID. The Description table features several labels: the Fully specified name and the Preferred Term, and some have one or more synonym labels.

For example, in the case of ConceptID 22298006, the Fully specified name is 'Myocardial infarction' (disorder) and the Preferred Term is 'Myocardial infarction'. It also has a number of synonyms:

- Heart attack
- Myocardial infarct
- Infarction of heart
- MI – Myocardial infarction
- Cardiac infarction

The system must allow matching of synonyms as clinicians often use different terms from one another. Even leading experts in a discipline often refer to a pathology using different terms from one another. Failure to account for synonyms in a noting system could mean that many commonly used terms are left unmatched and, therefore, unencoded. The fourth term in the list above ('MI – Myocardial infarction') is an example of an abbreviation. These abbreviations must also be accounted for in a matching process, owing to their common usage, and efficiency of use.

The system will match text with synonym description labels as well as with Preferred term description labels. However, when a synonym is matched, the system will clearly communicate that it is a synonym in the selection fly-out (see Figure 25). This is because, unlike the Preferred term description label, the synonym label is often different to the Fully specified name label that is also displayed in the fly-out.

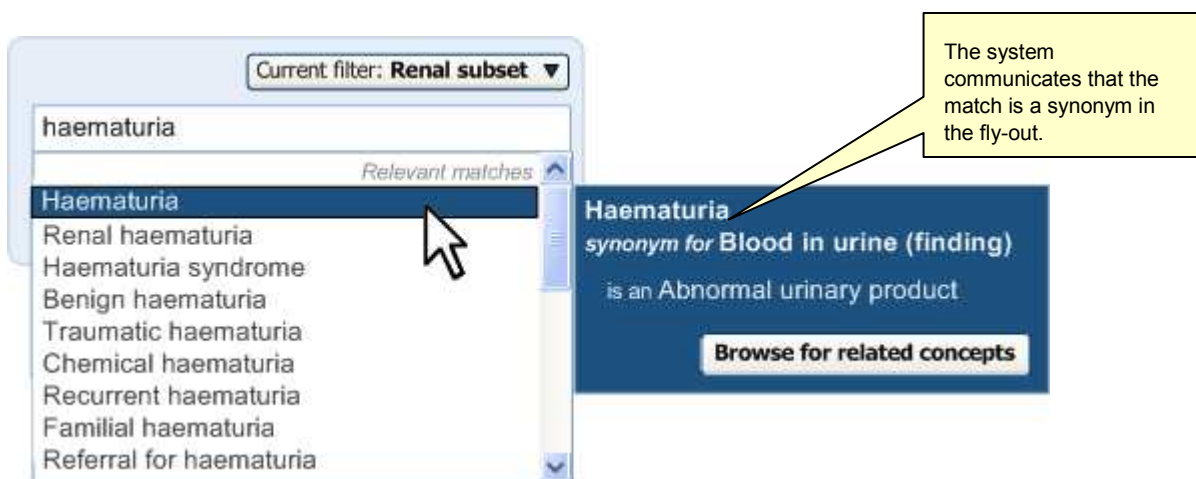


Figure 25: System Communicates that a Match is a Synonym

Also, in order to allow for clinicians to express phrases in multiple synonymous ways, SNOMED-CT publishes tables of 'equivalence'. This provides the match between, for example, 'nose' and 'nasal', or 'boil' and 'furuncle'. These tables may also, in the future, express equivalence between abbreviations and their full terms, such as 'FDP' and 'Flexor digitorum profundus'.

Using these equivalence tables, the system could return equivalence matches, such as 'nasal furuncle' if the user types in 'nose boil'. This could be very useful for the user who may decide, upon viewing the matches, that 'nasal furuncle' is the correct term. It can also allow for matching of phrases where only a single input word is synonymous with the desired match. For example, matching the text 'rupture of cervix' without any equivalence matching would return the possibly over-specific concept 'rupture of uterine cervix'. However, if the system recognises that 'rupture' is equivalent to 'tear', it can provide the match 'tear of cervix', which could be more similar wording to what the user intended. Similarly, if the appropriate terms were featured in the equivalence tables, the system could also return matches for 'FDP tear', that is, 'Rupture of flexor digitorum profundus tendon', which it would not do without equivalence matching.

#### Note

The term 'equivalence matching' is used in this section in a different way to 'canonical equivalence', that is, the equivalence between a coordinated SNOMED-CT concept and its component attribute concepts.

When implementing word equivalence matching in a user interface, it is important to ensure that the user is explicitly aware of what is going on, as it breaks the typical word matching rules. We would recommend that the system explicitly communicates all the words against which it is searching for matches, and that this is displayed close to any search input field. We also recommend that the user can 'opt out' of the equivalence matching (on a match-by-match basis). Also, progressive matching must handle equivalence matching in an elegant way: the system can only show equivalent matches against complete words rather than partial words. We would recommend that, for progressive matching, the system does not search for equivalence by default, unless the system cannot return a matching concept after a word boundary has been defined by the user, that is, by inserting a space or carriage return after the last character in the text string. In the case of not returning a concept, the system would automatically attempt to match any equivalence words it recognised from the equivalence tables. If the system returns matches, then the equivalence matching remains switched off by default, but the system provides a control that allows users to switch it on.

Figure 26 and Figure 27 show a situation where equivalence matching could apply. In the example, the user starts to type in the words 'nose boil'.

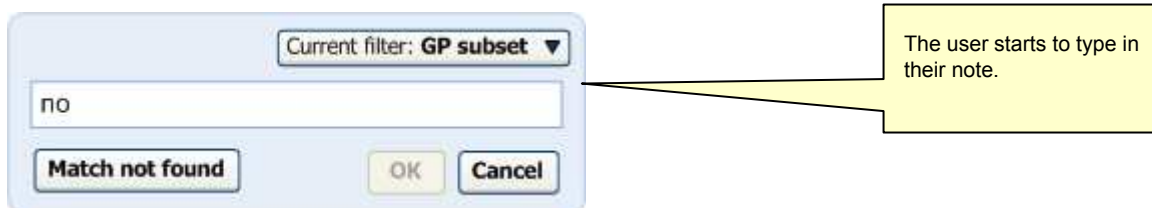


Figure 26: User Starts to Type Input



Figure 27: System Offers Option to Match Equivalent Words

When the user clicks on the control to switch on word equivalence, the list expands to include matches with the equivalent terms (see Figure 28).

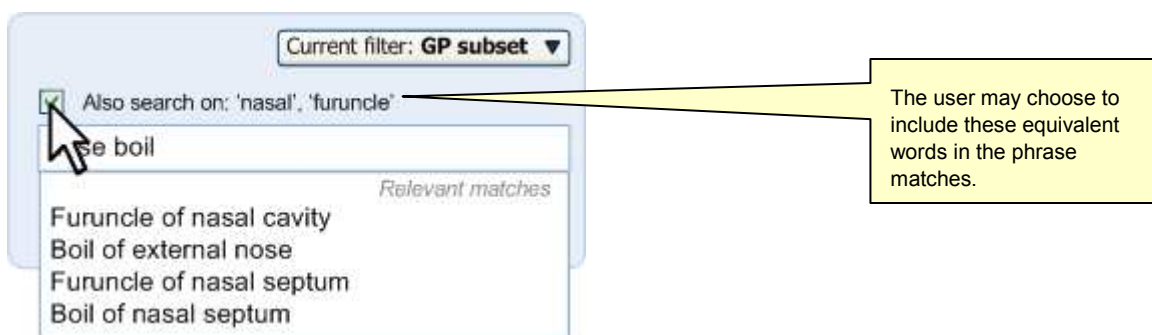


Figure 28: User Switches on Word Equivalence

There will be some cases where equivalence matching is the only way for the system to return results. If the system cannot return any results, but it recognises equivalent words, it will automatically switch on the equivalence and will display the control switched to 'on' (see Figure 29 for details). The synonym 'FDP' is not yet listed in the equivalence tables, but we would expect that this would be a good candidate for inclusion in the future. Abbreviation synonyms will be used frequently and it will be useful if these return matches when used within larger expressions.



Figure 29: System Cannot Return Matches and Therefore Switches on Word Equivalence

### 2.3.1.1 Guidance

The system:

- Must match text against SNOMED-CT concept 'Preferred term' and 'synonym' descriptions
  - Should employ a statistical word matching algorithm
  - Should feature a vector-space matching algorithm for text that contains multiple words
- Must communicate to the user where a match is a synonym
  - Should communicate to the user in the fly-out that a match is a synonym. The fly-out appears when the user moves the mouse over the concept in a list
- Must allow the user to view the Fully specified name for any concept
  - Should allow the user to view the Fully specified name for the concept in a fly-out that appears when the user moves the mouse over the concept in a list
- Must feature a consistent method of triggering the matching event in the text parser approach
  - Could invoke a matching event upon input by the user of each new character ('progressive' matching)
  - Could invoke a matching event when the user defines a new word boundary (that is, by inserting a space after a text string)
  - Could invoke a matching event when the user defines a new sentence boundary (that is, by typing a full stop or a carriage return)
  - Could invoke a matching event at regular intervals during the noting session (for example, once every 200 milliseconds)
- Should filter out false positives by rejecting any match which fails to achieve a threshold of similarity with the corresponding SNOMED-CT label
- Should match text against equivalent SNOMED-CT concepts, as defined in the equivalence table(s) in the latest SNOMED-CT release data
  - Must provide two matching states for equivalence matching: 'on' and 'off'
    - Must provide a control to allow the user to choose whether equivalence matching is switched on or off
    - Must ensure that the equivalence matching is switched off by default in those situations where the matching is done progressively as the user types (that is, in the single concept matching and in the encoding dialog in the text parser approach)
    - Could ensure that equivalence matching is switched on by default in those situations where matching is not done progressively
      - Must clearly indicate where equivalence matching is switched on, that is, where the system has attempted to match on equivalent words
        - (i) Should communicate this in a location close to the match results list
  - Must communicate which equivalent words the system is searching
    - Should display these equivalence words adjacent to the input field
- Should feature partial, or 'prefix', matching in the case of single concept matching and matching within the encoding dialog

- Should feature progressive matching in the case of single concept matching and matching within the encoding dialog, that is, typing in a new character (or deleting a character) invokes a matching event
  - Must display the SNOMED-CT matches close to the input field (in the case of single concept matching and matching within the encoding dialog)
    - Should display the SNOMED-CT matches below the input field
  - Must ensure that the matching event invoked during progressive matching is sufficiently timely
    - Should ensure that the matching event is invoked within 200 milliseconds of the key press
- Must be able to match multiple words against a SNOMED-CT description that contains multiple words
  - Must be able to match words regardless of order
- Must be able to match the longest string of adjacent possible, depending also upon the outcome of the post-coordination parsing process
- Must display the top match candidates (that is, the 'suggested matches') for each text string (where a viable match can be made), in a location visible to the user when they are typing
  - Should display the suggested matches in an area adjacent to the text parser input field (in the text parser matching approach)
    - Should locate the suggested match area immediately to the left of the text parser field
- Must allow the user to confirm the suggested matches before they are saved to record as SNOMED-CT codes

### 2.3.1.2 *How Not to Use the Design Guidance*

Usage	Format	Example	Comments
✗	Matching input text against the following SNOMED-CT descriptions: <ul style="list-style-type: none"> <li>■ Concept ID</li> <li>■ Fully specified name</li> </ul>		
✗	Switching on word equivalence matching automatically if some matches have been returned		

Table 9: How Not to Use the Design Guidance

### 2.3.1.3 *Benefits and Rationale*

We have explored a number of ways of matching text against SNOMED-CT matches (both in the context of the text-parsing and the single concept approaches). These have been based around statistical word matching, where the system matches the user-input text strings against SNOMED-CT concept text strings and determines the fit (in terms of percentages of matching characters and character/word orders). This also employs a vector-space matching algorithm which determines the relevance of a matched word in relation to all other occurrences of that word within SNOMED-CT (or a subset of SNOMED-CT), but this only works where there are more than one word in the in-focus text string.



We have demonstrated in prototypes and in user testing that matching can be well handled by statistical word matching (and Vector-space) matching. We have also shown that both full-word matching and partial (prefix) matching often result in a quick and easy-to-use matching process. The guidance falls in favour of prefix matching, which can match parts of words with SNOMED-CT expressions. It can also allow matching, irrespective of the order in which the chunks of words appear. As outlined in a previous section, the text strings 'nec fem' will result in matching of expressions such as 'Neck of femur', whether the text 'nec' is typed before the text 'fem' or vice versa. The fact that the system can match expressions even if the input text inverts the order of the words is important, given that often the expression can be articulated in either way, and because SNOMED-CT does not feature a synonym for each instance inverted order. For example, a clinician may type in 'neck fracture', but if the system required the ordering of the words in the expression to match, it would not find a match, as the match is 'Fracture of neck'.

The development team in the CUI programme have conducted some early technical feasibility studies, including testing a prototype, which works with actual SNOMED-CT data via a Web service, under a series of stress conditions, including under simulated delays. The performance was good, especially when the communication with the Web service was asynchronous, with the process ignoring changes to text in between making the call and receiving the response. This asynchronous process involved assigning an incremental integer to each chunk of text matched via the Web service, and detecting whether the original text had changed upon receiving the response. This process was shown to work well, in spite of artificial delays imposed to simulate poor network connections.

Also, the fact that the Web service must exist on the same domain as the client, according to an Asynchronous Javascript and XML (AJAX) approach, should defuse many concerns with performance.

These results and analyses are encouraging, although further development and testing should be conducted before firm guidance can be given.

Regarding the user experience associated with the various matching approaches, further research needs to be carried out using interactive prototypes, in order to compare the user experience for each approach. To date, we have only been able to test wireframes and an interactive demonstrator limited to a narrow functionality.

However, further investigation is required in the matching processes before full word matching can be discarded as a viable and efficient matching approach. Potential updates in the guidance may result from this testing.

#### **2.3.1.4      *Confidence Level***

##### ***High***

- Must match text against SNOMED-CT concept 'Preferred term' and 'synonym' descriptions
  - Should employ a statistical word matching algorithm
- Must communicate to the user where a match is a synonym
  - Should communicate to the user in the fly-out that a match is a synonym. The fly-out appears when the user moves the mouse over the concept in a list
- Must allow the user to view the Fully specified name for any concept
  - Should allow the user to view the Fully specified name for the concept in a fly-out that appears when the user moves the mouse over the concept in a list
- Must feature a consistent method of triggering the matching event in the text parser approach

- Should feature progressive matching in the case of single concept matching and matching within the encoding dialog, that is, typing in a new character (or deleting a character) invokes a matching event
  - Must display the SNOMED-CT matches close to the input field (in the case of single concept matching and matching within the encoding dialog)
    - Should display the SNOMED-CT matches below the input field
  - Must ensure that the matching event invoked during progressive matching is sufficiently timely
    - Should ensure that the matching event is invoked with 200 milliseconds of the key press
- Must be able to match multiple words against a SNOMED-CT description that contains multiple words
  - Must be able to match words regardless of order
- Must be able to match the longest string of adjacent possible, depending also upon the outcome of the post-coordination parsing process
- Must display the top match candidates (that is, the 'suggested matches') for each text string (where a viable match can be made), in a location visible to the user when they are typing
  - Should display the suggested matches in an area adjacent to the text parser input field (in the text parser matching approach)
    - Should locate the suggested match area immediately to the left of the text parser field
- Must allow the user to confirm the suggested matches before they are saved to record as SNOMED-CT codes

### **Medium**

- Could invoke a matching event upon input by the user of each new character ('progressive' matching)
- Could invoke a matching event when the user defines a new word boundary (that is, by inserting a space after a text string)
- Could invoke a matching event when the user defines a new sentence boundary (that is, by typing a full stop or a carriage return)
- Could invoke a matching event at regular intervals during the noting session (for example, once every 200 milliseconds)
- Should match text against equivalent SNOMED-CT concepts, as defined in the equivalence table(s) in the latest SNOMED-CT release data
  - Must provide two matching states for equivalence matching: 'on' and 'off'
    - Must provide a control to allow the user to choose whether equivalence matching is switched on or off
    - Must ensure that the equivalence matching is switched off by default in those situations where the matching is done progressively as the user types (that is, in the single concept matching and in the encoding dialog in the text parser approach)



- Could ensure that equivalence matching is switched on by default in those situations where matching is not done progressively
  - Must clearly indicate where equivalence matching is switched on, that is, where the system has attempted to match on equivalent words
  - Should communicate this in a location close to the match results list
- Must communicate which equivalent words the system is searching
  - Should display these equivalence words adjacent to the input field
- Should feature partial, or 'prefix', matching in the case of single concept matching and matching within the encoding dialog

### **Low**

- Should filter out false positives by rejecting any match which fails to achieve a threshold of similarity with the corresponding SNOMED-CT label

## **2.3.2 Presenting SNOMED-CT Matches**

The system must be able to display several aspects derived from the matching process. In the text parser approach to matching, the system will initially present 'top' matches only, with a control to view the top match listed with alternative matches. In the single concept matching process, the system immediately displays the full list of matches. Additionally, within both approaches, the system must be able to display each matched concept's 'definition' to help ensure the user fully understands the matches that they are choosing. This section outlines these types of matching.

