Design Guidance

Filtering Sorting and Grouping

Friday, 27 March 2009
Version 1.0.0.0

Prepared by
Microsoft

Microsoft

PREFACE

Documents replaced by this document

Document Title	Version
None	

Documents to be read in conjunction with this document

Document Title	Version
Design Guidance – Displaying Graphs and Tables	2.0.0.0
Design Guidance – Date Display	2.0.0.0
Design Guidance – Time Display	2.0.0.0
Design Guidance – Date and Time Input	2.0.0.0
Design Guidance – Medications Management – Medications Views	2.0.0.0
Design Guidance – Accessibility Checklist	1.0.0.0
Design Guidance – Accessibility Principles	1.0.0.0

TABLE OF CONTENTS

1 INTRODUCTION

This document provides guidance for the design of application functionality to filter, sort and group any clinical data within a single patient record displayed in a tabular form. It describes the area of focus, lists mandatory and recommended guidance points with usage examples, and explains the rationale behind the guidance.

The application of filtering, sorting and grouping covers a very broad range of functionality for a given data set. The functionality for these complex areas is set out in section 1.1. This design guidance covers only a limited area, as defined by the scope in section 1.3.

1.1 Definitions

Table 1 defines some of the key terms used throughout this document whose meaning is borne out by the user research conducted during the development of this guidance:

Term	Definition
Filtering	The selection of a subset of data so as to focus on the data that is relevant to the task at hand (in this case, the clinical task). The application of each filter criterion specifies a subset of data to keep in view.
Sorting	To arrange elements of a sequence according to some criterion, such as alphabetically (A to Z), or numerically (1, 2, 3...). A clinical example is: 'Show me all the medications this patient has ever been prescribed, in alphabetic order of medicine name'.
Grouping	To arrange elements of a collection into different categories. A clinical example is: 'Show me all of the patient's current and past medicines, grouped separately by Type such as Antibiotics '.

Table 1: Key Definitions

> **Important**
>
> The visual representations used within this document to display the guidance are illustrative only. They are simplified in order to support understanding of the guidance points. Stylistic choices, such as colours, fonts or icons are not part of the guidance and, unless otherwise specified, are not mandatory requirements for compliance with the guidance in this document.

1.2 Customer Need

Health care staff are routinely required to assimilate vast amounts of clinical patient data, gathered from different sources, such as from labs. In some settings, such as intensive therapy units (ITUs), a lot of patient data may be collected over a very short period of time. In a general practice (GP) setting, patient data typically accumulates over many years. In all cases, health care staff need to analyse and interpret data so as to identify the key indicators and relationships.

In secondary care, clinical processes are still often paper-based. However, there are no universally accepted standards relating to paper-based processes, which results in varying formats. In contrast, in primary care, clinical systems have made huge inroads into GP practices. These systems must address other concerns, for example the problem that computer screens are not capable of displaying a foldable chart that can be easily expanded to see a long (and wide) table of data.

Whatever the care setting, clinical systems must provide functionality, such as filtering, sorting and grouping, to aid in the analysis and interpretation of information. It is acknowledged that, at times, there is a requirement to present data that is already filtered and presented in an optimal fashion so that clinicians are not required to perform further data manipulation. Where filtering, sorting and grouping are required, there is a need to support this functionality in a consistent manner across all clinical applications. The availability of such functionality in common non-clinical applications, such as email readers and spreadsheets, means that many standards are already in place and increasingly used by clinicians either at home or while performing administrative tasks.

To mitigate any risk of a clinician misinterpreting a subset of data, system design must ensure that, where appropriate, the user is notified that a subset of data is displayed on a computer screen and not the complete set of data.

1.3 Scope

This section sets out the items that are in and out of scope in this design guidance.

1.3.1 Limitations

A very constrained subset of possible functionality in the areas of filtering, sorting and grouping has been considered in the development of this guidance. To the same extent, this guidance will only work with a subset of the kinds of data which will be typical. The limitations to functionality and data sets are described below.

For the purposes of generating this generic guidance around filtering, sorting and grouping functionality, it has been assumed that guidance published for any specific data types, such as medications, will be considered in the development of those systems.