### ***Top Match Suggestions***

In the text parser approach, the system will display 'top matches' for each of the text strings that the user has typed in. These are to be displayed in such a way that they do not distract the user to such an extent that they obstruct the typing of further notes. However, they should be easily noticeable and readable as they can give users useful feedback that the system is correctly recognising their typed notes. This feedback will be extremely useful if a progressive matching algorithm is implemented as users may type in a few characters of their desired term and can see the possible completed matches appear as they type; this has the potential to be a very useful interactive tool that could save users typing in the full text before confirming the concept match, thus rendering the complete text in the notes. For these reasons, the suggested 'top matches' must be:

- Located in a visible, consistent position that does not obstruct the typed text. We have shown that featuring a column to the left of the text input area is sufficiently visible, but also unobtrusive. The matches remain close to the typed text as the input text field is left-justified (the most common form of text justification).
- Sufficiently ordered so that the user can easily see which match is resulting from the text that they are typing. Stacking the matches vertically with the earliest matches at the top of the column and the most recent at the foot of the column is a well-understood way of achieving this order.
- Visually associated with the typed input text strings. We have linked them by colour, and the focus will move to the appropriate text expression in the input text depending on the match selected by the user in the left-hand column.

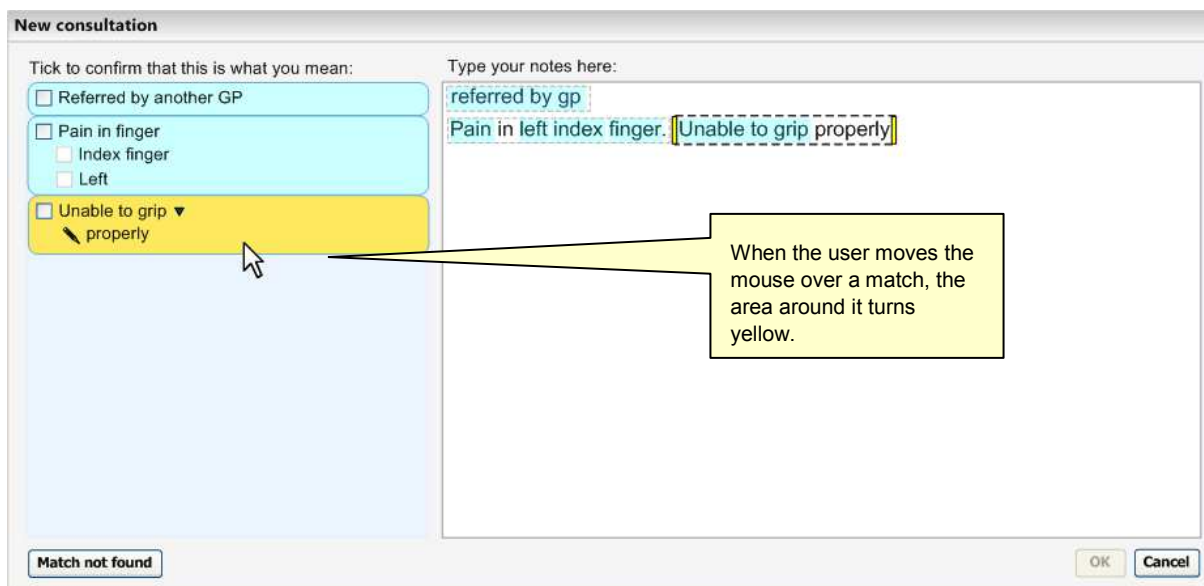


Figure 30: Top Match Suggestions are Displayed in the Left-Hand Column

### **Alternative Matches**

In the single concept matching approach, and in the 'view all matches' stage in the text parser approach, the system will display both the top SNOMED-CT match and all alternative concepts that fall within the matching threshold. The user will be able select alternative matches to the top match, in addition to changing the input text (and thus changing the matches on offer).

In order to support these user actions, the matches will be shown in a relevant order; in this case, in the order of statistical word relevance—plus some additional ordering of 'common' versus 'all other' matches; see section 2.4 for further details. In addition, the input field will be located in a position such that the user can view it simultaneously with the matches. The user should not be overwhelmed by a long list of matches (some lists of matches can comprise hundreds of items): the design assumes that users will be comfortable viewing up to nine matches simultaneously, and therefore only shows this number in the default view. Users may scroll down the list or stretch the dialog so that more matches are visible simultaneously.

All matches will be displayed in either their SNOMED-CT 'Preferred term' or 'synonym' description ID labels, depending upon which of these IDs has been matched.

In the text parser approach to matching, there are two potential, and mutually exclusive, mechanisms for viewing alternative matches.

The first, the default mechanism, is a control whereby the user accesses the alternative matches by clicking on the top match 'clickable area'. The match's area becomes clickable when the user moves the mouse over it; this is signified by the area changing colour and becoming slightly embossed/'3D'. Crucially, on moving the mouse over the area, the area also indicates if the system has returned:

- Alternative matches with very similar spelling (see Figure 31)
- Alternative matches that are further specific examples of the top match, that is, further down the hierarchical lineage (see Figure 31)
- Alternative matches with the same spelling (see Figure 32)

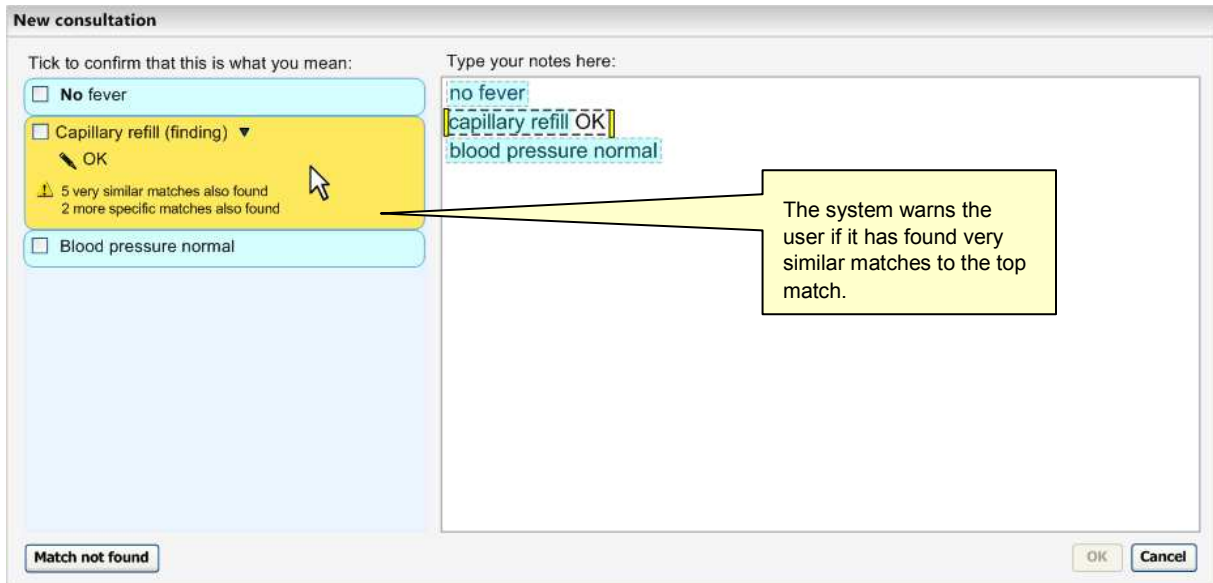


Figure 31: System Warns the User That There are Very Similar Matches

If there are any alternative matches with the same spelling, the check box will be disabled until the user has clicked on the area to view the alternative matches (see Figure 32).

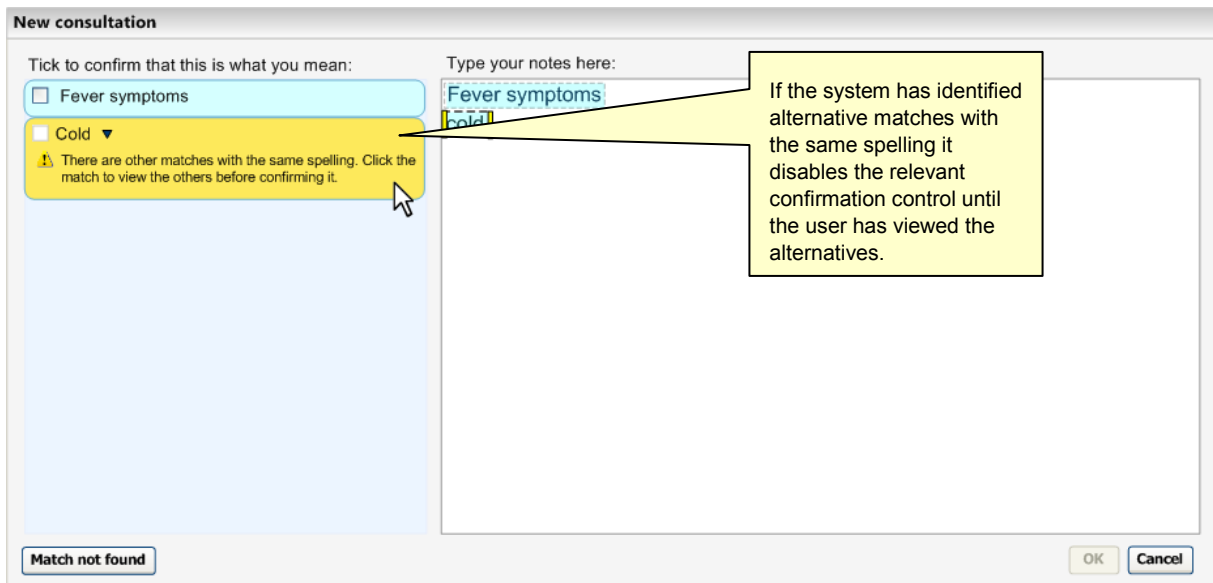


Figure 32: System Forces the User to View Matches with Same Spelling Prior to Confirmation

### Note

This solution requires thresholds for similarity to be agreed, as the level of similarity that triggers a warning has patient safety implications.

When the alternative matches are displayed in a list, the list width will allow 32 characters in a line. If the SNOMED-CT concept exceeds this length, it should wrap onto a second line which is indented by two characters. If the text for a single match exceeds 62 characters, the system must display all that it can over the two lines and feature an ellipsis ('...') at the end of the text, to indicate that it has been truncated. 95% of the SNOMED-CT concepts comprise 62 characters or less. The user may view the full label in the fly-out (which displays the Fully specified name).

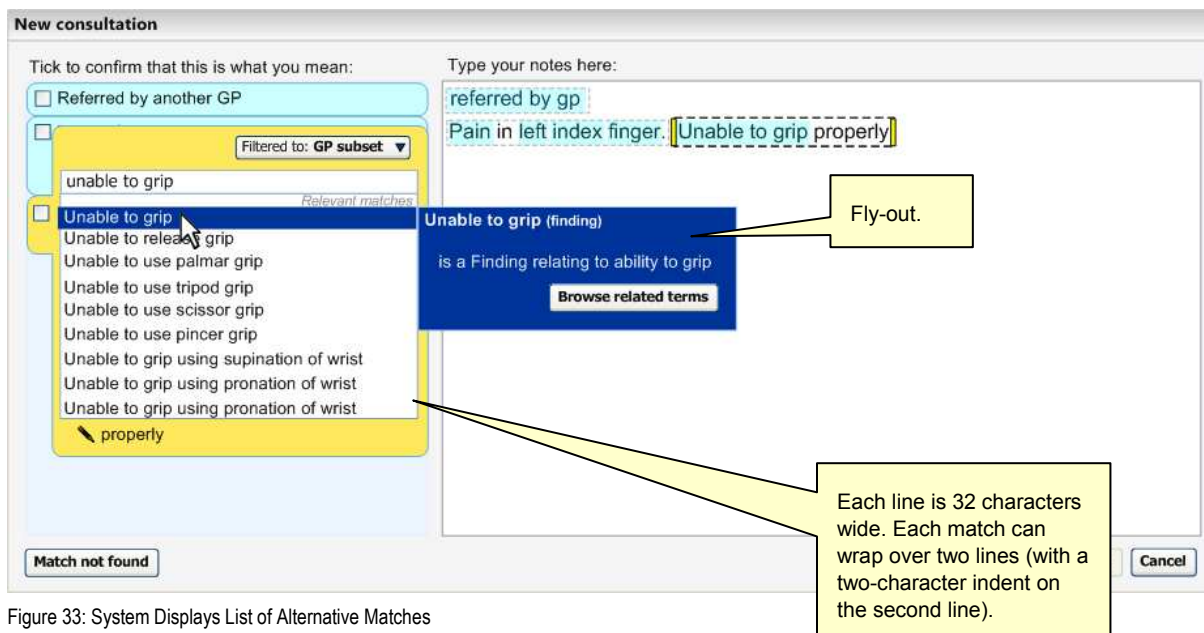


Figure 33: System Displays List of Alternative Matches

## Viewing the Concept 'Definition'

It will be important for the user to view a 'definition' of the concept, given the potential for confusion between similar sounding and similarly spelt concepts.

As a user moves focus over each results list item, a fly-out dialog displays a definition. This dialog opens automatically. The definition illustrated below is derived from the 'is a' relationships within SNOMED-CT (see Figure 34 and Figure 35).

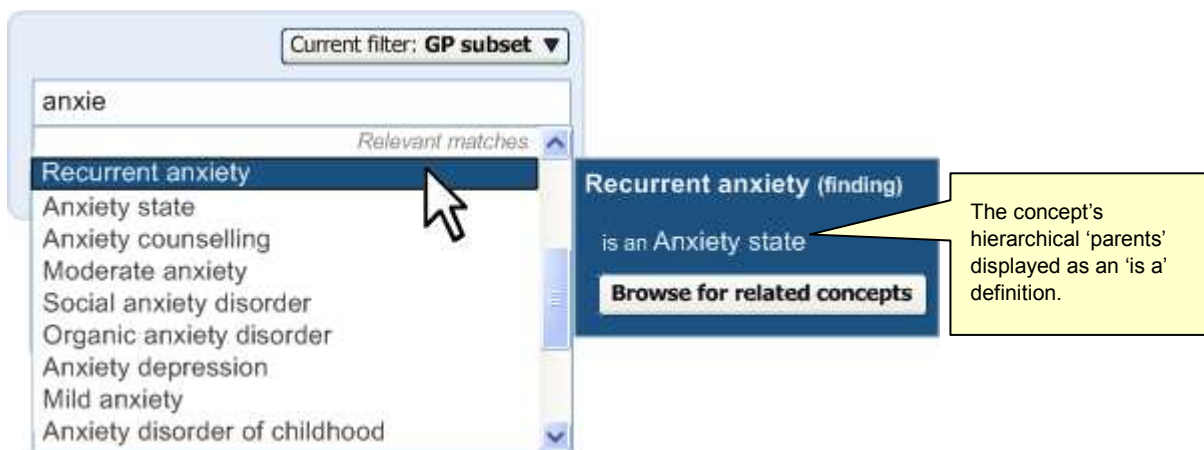


Figure 34: Definitional Fly-out

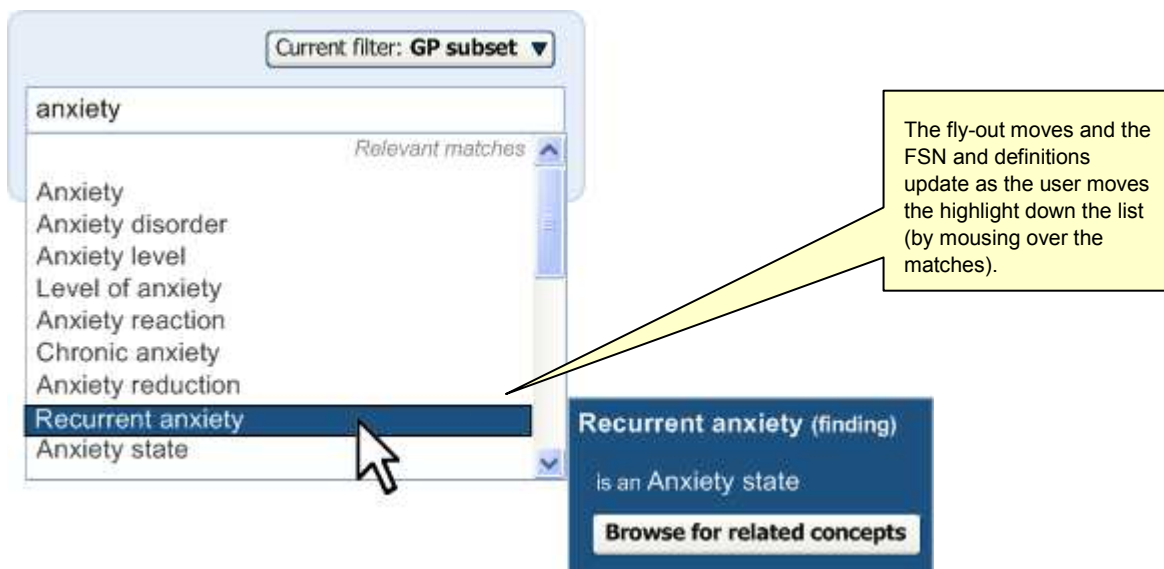


Figure 35: User Moves Mouse Down the List and Fly-out Moves with Highlight

The 'Is a' concepts, which are the parents of the highlighted concept, are displayed immediately below the highlighted concept. They feature appropriate labels, such as 'Is a'. However, if there is more than one parent, the second parent should be labelled 'And a', in order to avoid the user thinking that they are mutually exclusive choices.

This is a manageable solution to the need for a definition. There are other ways of defining a concept, such as displaying its subtypes or siblings, or by displaying a number of levels of supertypes, in order to pinpoint where it sits in the SNOMED-CT hierarchy. However, the solution outlined above allows clear definition of the concept, without overwhelming the user with references to related concepts. The

user may get a fuller indication of where the concept sits within the hierarchy by clicking on the 'Browse for related concepts', which opens up a dialog for browsing the hierarchy (see section 2.5).

The topic of possible ways to communicate concept definitions is further discussed in SNOMED Clinical Terms® Guide – Abstract logical models and Representational forms<sup>2</sup> {R4}.

### Presenting 'No Matches Found'

In the single concept matching approach, if the system cannot return any matches for a text input, it does not show any matches below the input field and no fly-out appears. Owing to the interactive nature of the progressive matching, it will be clear to the user that if nothing is showing, then there are no matches.

In the text parser matching approach, if the system cannot return any matches for a text input, it does not show any matches in the 'Suggested matches' column, neither does it highlight the match in the 'encodable' highlight.

Users can open the encoding dialog for any text they want in the text input area of the text parser approach, by highlighting the text, right-clicking to open the contextual menu and selecting 'Find matches for this text'. This will open up the encoding dialog with the input field pre-populated with the selected text. The user may then tweak the text in order to find a match.

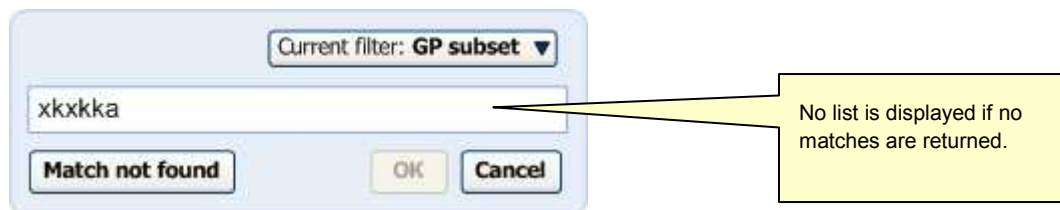


Figure 36: No Matches Found

### Reporting 'No Matches Found'

The user must also be able to report if the system has not been able to match the term that they need.

In the design below (Figure 37), the user has two ways of reporting 'no match found'. The first way involves right-clicking on the word that has not been matched. This will offer an option to report this. Alternatively, the user may click on the 'No match found' button at the foot of the page. This will launch a wizard which allows the user to enter the word that they could not match. Both methods will launch a process that will inform those who manage and maintain SNOMED-CT of the missing term. However, currently this process is undefined.

The system will not encourage the user to enter an 'approximate' concept. Instead, the user may either browse the hierarchy to a more general instance of the concept (if this is appropriate) or may leave the word in free text.

<sup>2</sup> Clinical Terms® Guide – Abstract logical models and Representational forms:  
[http://www.snomed.org/snomedct/documents/abstract\\_models\\_and\\_representational\\_forms.pdf](http://www.snomed.org/snomedct/documents/abstract_models_and_representational_forms.pdf)

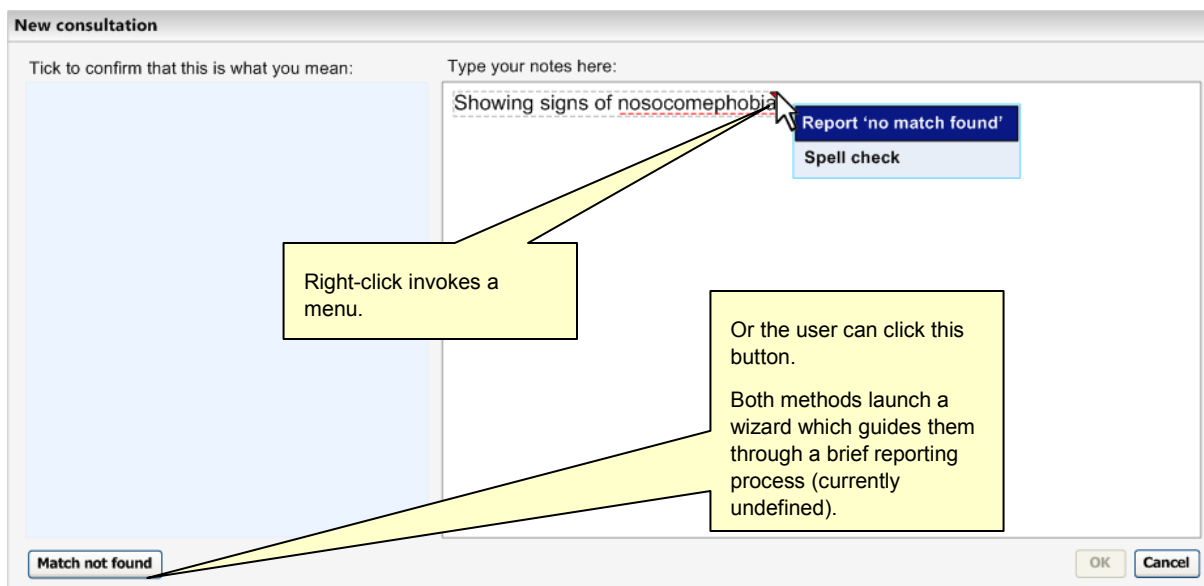


Figure 37: Reporting No Match Found

### 2.3.2.1 Guidance

The system:

- Must display top matches to the user while the user is typing their notes
- Must ensure that the suggested matches do not obstruct the user's noting
- Must ensure that the suggested matches are visible to the user as they type in their notes
- Should stack the suggested matches vertically
- Should bound each suggested match visually (for example, in a rectangular or lozenge-shaped perimeter)
- Must provide an automatic scroll bar in the suggested matches area, if the matches exceed the space available
- Must warn the user if there are very similar alternative matches or matches which constitute a 'child' (in terms of the SNOMED-CT hierarchy)
  - Should communicate to the user that they can access these alternative matches by clicking on the suggested match area
- Must display the matched synonym description label if the match is with a synonym description and the Preferred term description label if the match is with a Preferred term description
- Must directly expose clinicians to SNOMED-CT labels; Preferred term, synonym (where appropriate) and Fully specified names
- Should display the highlighted concept's parent concept labels
  - Should display the highlighted concept's parent concept labels in the fly-out
  - Should feature appropriate labels next to each parent concept
    - Should feature the labels 'Is a' for the first parent, and 'And a' for further parents
- Must keep SNOMED-CT Concept IDs hidden from the clinician



- Should display nothing if a word or phrase cannot be matched
- Must provide the user with a method of reporting 'No matches found'
- Must allow a width of 32 characters for the matches list
- Should wrap labels that exceed 32 characters over two lines, with the second line indented by two characters
- Should truncate labels that exceed 62 characters and feature an ellipsis to communicate the truncation

### 2.3.2.2 *How to Use the Design Guidance*

Usage	Format	Example	Comments
✓	Ensure that matches are presented sufficiently promptly	Display matches within 200 milliseconds of the last key press	Insufficient responsiveness can cause the user to think that something is wrong, and they may try to type other characters in order to get a response

Table 10: How to Use the Design Guidance

### 2.3.2.3 *How Not to Use the Design Guidance*

Usage	Format	Example	Comments
✗	Feature the Top Level Concepts (TLCs) next to each match	'Fever (clinical finding)	In testing, users were confused by the top level concept labels, especially 'Clinical finding'
✗	Feature numbering next to each list item	'1. Anxiety 2. Anxiety disorder 3. Anxiety level'	In testing, users were confused by a system of numbering

Table 11: How Not to Use the Design Guidance

### 2.3.2.4 *Benefits and Rationale*

The matches should be displayed in a visible, but unobtrusive manner. The user should not be distracted by the matches, and the matching process should definitely not interfere or stop their typing. This is especially important given the interpersonal interaction that may be taking place between the clinician and their patient, or the clinician and their colleagues during the noting activity.

These designs have been tested with clinicians, who noticed the matches and understood the matching process.

Testing has shown that many users (50% in a recent test) end up choosing a match that is more specific than the text that they had originally entered. For example, when they had typed in 'chest pain', they would end up choosing 'Acute chest pain'. It is for this reason that the system should indicate where there are more specific instances of the top match within the list of alternative matches, and should encourage users to view this list before confirming the match.

Also, testing showed that users were confused by the parent concept labels if there were more than one present. Users thought they were mutually-exclusive selections. Appropriate labelling should reduce this risk.

In testing, users also commented on the usefulness of presenting the suggested matches in view of the text entry area, as they provided a 'confirmation' of their noting. All users understood, without prompting, that the suggested matches in the left-hand column were the most likely code matches proposed by the system. Users described them as 'predictive encoding', 'do you mean?', 'suggesting a



code', 'is this what you meant?' and 'asking you to confirm a queried code'. Also, most users understood that the matches are not coded immediately, but need confirmation.

In previous designs, unconfirmed matches featured a '?' symbol, but this was replaced with a check box as some users confused this with the communication of a query. Also, the check box emphasises the fact that the left-hand column is interactive. In previous designs that did not feature the check box, 50% users felt that items in this column were not interactive. In subsequent testing, the check box design was shown to be understood by all clinicians as meaning 'coded' and 'not coded'.

In recent testing, users were shown wire-framed sequences of 'auto-completion' matches, which auto-completed the users' words as they typed. Users thought that this is a useful idea as it allows them to 'keep an eye on the codes' and gave 'helpful suggestions'. However they felt that the auto-completion of the text that they were typing was distracting and could slow their noting. The current design includes the 'concept suggesting' feature, but without the distracting auto-complete function in the text entry area.

Testing also revealed that users prefer labels to be wrapped over two lines, rather than be truncated to fit a single line (if the text exceeds 32 characters in length).

Some areas of this guidance have not undergone rigorous user testing, such as the 'No matches found' feature, and so further usability testing is expected, which will possibly result in potential updates.

### 2.3.2.5 *Confidence Level*

#### *High*

- Must display top matches to the user while the user is typing their notes
- Must ensure that the suggested matches do not obstruct the user's noting
- Must ensure that the suggested matches are visible to the user as they type in their notes
- Should stack the suggested matches vertically
- Should bound each suggested match visually (for example, in a rectangular or lozenge-shaped perimeter)
- Must provide an automatic scroll bar in the suggested matches area if the matches exceed the space available
- Must display the matched synonym description label if the match is with a synonym description, and the Preferred term description label if the match is with a Preferred term description
- Must directly expose clinicians to SNOMED-CT labels; Preferred term, synonym (where appropriate) and Fully specified names
- Must keep SNOMED-CT Concept IDs hidden from the clinician
- Should display nothing if a word or phrase cannot be matched
- Should display the highlighted concept's parent concept labels
  - Should display the highlighted concept's parent concept labels in the fly-out
  - Should feature appropriate labels next to each parent concept
    - Should feature the labels 'Is a' for the first parent, and 'And a' for further parents
- Must allow a width of 32 characters for the matches list

- Should wrap labels that exceed 32 characters over two lines, with the second line indented by two characters

### **Medium**

- Must warn the user if there are very similar alternative matches or matches which constitute a 'child' (in terms of the SNOMED-CT hierarchy)
  - Should communicate to the user that they can access these alternative matches by clicking on the suggested match area
- Must provide the user with a method of reporting 'No matches found'
- Should truncate labels that exceed 62 characters and feature an ellipsis to communicate the truncation

## **2.3.3 Selecting and Confirming SNOMED-CT Matches**

Users must be able to select SNOMED-CT matches in a quick and consistent manner. The guidance outlines how this could be achieved.

### ***Selecting and Confirming in the Text Parser Approach***

As outlined earlier, in the text parser approach to matching (section 2.1.2), the system displays the top matches in the Suggested matches area, in the left-hand column. At this point, the user may:

- Select the check box to confirm that the match is correct
- Click on the match's label to view and select alternative matches
- Change the text they have typed

As the user moves the mouse down the suggested match areas in the left hand column, the selection areas become yellow. If the user clicks on the yellow area (but not necessarily on a label area) this will move the marquee selection in the right-hand text input area.

Moving the mouse over the marquee does not move the selection area (on either side), but if the user moves the focus in the text input area, the corresponding selected match is highlighted in the left-hand column (see Figure 38).

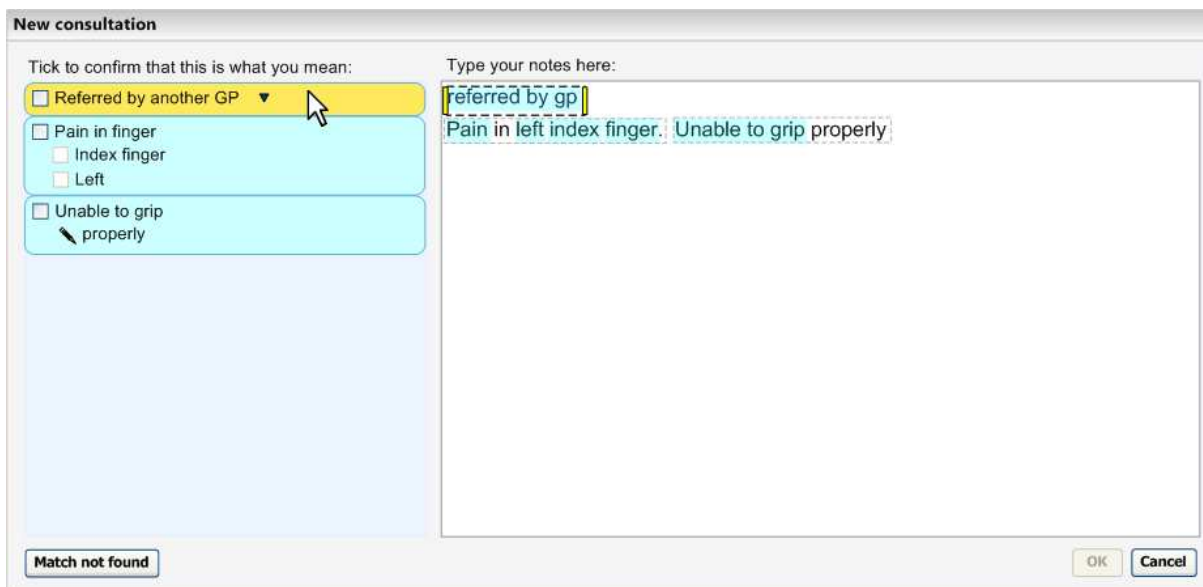


Figure 38: Moving the Mouse Over a Suggested Match Highlights the Area in Yellow

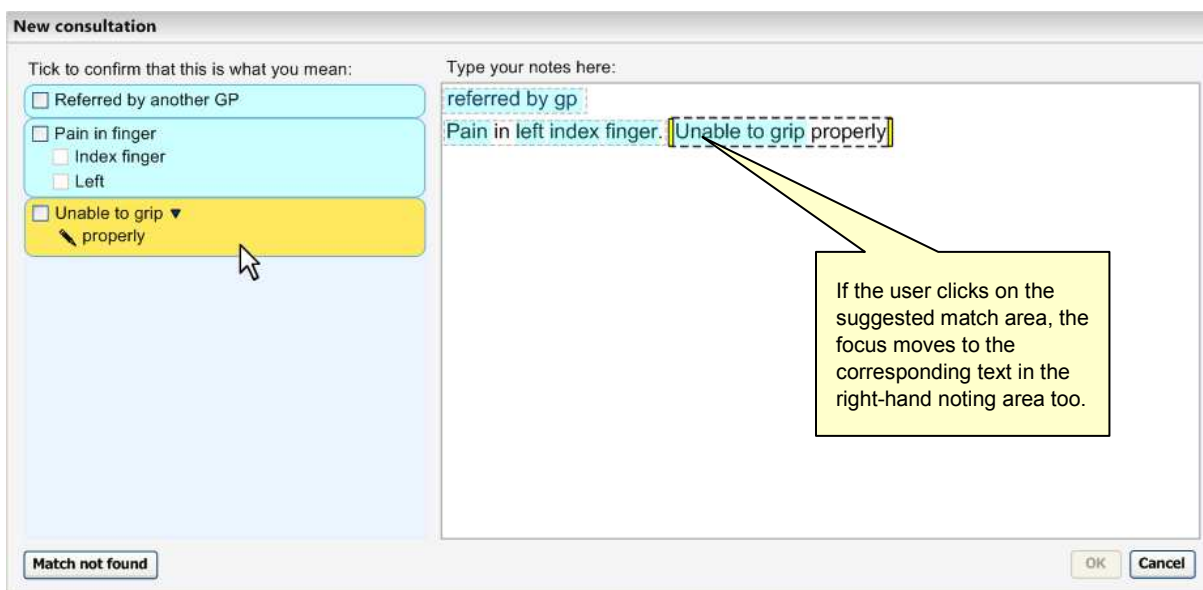


Figure 39: Moving the Mouse to a Selected Area and Clicking on it Moves the Focus in the Right-Hand Area

At this point, if the system has returned similar matches to the one displayed, the system will communicate a warning to the user (see Figure 40).

Figure 40: Warning That There are Very Similar Matches

The user can click the appropriate check box to confirm that the match is correct. This match will then be encoded when the record is saved (see Figure 41).

Figure 41: Confirming the Match

Once confirmed, the system will replace the user-typed 'original' text with a rendering of the SNOMED-CT concepts. If it is a single pre-coordinated SNOMED-CT concept, the system will simply replace the text with either the 'Preferred term' or 'synonym' label.

The confirmation check box is only enabled if there are no unselected mandatory fields associated with the selected match. For example, if the matched concept is a body structure that requires an indication of laterality, the check box is not enabled until the user has selected a side (which could be 'unspecified').

Alternatively, the user may choose to view the alternative matches. In the example below the user moves the mouse over onto the label itself, which turns orange and appears 'clickable' (that is, slightly embossed). See Figure 42.

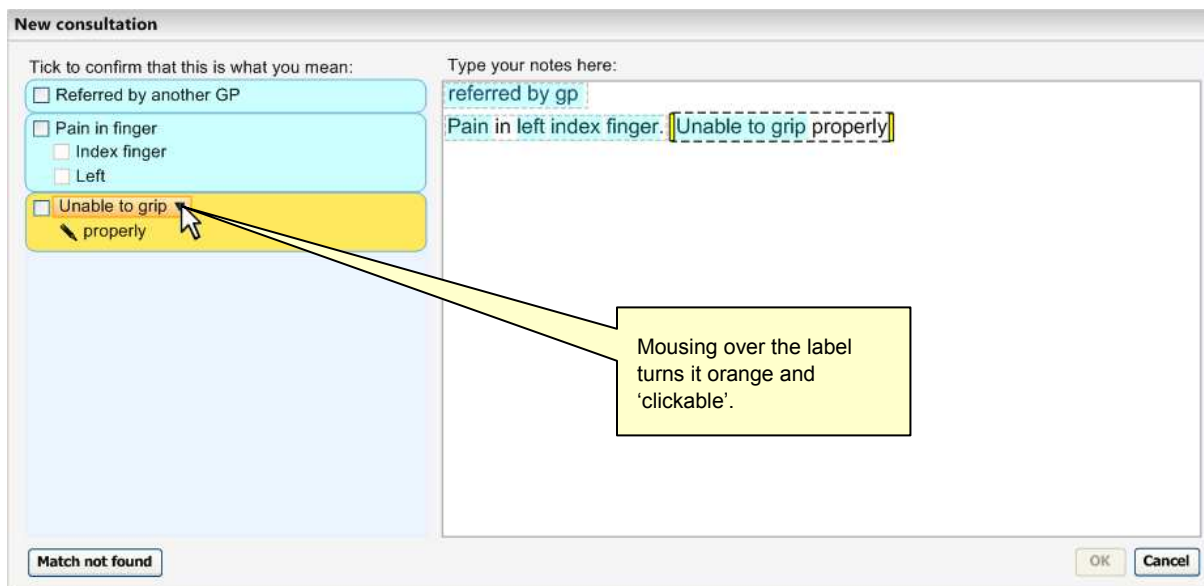


Figure 42: User Moves Mouse onto Label which Turns Orange and Clickable

The user then clicks the label which reveals a list of alternative matches, and a field into which they may adjust the input text (using progressive matching). See Figure 43.

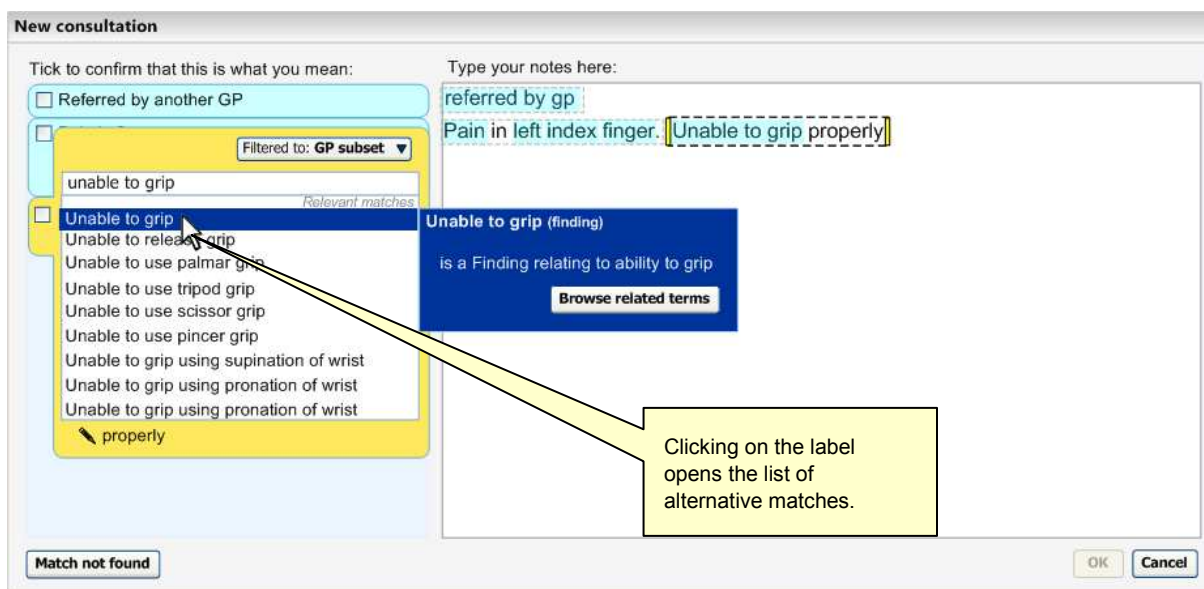


Figure 43: User Clicks on Label to Reveal Alternative Matches

The user may move the mouse down the list (which alters the content of the fly-out) and select an item by clicking on it. See Figure 44.

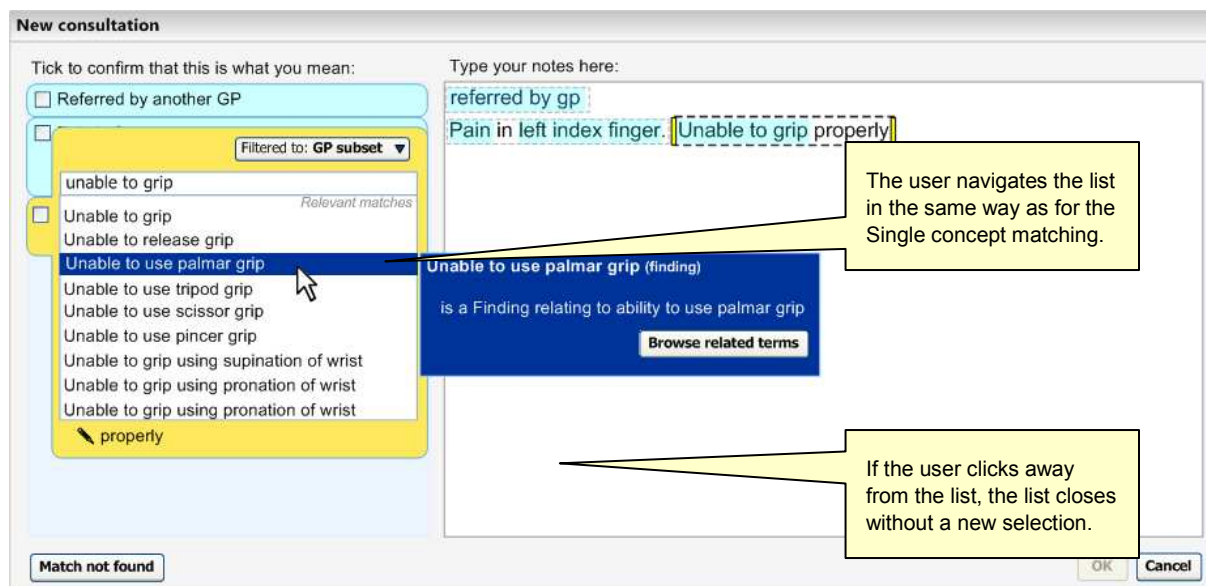


Figure 44: User Moves Mouse Down the List

Selecting an item from the list closes the expanded list view and automatically confirms the match. See Figure 45.

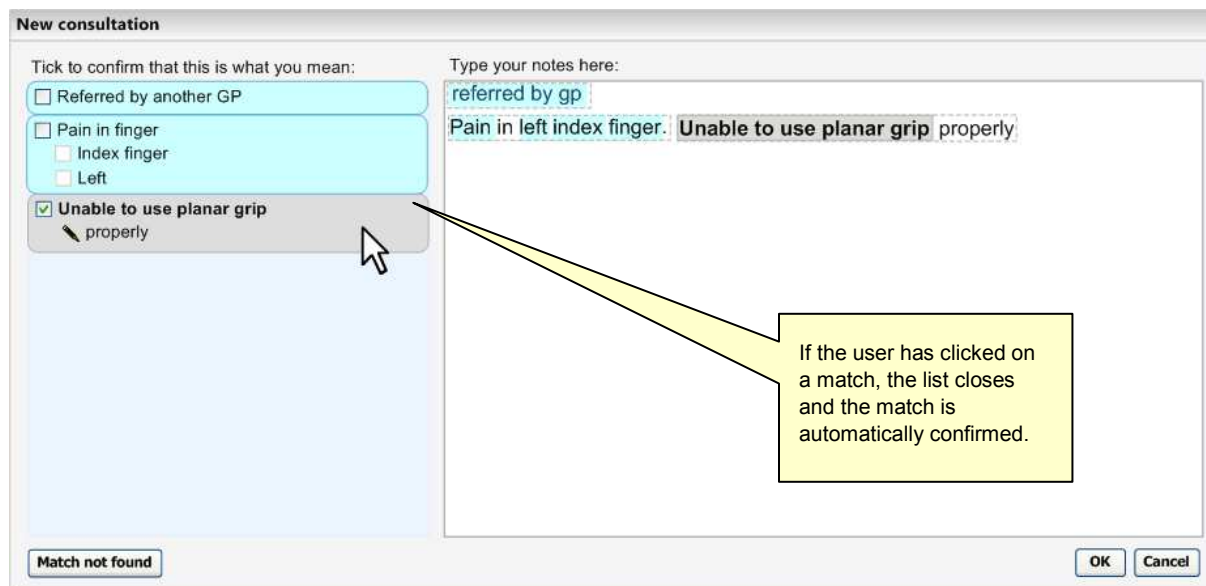


Figure 45: Clicking on a List Item Closes the List and Confirms the Match

### 2.3.3.1 *Guidance*

The system:

- Must allow the user to confirm, or not confirm suggested matches
  - Should provide the user with a clear confirmation control for each suggested match
    - Should feature a check box to enact confirmation
- Must allow the user to view the full list of matches for each suggested match
  - Should allow the user to view this full list by clicking on the relevant match label
    - Could display the relevant match label in orange and emboss it when the user moves the mouse over it, in order to communicate that it is clickable
- Must clearly display which match the user has selected
  - Could highlight the suggested match area in yellow when the user moves the mouse over it
  - Should display 'drop-down' arrows next to each of the labels in the highlighted area to indicate that there are more matches available
- Should ensure that the highlight in the left hand 'suggested matches' area is reflected by the focus in the text input area. Clicking on a suggested match highlights that area and also moves the focus to the corresponding text in the text input area
- Should replace the original text in the text input area with the relevant SNOMED-CT concept label (which will be either a 'Preferred term' label or 'synonym' label) upon confirmation
- Should only enable the confirmation control if there are no unselected mandatory elaboration fields associated with the match
- Should disable the confirmation control if there is an alternative match that has the same spelling as the top match. The user must view the expanded list of matches prior to confirmation
- Must warn the user where there are very similar matches or matches that are 'children' of the top match

### 2.3.3.2 *Benefits and Rationale*

The system must encourage the user to confirm the matches before saving the note to record, and must feature appropriate controls for doing this. A vertical stack of check boxes is a clear and easy way of doing this, and this follows the standard 'checklist' metaphor. User testing has confirmed that clinicians understand this.

Also, the system must allow users to view the alternative matches as the top match may not be appropriate, and this could have safety implications if it is wrong. Again, user testing has supported this guidance.

Although user testing has shown that users understand the process of ticking the boxes to confirm matches, this has not been tested with an interactive prototype. Therefore, further usability testing is expected, which may result in potential updates.



### 2.3.3.3 Confidence Level

#### High

- Must allow the user to confirm, or not confirm suggested matches
- Must allow the user to view the full list of matches for each suggested match
  - Should allow the user to view this full list by clicking on the relevant match label
    - Could display the relevant match label in orange and emboss it when the user moves the mouse over it, in order to communicate that it is clickable

#### Medium

- Should provide the user with a clear confirmation control for each suggested match
  - Should feature a check box to enact confirmation
- Must clearly display which match the user has selected
  - Could highlight the suggested match area in yellow when the user moves the mouse over it
  - Should display 'drop-down' arrows next to each of the labels in the highlighted area to indicate that there are more matches available
- Should ensure that the highlight in the left hand 'suggested matches' area is reflected by the focus in the text input area. Clicking on a suggested match highlights that area and also moves the focus to the corresponding text in the text input area
- Should replace the original text in the text input area with the relevant SNOMED-CT concept label (which will be either a 'Preferred term' label or 'synonym' label) upon confirmation
- Must only enable the confirmation control if there are no unselected mandatory elaboration fields associated with the match

### 2.3.4 Dealing with Abbreviations

The system looks for matches in synonyms, including abbreviations, from within SNOMED-CT. When the user types in an abbreviation; the resulting abbreviation is shown with the Fully specified name (FSN) and its hierarchical parents (see Figure 46).

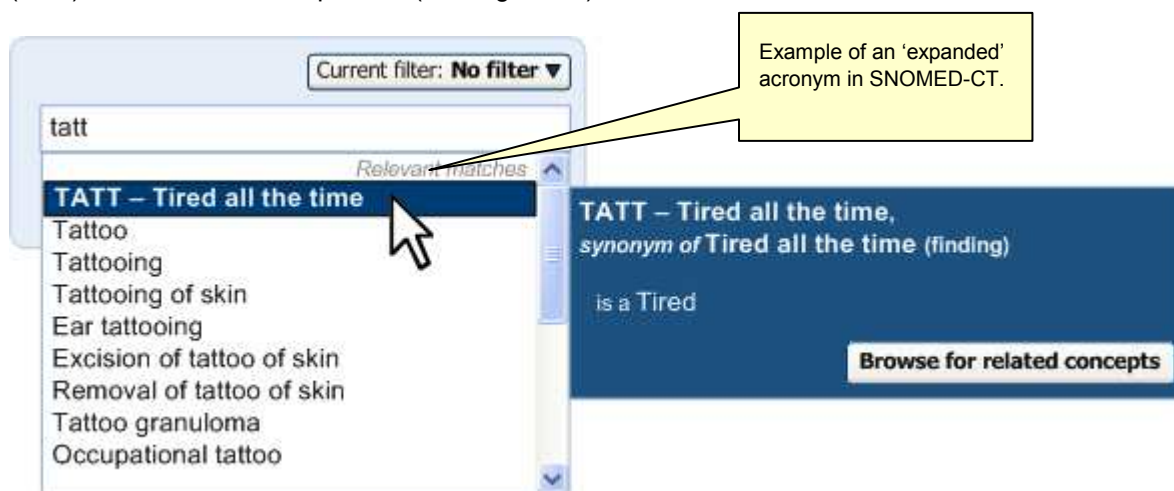


Figure 46: Displaying Abbreviations



The use of abbreviations and acronyms does introduce further risk that the user selects the wrong concept because:

- Some abbreviated terms in SNOMED-CT do not feature the expansion in the label
- In a number of instances multiple concepts share the same abbreviation or acronym

In the worst cases, there are abbreviations/acronyms for multiple concepts which do not feature the expansion in their labels. For example there are two 'SLE' acronyms in SNOMED-CT that do not have any further text in their labels. One is a synonym for the disorder, 'Systemic lupus erythematosus' (ConceptID 55464009), while the other is a synonym for the disorder, 'Neuroinvasive St. Louis encephalitis virus infection' (ConceptID 417607009). In these cases, the meaning of the acronym only becomes apparent in the Fully specified name (FSN). Therefore, the system must always display these matches with the synonym name and the FSN (minus the reference to the high-level category, such as 'disorder) in a combined label (see Figure 43). This combined label will also be displayed in the right-hand noting area upon confirmation.

Where there are two acronyms/abbreviations with the same spelling, the mechanism for dealing with same-spelling matches will apply (see Figure 32).

However, there are a few cases where the acronym does not need to be expanded, as in the case of 'Laser'. These would be excluded from the list of those acronyms/abbreviations that require the FSN in the label.

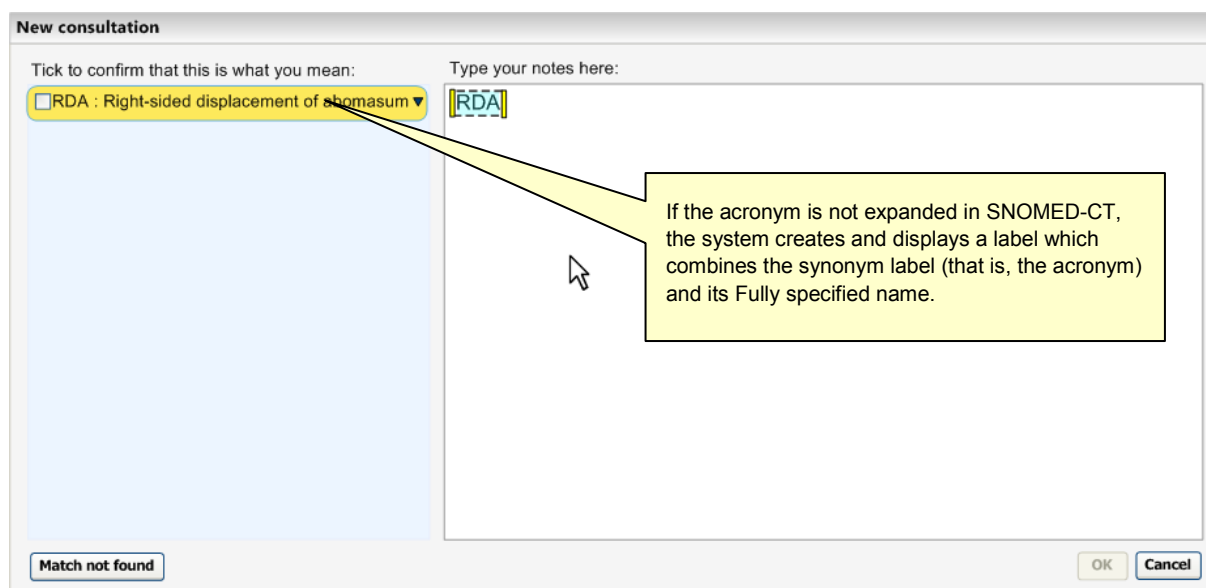


Figure 47: System Forces the User to View the Acronym Definition Prior to Confirming it

### 2.3.4.1 Guidance

The system:

- Must allow users to search using SNOMED-CT abbreviations in the same way as for any other synonym
- Must allow the user to search on an abbreviation in both the 'single concept' and 'text parser' approaches
- Should not treat abbreviations as case sensitive (that is, treat 'TATT', 'Tatt' and 'tatt' as equivalent entries)
- Should display both the abbreviation and FSN in the fly-out (as with other SNOMED-CT synonyms)
- Must display a combined label of both the acronym and the FSN in those instances where the acronym is not expanded in the synonym label
  - Must render the combined acronym/FSN label in the right-hand text input area upon confirmation of the match (this applies only to the text parser approach)

### 2.3.4.2 How to Use the Design Guidance

Usage	Format	Example	Comments
✓	Always expand the abbreviation in the search results list and in the modifier dialog	See Figure 46	The user must be made aware of the full term to avoid mistakenly choosing an incorrect concept
✓	Ensure that abbreviations are always written in capital letters and in bold	See Figure 46	This ensures that they are prominent, distinct from normal concept labels and consistently formatted

Table 12: How to Use the Design Guidance

### 2.3.4.3 How Not to Use the Design Guidance

Usage	Format	Example	Comments
✗	Do not force the user to type in the abbreviation in capital letters even though they are displayed by the system in capitals. Mixed or lower case letter combinations should be recognised too	n/a	This allows an efficient interaction, in that it does not force the user to capitalise letters

Table 13: How Not to Use the Design Guidance

### 2.3.4.4 Benefits and Rationale

Users should not be penalised for using abbreviations recognised by SNOMED-CT, therefore abbreviations should be treated in exactly the same way as other terms and synonyms.

In recent testing, several users were 'pleasantly surprised' by the abbreviation recognition provided by SNOMED-CT (by way of synonyms), and it is imperative that the user interface does not obstruct this recognition.

### 2.3.4.5 Confidence Level

Although not specifically tested in wireframe testing, we are confident that, as this method of input and matching is essentially the same as for matching unabbreviated terms in SNOMED-CT, the good response users gave the vanilla matching can translate to matching abbreviations.

#### High

- Must allow users to search using SNOMED-CT abbreviations in the same way as for any other synonym or preferred term
- Must allow the user to search on an abbreviation in both the 'single concept' and 'text parser' approaches
- Should not treat abbreviations as case sensitive (that is, treat 'TATT', 'Tatt' and 'tatt' as equivalent entries)
- Should display both the abbreviation and FSN in the fly-out (as with other SNOMED-CT synonyms)

#### Low

- Must display a combined label of both the acronym and the FSN in those instances where the acronym is not expanded in the synonym label
  - Must render the combined acronym/FSN label in the right-hand text input area upon confirmation of the match (this applies only to the text parser approach)

### 2.3.5 'Undoing' Matches

The user may 'undo' confirmed matches, before they are saved to record, by either:

- Double-clicking on the appropriate concept text in the text entry field. This will open up the appropriate encoding dialog with the confirmation check box deselected, or
- Unselecting the check box next to the appropriate match in the 'Suggested matches' column

The system should provide 'undo' and 'redo' buttons that will undo the last matching or parsing action.

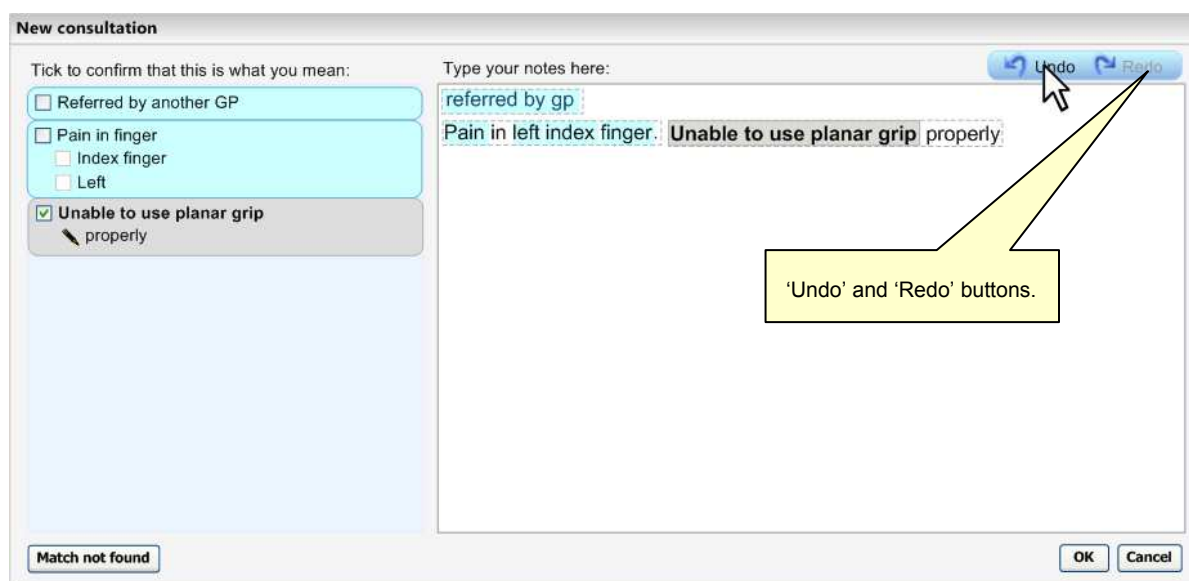


Figure 48: Undo and Redo Buttons (Top Right Hand Corner)

### 2.3.5.1 *Guidance*

The system:

- Must allow users to undo the confirmation of a matched expression
  - Should allow the user to undo a confirmed match by deselecting the appropriate check box
  - Should allow the user to undo a confirmed match by clicking on the appropriate text in the text input area
- Must return the text to its original form upon un-confirming a matched expression
- Must provide an 'undo' and 'redo' function which undoes the effects of the last send matching request
  - The controls should be visible from the main window

### 2.3.5.2 *Benefits and Rationale*

It is good practice to feature an 'undo' function, and users will expect it, given its prevalence in most office-based software packages. Users should also have the opportunity to un-confirm a confirmed item before saving it to record.

### 2.3.5.3 *Confidence Level*

#### *High*

- Must allow users to undo the confirmation of a matched expression
  - Should allow the user to undo a confirmed match by deselecting the appropriate check box
  - Should allow the user to undo a confirmed match by clicking on the appropriate text in the text input area
- Must return the text to its original form upon un-confirming a matched expression

#### *Low*

- Must provide an 'undo' and 'redo' function which undoes the effects of the last send matching request
  - The controls should be visible from the main window

## 2.4 *Context*

Context plays an important role in any kind of clinical noting. In this section, we refer to context in two distinct ways:

- Context as a giver of meaning to an encoded concept ('semantic context')
- Context as a filter for improving searches for concepts or for preventing erroneous matches

These two interpretations of the term 'context' are distinct, but in certain ways, they can be handled using similar mechanisms in the user interface.

## ***Semantic Context***

The context in which the user has written the note will affect the meaning of the note, and so it is important that this context is made explicit, both at the point of encoding and at the point of retrieval.

For example, if the clinician were to record the concept 'Aspirin', it would not mean much in clinical terms. However, if they recorded this in a field marked 'Does the patient suffer from any drug allergies?', they would assume that the patient suffers from a drug allergy, the causative agent being the analgesic.

In this instance, it would be meaningless to save the code for the substance 'Aspirin' (ConceptID 387458008) by itself. Instead, the system must record the implication that the substance is the causative agent of the allergy which is suffered by the patient. This would require a post-coordinated expression, such as:

Allergic reaction to drug (ConceptID 416093006 ) | Has causative agent (ConceptID 246075003) | Aspirin (ConceptID 387458008).

This expression is canonically equivalent to 'Aspirin allergy' (ConceptID 293586001)

Also, there may be other specific circumstances when a concept is modified by context-attributes. These may be set by:

- The nature of the modifying clinical expression
- The placement of the concept within a record, document or message component
- Default context value settings

## ***Context As a Filter***

The large number of concepts in the SNOMED-CT Terminology means that restricting the search according to context will reduce the load on the user; it should make it easier for the user to get to the desired concepts that they wish to articulate by avoiding many irrelevant concepts. Sometimes context must be imposed. For example, in a field for entering details of an allergy, the clinician should be prevented from entering anything other than an allergen or an allergy (and if they do enter an allergen, the system must ensure that this is saved as a post-coordinated expression with the concept of 'allergy').

The system would do this by reducing the number of results presented to the user and by providing a basis for prioritising the search results. This prioritisation would help users to differentiate synonyms, by promoting the most relevant synonyms up the results list.

Context also allows the system to further reduce the load on the user by selecting and suggesting default values (during the 'elaboration' steps of the interaction).

The context of an encoding interaction depends on a number of factors, each of which may affect the way in which the system filters and presents search results, these are:

- The corporate requirements (for example, different clinical practices may have different requirements for encoding)
- The clinical specialities (for example, a diabetes clinic versus a casualty department)
- The healthcare provider (for example, a consultant versus a general practitioner)
- The patient (for example, an infant versus a patient suffering from chronic heart disease)

- The note-taking task (for example, describing family history versus describing planned procedures)

These context descriptors may be set by the system or by the user. For example, when a user enters notes under a 'Family history' heading, the system may automatically adjust the context accordingly. Equally, the user could restrict the context by choosing to search only for 'symptoms' rather than for the full range of options.

### 2.4.1 Optimising Matching by the Use of Contextual Limitation

In the text parser approach to matching (see Figure 49), the design allows the user, or the workflow, to set the context for matching through the use of 'clerking headings'.

The screenshot shows a 'New consultation' window. On the left, under 'Tick to confirm that this is what you mean:', there is a list of checkboxes: 'Referred by another GP', 'Allergy' (with a sub-item 'House mite'), 'Abdominal pain', 'Vomiting', 'Diarrhoea', 'Fever', and 'No rash' (which is highlighted in yellow). On the right, under 'Type your notes here:', there is a text input area containing the following text: 'referred by gp', 'Allergies ▾', 'mite', 'Presenting complaint ▾', 'abdom pain, vomiting, diarrhoea', 'On examination ▾', and 'Fever, [no rash]'. A yellow callout box points to the 'Allergies' and 'Presenting complaint' headings, stating: 'Clerking headings that filter and provide meaning for the matches below them. The control for inserting these headings (either by the user or by the workflow) is currently undefined.' At the bottom left of the window is a 'Match not found' button, and at the bottom right are 'OK' and 'Cancel' buttons.

Figure 49: Clerking Headings

The user may view which subset of filters apply to the matches by clicking on the clerking heading (see Figure 50). They may adjust the control by expanding the subset to a higher level. However, if such 'nested' subsets are not available, the system will present a binary choice of 'Filter' or 'No filter' (see Figure 51).

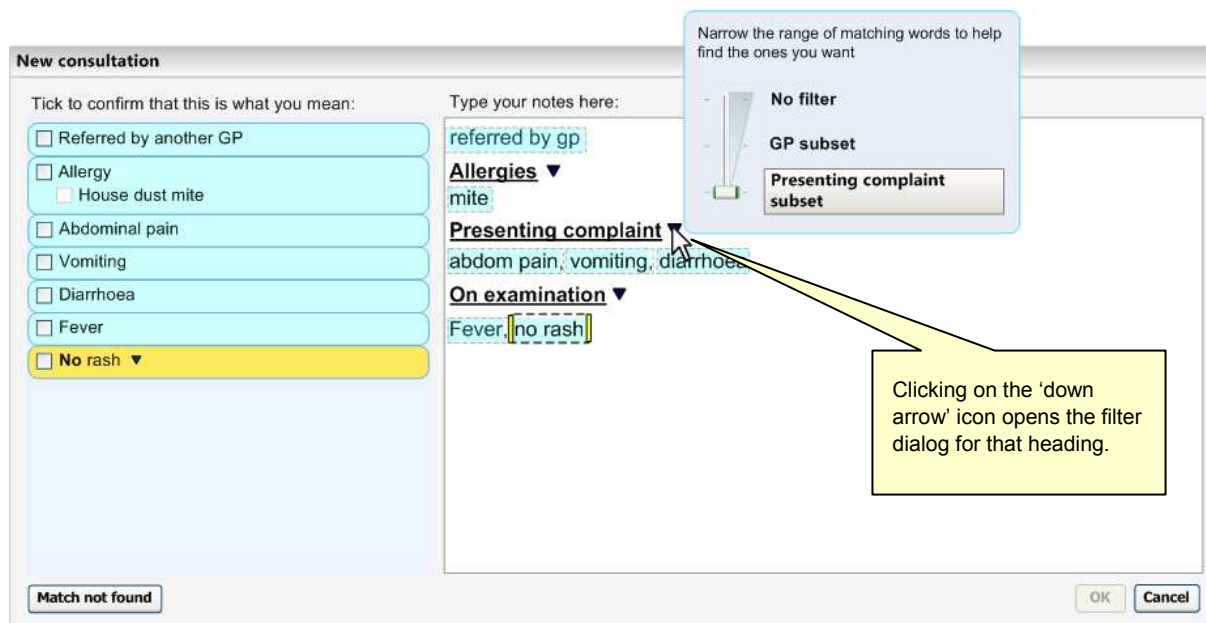


Figure 50: Subset Control

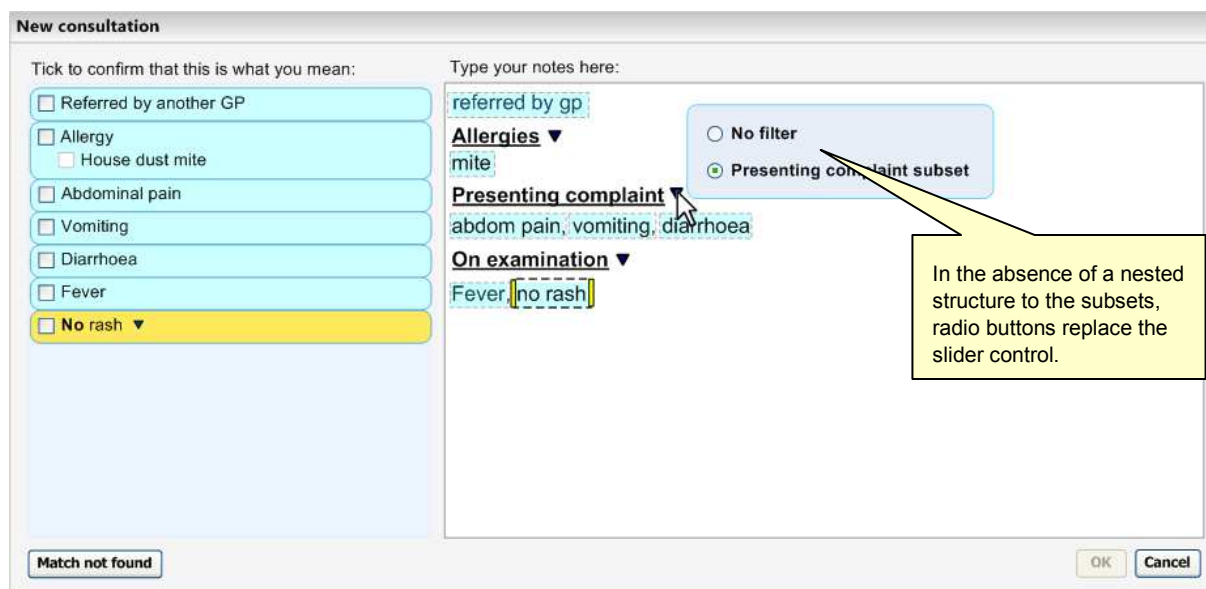


Figure 51: Binary Subset Control

In the single concept matching approach, the system will display the subset which is being applied in a button above the matching entry field (see Figure 52). The label will contain part, or all, of the 'human readable' label of the subset. If the subset label exceeds 20 characters, it should be truncated at the end and feature an ellipsis ('...').

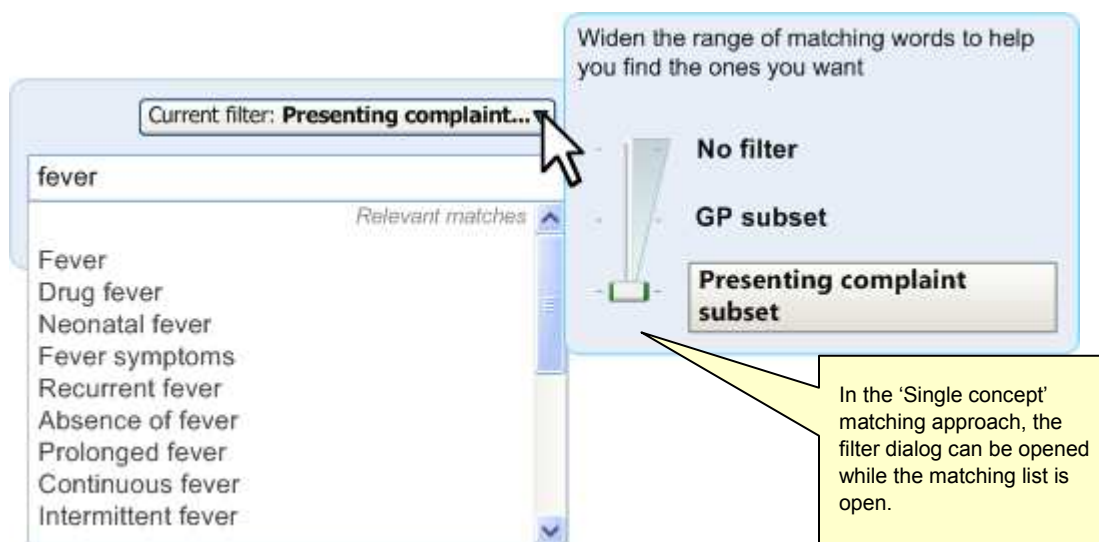


Figure 52: Subset Filter Control for the Single Concept Matching

The subset control features instructional text to communicate to the user what they can do with the control (see Figure 52). This text changes depending on the setting that the user has chosen (see Figure 53).

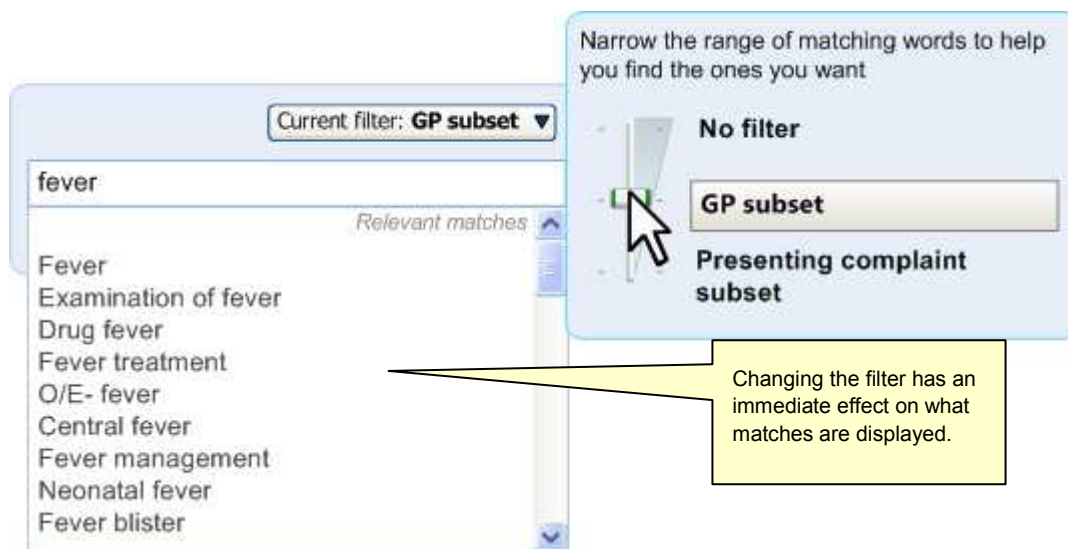


Figure 53: Subset Filter Control: 'GP subset' Selected

As shown in the examples above, the user may adjust the control when the list of alternative matches is being displayed. When the user adjusts the control, the list automatically updates, possibly revealing or hiding match options.



Additionally, the system will reorder the matches list according to a 'common matches' subsets. It will split the matches list with a line, and appropriate headers within the list (see Figure 54).

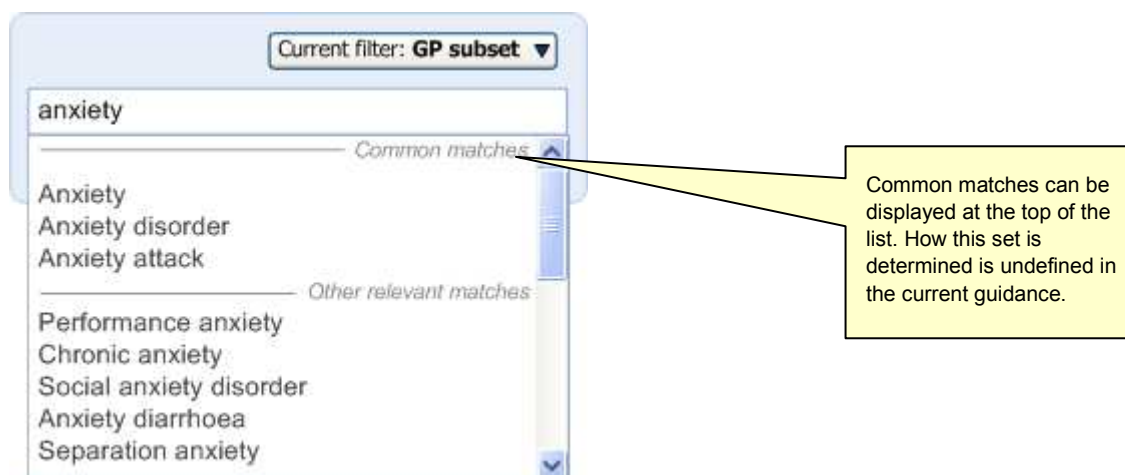


Figure 54: System Distinguishes Common Matches and Pushes Them Up the List

In addition to these specific filters, a number of global subsets should also apply: the 'Core' set of SNOMED-CT terms, plus UK extension components, filtered by the UK language set. Additionally, the only concepts to be included will have a status of 'current' or 'pending move'.

Also in the text parser approach (as stated in section 8), the system will filter the matches to certain top-level categories and their attributes (which could be drawn from anywhere in the hierarchy). Typically, these 'base' concepts will be 'Clinical findings', 'Procedures', 'Observable Entities' and 'Situations with explicit context, but this filter may change according to the necessary context (for example, to include 'Events' as well).

#### Note

This solution requires the creation of appropriate subsets and contextual 'hooks' to be defined.

The system will also appropriately post-coordinate those concepts which derive part of their meaning from the heading under which they are written, such as when 'Aspirin' is written under the heading 'Allergies'. The system will display the simplest post-coordination solution; in this case, the base concept 'Allergies' and the attribute value, 'Aspirin'. The system will not display the attribute name (in this case, 'Has causative agent').

However, there may be cases where the base concept and attribute value labels are insufficient, and therefore further research and user testing should be conducted in this area (see section 3).

### 2.4.1.1 Guidance

The system:

- Must filter the concepts considered during the matching process, by subsets, where such subsets are available
- Must allow users to adjust the subset filters
- Could provide a control next to the clerking headings and above the encoding dialog matching input field
  - Should feature an '▼' icon to open the subset control
  - Must not obscure the listed matches with the control
  - Must display the subset control level with or above the header label, in order to reduce the risk that the control obscures the relevant text
  - Should feature a slider control if there is a linear relationship between the subsets, that is, if the subsets are logically nested
  - Must not display more than three levels of subsets
  - Should not feature a slider control if there is no relationship between the subsets
  - Must feature appropriate instructional text within the control that explains to users what they may do with the control and why they would want to use it
    - Could feature dynamic instructional text that changes depending upon which level of subsets is currently chosen
  - Could display further information, if such information is made available, about the subset if the user clicks on the subset label in the subset control
  - Should close the subset control dialog if the user clicks away from the dialog area
- Could refer to limiting matches by subsets such as 'Filtering'
- Should ensure that adjusting the subset filters has an immediate effect on the matches displayed
- Must display the 'human readable' labels for the subsets.
  - Should truncate those labels on the subset button which exceed the button size (without wrapping) and feature an ellipsis ("...")
  - Should display the full 'human readable' labels within the subset control
- Must allow multiple subsets to apply simultaneously, if appropriate
- Should provide a listing of matches from a 'common matches' subset, that is, push them to the top of the matching list
  - Should distinguish between 'common' and other matches in the list (where common matching applies)
- Should only display clerking headings in the text input area
- Must appropriately post-coordinate those concepts which derive part of their meaning from the heading under which they are written

- Should display the simplest post-coordination solution, that does not, for example, feature soft status defaults (for example, status of a finding or procedure) that have not been modified by the user
- Must filter matches to the 'Core' set of SNOMED-CT terms, plus UK extension components
- Must filter to the UK language set
- Must only match concepts that are 'current' or 'pending move'.

### **2.4.1.2 Benefits and Rationale**

Users should be able to adjust the subsets in those situations where they cannot match what they want under the current subset. It is important that the system clearly communicates what subset filter is being currently applied, so that the user is aware of why the system is matching as it is.

In recent testing, users seemed to understand the notion of subsets and understood that certain concepts would not be made available in certain concepts.

The subset control must be located in a prominent position. In previous designs where the subset control was featured immediately below the list, users often did not see it. Therefore, the system must display the control in a highly visible location. Positioning it immediately above the text entry field also mirrors the use of clerking headings, thus employing a consistent layout of related features (that is, subset controls and headings).

Test results indicated that the subset control must also give an indication of the current subset filter affecting the matching. For example 'Current filter: Lifestyle and Allergens' was understood, and preferred to a label that simply read 'Filter = On'.

Also, in tests, all users who were questioned indicated that they grasped the idea of the slider control. It was preferred to two other alternative designs. However, they were not sure if they were supposed to narrow or widen the matching scope. Therefore, appropriate labelling is necessary to give users confidence to adjust these settings.

In recent testing, 75% of users who commented on the 'common matches' versus 'other relevant matches' design feature, immediately understood its presentation. All users who commented on it also thought that it was sensible to feature the most common match results at the top of the list.

Clerking headings is a common noting tool used by clinicians, especially those working in Secondary Care.

Please note that the latest version of this guidance has not undergone rigorous user testing. Therefore, further usability testing is expected, which may result in potential updates. It is also worth noting that the nature, and potential usage, of the subsets that will be available over the coming years is not fully defined. Therefore, the guidance may need to be adapted once this picture is clearer.

### 2.4.1.3 *Confidence Level*

#### *High*

- Must filter the concepts considered during the matching process, by subsets, where such subsets are available
- Should ensure that adjusting the subset filters has an immediate effect on the matches
- Should feature an '▼' icon to open the subset control
- Must not obscure the listed matches with the control
- Must display the subset control level with or above the header label, in order to reduce the risk that the control obscures the relevant text
- Should not feature a slider control if there is no relationship between the subsets
- Must filter matches to the 'Core' set of SNOMED-CT terms, plus UK extension components
- Must filter to the UK language set
- Must only match concepts that are 'current' or 'pending move'.

#### *Medium*

- Must allow users to adjust the subset filters
- Should provide 'velocity' listing of matches from a 'common matches' subset, that is, push them to the top of the matching list
  - Should distinguish between 'common' and other matches in the list (where common matching applies)
- Should feature a slider control if there is a linear relationship between the subsets, that is, if the subsets are logically nested
- Must feature appropriate instructional text within the control that explains to users what they may do with the control and why they would want to use it
  - Could feature dynamic instructional text that changes depending upon which level of subsets is currently chosen
- Should close the subset control dialog if the user clicks away from the dialog area
- Could refer to limiting matches by subsets as 'Filtering'
- Must display the 'human readable' labels for the subsets
  - Should truncate those labels on the subset button which exceed the button size (without wrapping) and feature an ellipsis ("...")
  - Should display the full 'human readable' labels within the subset control
- Must allow multiple subsets to apply simultaneously, if appropriate

**Low**

- Could provide a control next to the clerking headings and above the encoding dialog matching input field
- Should only display clerking headings in the text input area
- Could display further information, if such information is made available, about the subset if the user clicks on the subset label in the subset control
- Must not display more than three levels of subsets
- Must appropriately post-coordinate those concepts which derive part of their meaning from the heading under which they are written
  - Should display the simplest post-coordination solution that does not, for example, feature soft axial modification defaults that have not been modified by the user

**2.5 Refinement****2.5.1 Refining a Selected Concept**

In addition to viewing possible SNOMED-CT matches for a text input, the system will also offer the user the opportunity to refine a selected concept by browsing (and selecting) concepts that are hierarchically related in the following ways:

- Parents of the selected concept
- Children of the selected concept
- Siblings of the selected concept (that is, the children of the concepts' parents)

This will allow the user to select a more general or more specific instance of the concept. This could be very useful in allowing the user to precisely express their notes. It will be especially important when users are learning the SNOMED-CT terminology or they are noting in an unfamiliar topic area, as they may not be aware of what terms they can match. As they become more familiar with the terminology, they will be less likely to want to refine concepts as they will type in more precise terms in their notes.

However, this will also expose users to the SNOMED-CT hierarchy, which is not particularly user-friendly, in that there may be areas of it which do not fit with the user's concept of semantic relationships between concepts. This means that, without proper safeguards, the user could get lost within the hierarchy. It is for this reason that hierarchy browsing is not the primary method of concept matching, but should be available for those instances where the user cannot find what they want, or are unsure about the precise labelling of what they want. In the design, we have hidden this feature so that the user is not exposed to it immediately. Instead the user is firstly presented with top matches, then they can choose to view alternative matches and finally they can choose to browse the hierarchy itself.

We will also be allowing the user to refine attribute values, which refer to the defining concepts that comprise a fully defined SNOMED-CT concept. So, for example, the user may refine the body structure that is the site of a procedure. This is important, given that, in many cases there will not be an available pre-coordinated term for these refinements.

This refinement process is relevant to both the text parser and single concept approaches.

The user will be able to access the refinement controls by clicking a button in the selected concept's fly-out panel. This will open a modal dialog that appears over the top of the encoding dialog. This dialog will provide lists of the parents, siblings and children of the selected concept.

In the example below (Figure 55, Figure 56, Figure 57, Figure 58, Figure 59 and Figure 60) the user clicks on the suggested match to open the expanded list view. They then click on the 'Browse for related concepts' button in the fly-out. This opens the navigation dialog, from which they may browse for related concepts.

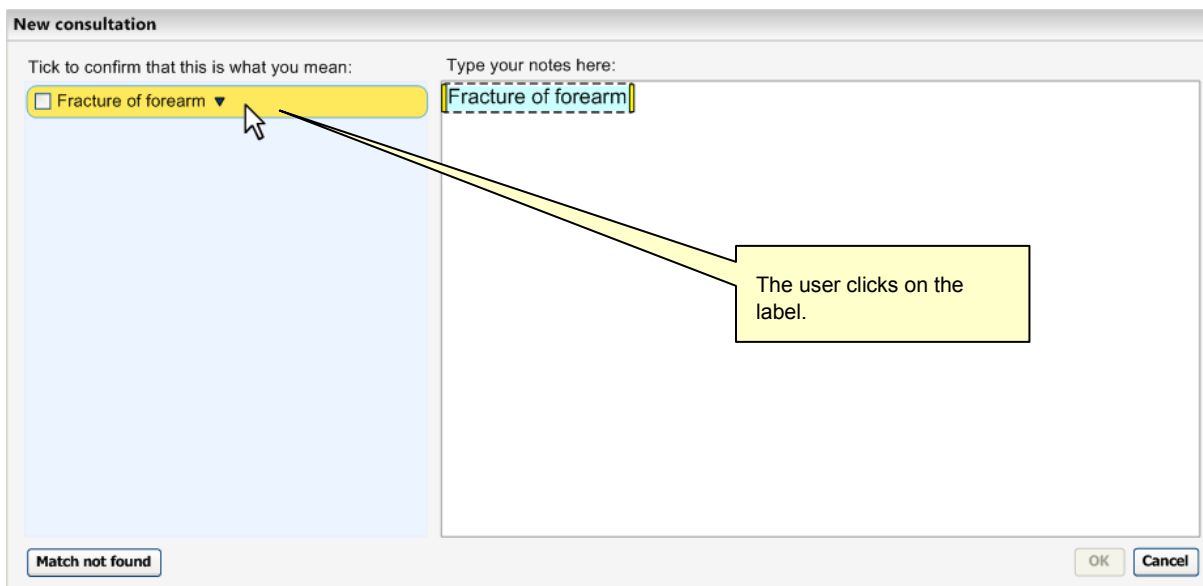


Figure 55: User Moves Mouse Over the Match They Wish to Refine

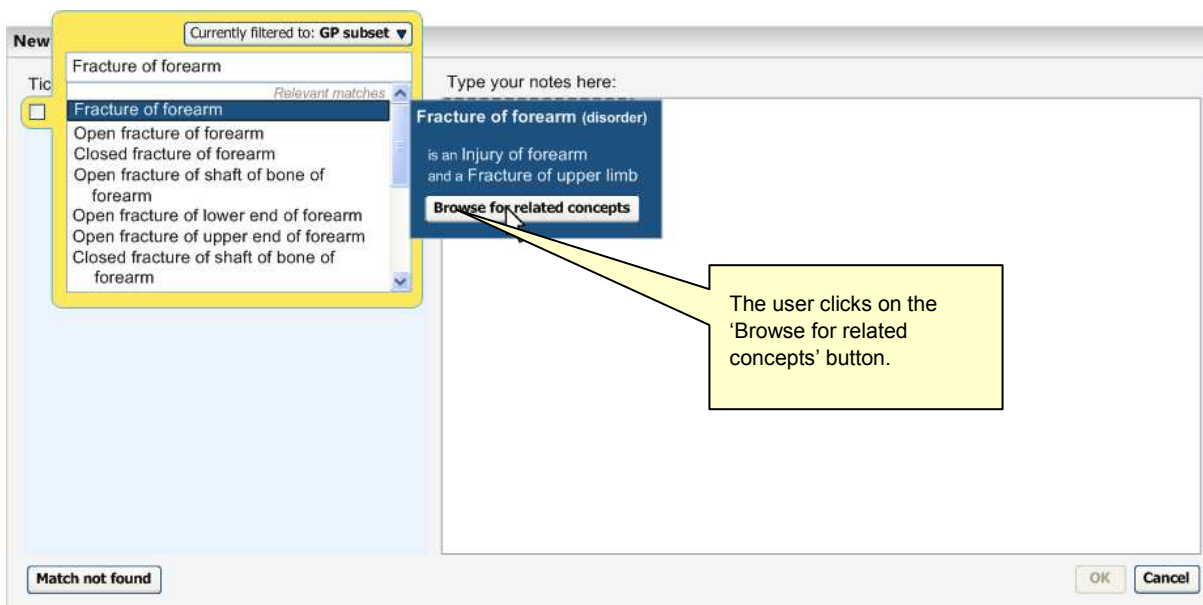


Figure 56: User Clicks on the 'Browse for related concepts' Button

The navigation dialog shows three columns (see Figure 57). The far left column displays the parents of the selected concept, the middle column displays the children of the parents (that is, the concept's 'siblings') and the far right column displays the children of the selected concept. Given the absence of any other logical ranking, all the items in each list are ordered alphabetically.

When the user selects a concept from the list, this concept becomes the 'selected' concept. When the user clicks 'OK', the dialog closes (along with the expanded list view) and the selected concept is automatically confirmed.

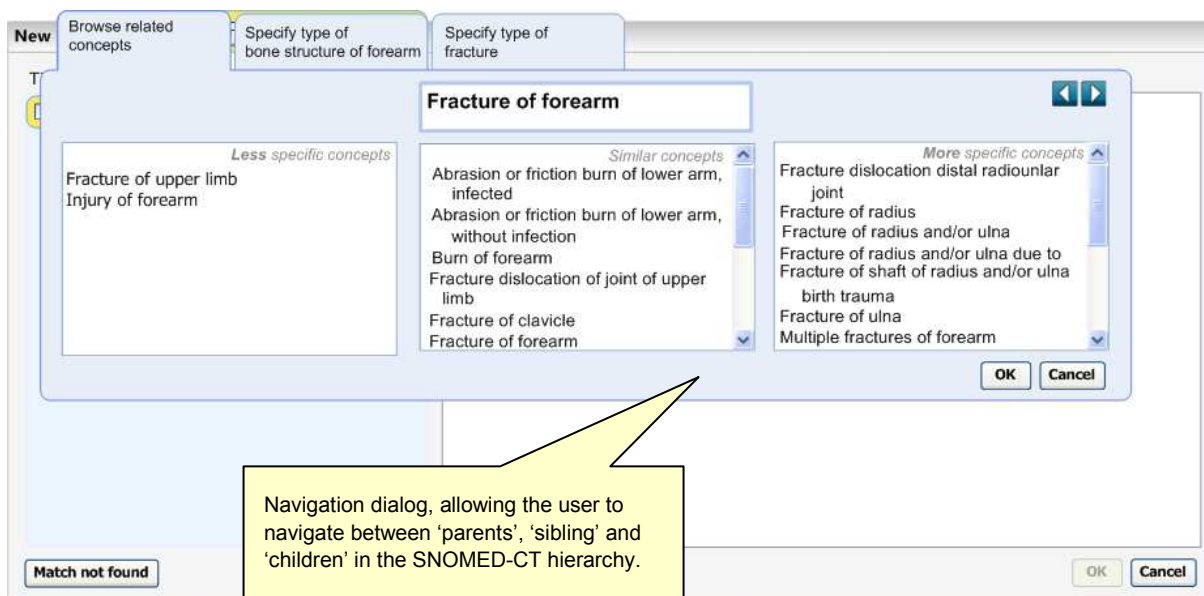


Figure 57: System Displays a Navigation Dialog

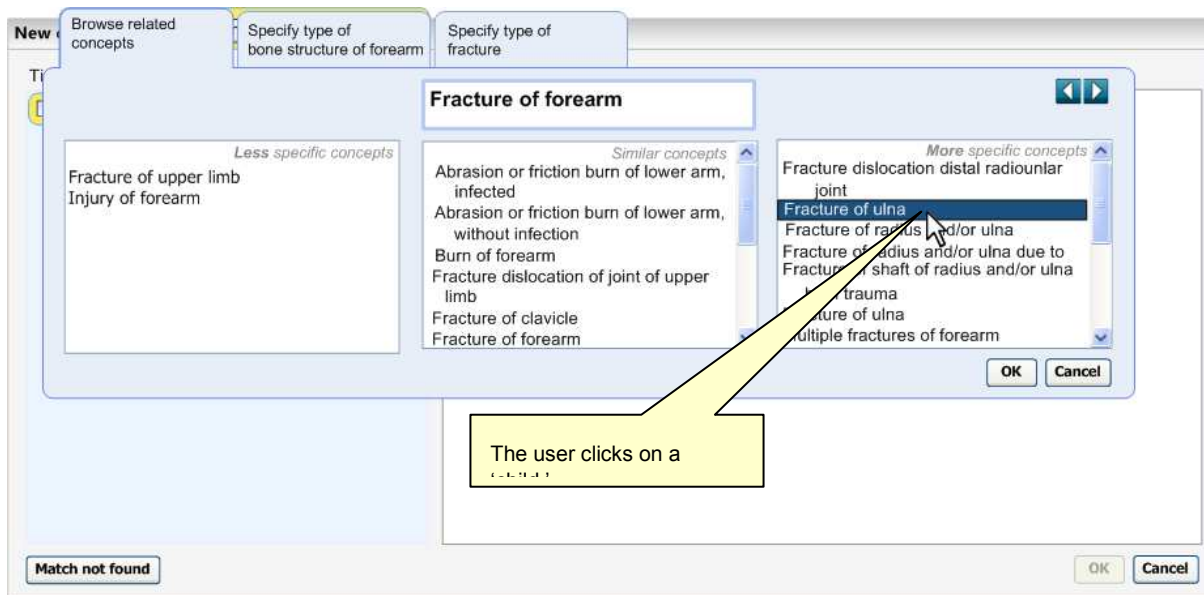


Figure 58: User Selects 'Fracture of ulna'

The user may also refine the defining attributes of a selected concept (if the concept is 'fully defined' rather than 'primitive'). For example, in the case of the concept 'Fracture of forearm', the user may refine either of its attributes: the associated morphology, 'Fracture', and the finding site, 'Bone structure of forearm'.

The design allows them to do this by clicking on the appropriate tab and refining in the same way as for the concept itself. The refined concept appears in the 'selected' concept field with user-friendly attribute labels joining up the refined concepts; for example, 'Fracture, site of Bone structure of radius', where 'site of' is an attribute label.

Once the user has refined an attribute of the selected concept, the 'Browse related concepts' tab is hidden, as the user would not then be able to browse related concepts for the newly post-coordinated



selected concept. They can, however, navigate back to an earlier refinement using the 'Back' navigation button, to a point where the tab reappears.

Following selection and confirmation of a refined concept, if the user wants to re-open the encoding dialog, the input field will be blank by default, and only the refined concept will be displayed below it.

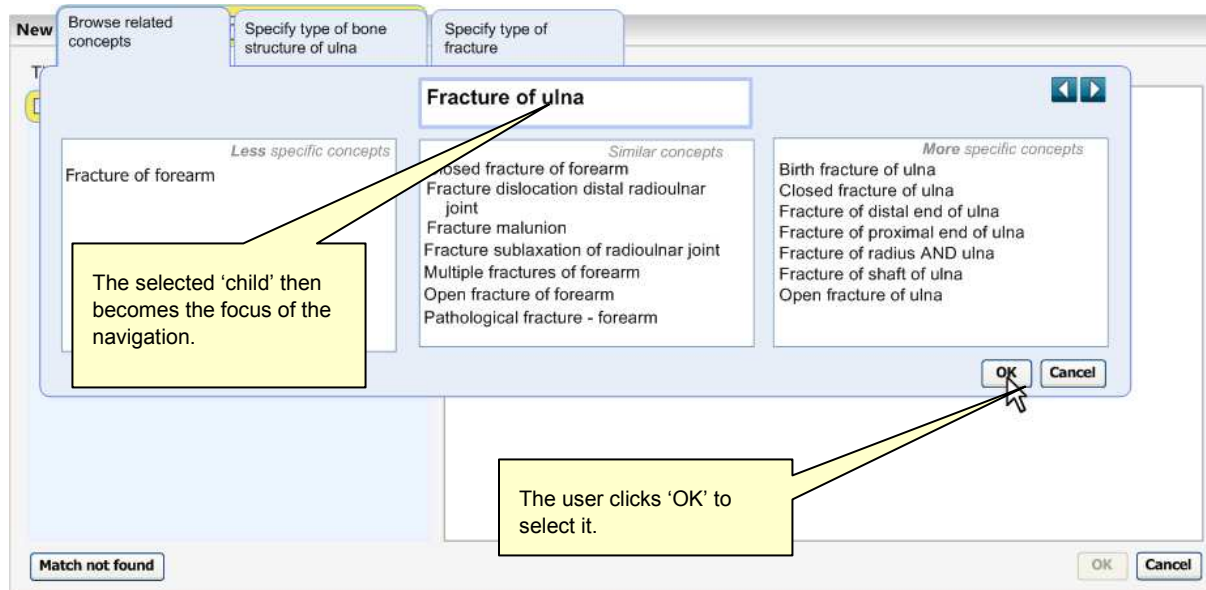


Figure 59: User Clicks 'OK' to Confirm This is the Term They Want

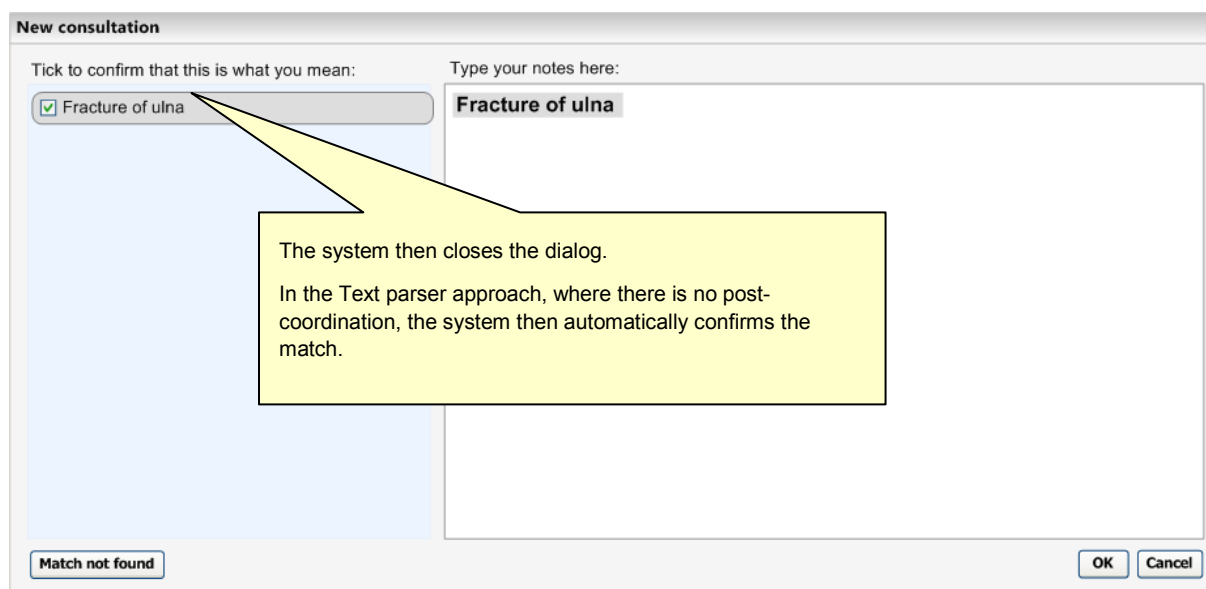


Figure 60: Selecting the Refined Item Closes the Expanded List and Confirms the Match

Double-clicking on a concept in the list selects that concept, and it will be displayed in the 'selected' text area (and will be the 'in-focus'). Clicking 'OK' will close the dialog and, if there are no outstanding mandatory fields, will confirm the selected (refined) concept and close the encoding dialog.



### 2.5.1.1 *Guidance*

The system:

- Must allow the user to navigate parts of the SNOMED-CT hierarchy
- Should only allow the user to access the SNOMED-CT hierarchy at the point of having selected a concept
- Must distinguish between the parents, siblings and children of a selected concept
  - Should feature a 'three list box' solution: a list for the parents, a list for the siblings of all parents and a list of the children
  - Must feature appropriate labels for each list box
  - Should order each list alphabetically
  - Must display the currently selected concept clearly
  - Should allow the user to double-click to select a concept and close the dialog
  - Could allow the user to build up a post-coordinated expression by refining the selected concept's attribute values from hierarchical lists
- If the user is browsing a concept that is part of a larger post-coordinated expression, [the system] must limit the hierarchy according to SNOMED-CT-allowed concept relationships. In other words, the system will only show a subset of the hierarchy, namely those concepts that can post-coordinate with the base concept

### 2.5.1.2 *Benefits and Rationale*

This navigation is a necessary feature in a small number of cases. We do not predict that it will be used much in everyday noting, but its presence may be useful in those cases where the user cannot find what they want using the normal matching process.

In testing, although users were unsure about the attribute refinement areas (which have been replaced by tabs in the current design), they did correctly guess that it might enable them to refine part of the concept.

Most users also felt that it is preferable to hide the navigation dialog unless it is specifically requested, as is the case in the current design. They felt that making this dialog visible too soon is overwhelming. As one user commented, 'initially it needs to be simple'. Also, presenting the users with the navigation dialog without the user's request, leads to users incorrectly thinking that they **must** refine the concept.

In tests, the users disliked the traditional 'tree' design, but instead preferred the 'three list boxes' approach. Regarding the 'three list boxes approach', most preferred to see them stacked vertically (or rather, diagonally). However, due to design constraints, this is not possible, but we are confident that the current 'three list box' design will be understood, particularly if each list box is well labelled.

Please note that the latest version of this guidance has not undergone rigorous user testing. Therefore, further usability testing is expected, which may result in potential updates. In particular, it would be useful to test whether users understand the display of 'step' siblings; that is, showing all the children of all the parents of a concept.

We would also suggest that further design development should be conducted into a design that provides a 'search' facility for refining attribute values (see section 3).

### 2.5.1.3 *Confidence Level*

#### *Low*

- Must allow the user to navigate parts of the SNOMED-CT hierarchy
- Should only allow the user to access the SNOMED-CT hierarchy at the point of having selected a concept
- Must distinguish between the parents, siblings and children of a selected concept
  - Should feature a 'three list box' solution: a list for the parents, a list for the siblings of all parents and a list of the children
  - Must feature appropriate labels for each list box
  - Must display the currently selected concept clearly
  - Should order each list alphabetically
  - Should allow the user to double-click to select a concept and close the dialog
  - Could allow the user to build up a post-coordinated expression by refining the selected concept's attribute values from hierarchical lists
- If the user is browsing a concept that is part of a larger post-coordinated expression, [the system] must limit the hierarchy according to SNOMED-CT-allowed concept relationships. In other words, the system will only show a subset of the hierarchy, namely those concepts that can post-coordinate with the base concept

Although some navigation designs have been tested with clinicians, further usability work would be required in order to raise the confidence level in this guidance.

### 3 NEXT STEPS

In this section, we briefly outline some areas of further design work that have been identified as logical next steps in the development of the guidance. Please note that this list is not exhaustive, but instead covers specific issues that were identified during the development of Release 4 design guidance.

- Test the 'similar matches' warning messages

Presenting the user with a message to warn them that similarly-worded matches have been found, in order to encourage users to click on the match and view its alternatives, has not been tested. An alternative solution is to force the user to view these alternative matches by automatically opening the full list when the user moves the mouse over the relevant confirmation checkbox. The efficacy and efficiency of either solution cannot be properly compared until both solutions have been tested with a sufficiently interactive prototype. For example, we need to find out whether users do actually notice the message and click further. Equally, we would like to find out whether the alternative 'hover-over' solution is considered too obtrusive and overwhelming by users.

- Consider a mechanism that allows users to search by word endings as well as by prefixes

Although prefix matching has an intuitive appeal, there may be situations where a clinician knows what word ending they want, but is unsure of the beginning of the word. In these cases, they would be better served by a mechanism that allows users to search by word endings. For example, the clinician may know that they are searching for an '...ectomy', but not know the precise wording of the beginning of the word. However, we need to better define these situations prior to developing any solutions.

- Review, and possibly develop, the concept of the 'exclusion list'

The notion of excluding very commonly occurring words, such as prepositions, has been shown to work, but only to a certain extent. In some situations this practice can result in legitimate matches not being found. Any further work in this area must be done in conjunction with the research into matching algorithms.

- Further disambiguation may be required for recording 'Pharmaceutical/Biological Products'

The recording of, and possible post-coordination of, concepts from within the category, 'Pharmaceutical/Biological Products' requires an additional layer of disambiguation that is specific to this category. For example, if the clinician has typed in the word 'Salbutamol', they must indicate whether they wish to:

- Prescribe this medication
- Indicate that they have administered this medication
- Record a history of administration of this medication
- Record that the patient has a supply of this medication, for example, at home

Not only will these contexts influence the meaning of the recorded concept and the way in which it could be post-coordinated, but in the case of prescription, the system may need to force the clinician to prescribe via an external prescription mechanism.

- User testing of possible expressions that could arise from post-coordinating concepts with axis modifiers

The issue of how to display modified concepts in close-to-user forms deserves further user testing.

- User testing of displaying 'step' siblings

Displaying 'step' siblings, that is, the hierarchical children of multiple parents of a concept is a relatively unknown practice and could result in a number of very different concepts being presented in a single list. Further research should be conducted to assess whether users understand them being presented in a single list.

- Develop a 'search' facility for attribute refinement

The notion of refining specific defining concepts was not fully understood by users in recent testing, and an alternative solution could involve a generic 'search for attributes' feature. This would require further design mechanisms to be developed and tested.

- Investigate the current use of and scope for guidance regarding keyboard shortcuts

The designs behind the guidance have been created so that they do not preclude a keyboard-only interaction. However, we have not specified any keyboard shortcuts within the guidance. The problem is that existing and planned clinical applications may employ keyboard shortcuts for a variety of uses. In order to avoid conflicts, we would need to gain an understanding of this usage and investigate the extent to which guidance can be provided regarding such keyboard-only shortcuts.

## 4 DOCUMENT INFORMATION

### 4.1 Terms and Abbreviations

Abbreviation	Definition
FSN	Fully Specified Name
SCT	Systematised Nomenclature of Medicine-Clinical Terms
SNOMED-CT	Systematised Nomenclature of Medicine-Clinical Terms
TLC	Top Level Concept
UI	User Interface

Table 14: Terms and Abbreviations

### 4.2 Definitions

Term	Definition
Current best practice	Current best practice is used rather than best practice, as over time best practice guidance may change or be revised due to changes to products, changes in technology, or simply the additional field deployment experience that comes over time.

Table 15: Definitions

### 4.3 Nomenclature

This section shows how to interpret the different styles used in this document to denote various types of information.

All content subject to completion, agreement or verification is denoted with **highlighting**.

#### 4.3.1 Body Text

Text	Style
Code	Monospace
Script	
Other markup languages	
Interface dialog names	<b>Bold</b>
Field names	
Controls	
Folder names	Title Case
File names	

Table 16: Body Text Styles

### 4.3.2 Cross References

Reference	Style
Current document – sections	Section number only
Current document – figures/tables	Caption number only
Other project documents	<i>Italics</i> and possibly a footnote
Publicly available documents	<i>Italics</i> with a footnote
External Web-based content	<i>Italics</i> and a <a href="#">hyperlinked footnote</a>

Table 17: Cross Reference Styles

## 4.4 References

Reference	Document	Version
R1.	Design Guidance – Terminology – Display Standards for Coded Information	1.0.0.0
R2.	Design Guidance – Terminology – Elaboration	1.0.0.0
R3.	SNOMED-CT: <a href="http://www.snomed.org/">http://www.snomed.org/</a>	
R4.	SNOMED Clinical Terms ® Guide – Abstract logical models and Representational forms <a href="http://www.snomed.org/snomedct/documents/abstract_models_and_representational_forms.pdf">http://www.snomed.org/snomedct/documents/abstract_models_and_representational_forms.pdf</a>	Version 5

Table 18: References