1.3.2 In Scope

The following items are in scope:

- Single patient record data accessed using computerised clinical systems in all care settings (medications lists and test results were used in the development of this guidance)
- Homogenous data sets in a tabular form, where each data set appears in a row with columns displaying the attributes of each data item. The tables have no empty cells and the data items in each row are for the same time point and not a time range.

These aspects are illustrated Figure 1:

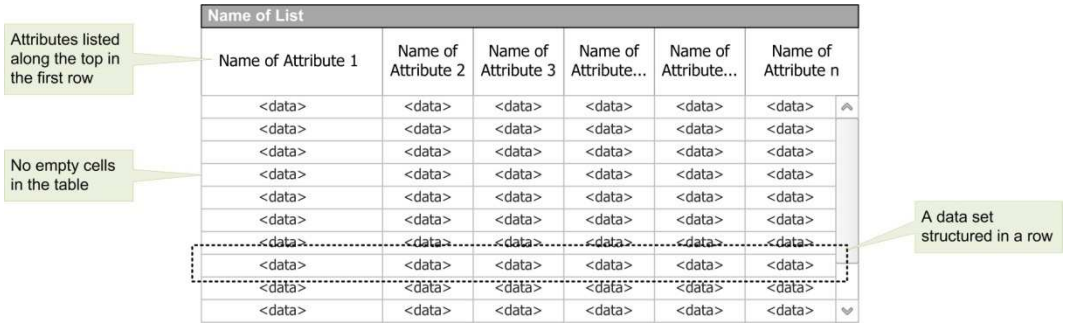


Figure 1: Example In-Scope Tabular Layout

1.3.3 Out of Scope

This section details items that are:

- Out of scope for this guidance
- Items not or only partially tested

We consider that the inclusion of these two lists correctly identifies a requirement for additional guidance when certain features or functionality are being included in designs.

The following items are out of scope:

- Tables containing heterogeneous data sets, data in time ranges or empty cells and where the data is ordered horizontally (that is, where the first entry in each row states the name of the attribute and the remaining cells in the row display the attribute's values). These aspects are illustrated in Figure 2

- User interface (UI) aspects relating to a data view (such as default column widths, the default order of columnar display and the Look-Ahead Scroll Bar as defined in the document Design Guidance – *Medications Management – Medications Views* **{R1})**
- UI functions that manipulate the data view (such as resizing a table or moving columns within a table)
- Choosing which columns or attributes to view
- Specific and system-defined sort orders, groups and filters (because these depend on the data and on care settings and are externally generated)
- Saving filter criteria for later use
- Data entry and editing
- Data comparison
- Range values are out of scope when mixed with continuous data

Figure 2 illustrates the kind of tabular layout that is out of scope:

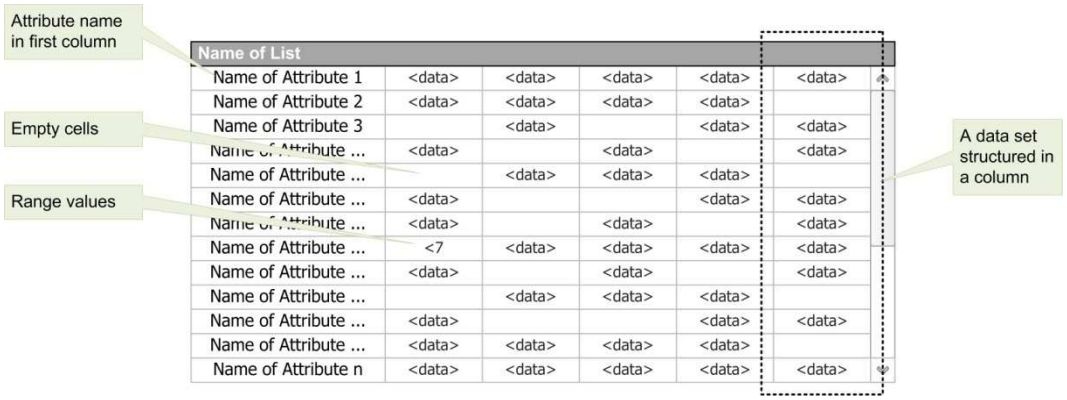


Figure 2: Example Out of Scope Tabular Layout

The following items are not, or are only partially, tested:

- Multi-patient records
- Clinical Noting and Patient Lists
- The unstructured (that is, free text) part of the patient record
- Images
- Mixed data types (that is, data types that are discrete or continuous that have a floor value but which the test cannot be precise about, such as those which represent certain test results, for example, '<7')

1.4 Assumptions

ID	Assumption
A1	The target audience comprises health care staff who need to view and analyse patient data within a single record
A2	A single user is logged on to the clinical application
A3	The format and database in which the underlying data is stored does not constrain, or is not relevant to, the data manipulation functions, namely filtering, sorting and grouping

Table 2: Assumptions

1.5 Dependencies

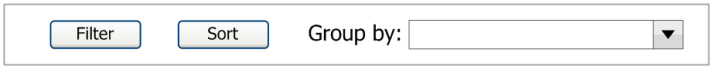
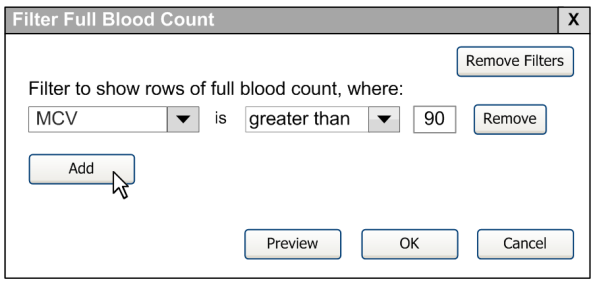
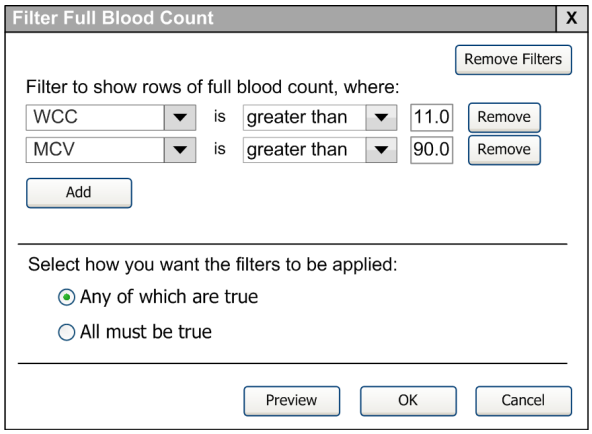
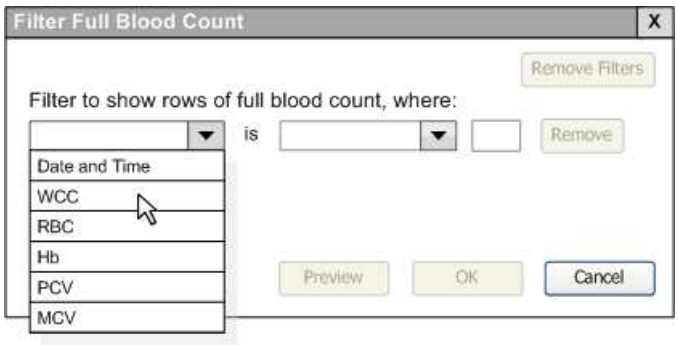
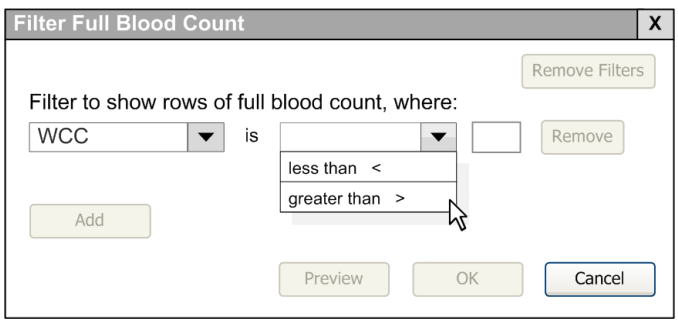
ID	Dependency
D1	Formats for displaying dates are dependent on the document *Design Guidance – Date Display* **{R2}**
D2	Formats for displaying times are dependent on the document *Design Guidance – Time Display* **{R3}**
D3	Formats for entry of dates and times are dependent on the document *Design Guidance – Date and Time Input* **{R4}**
D4	Formats for displaying tables are dependent on the document *Design Guidance – Displaying Graphs and Tables* **{R5}**

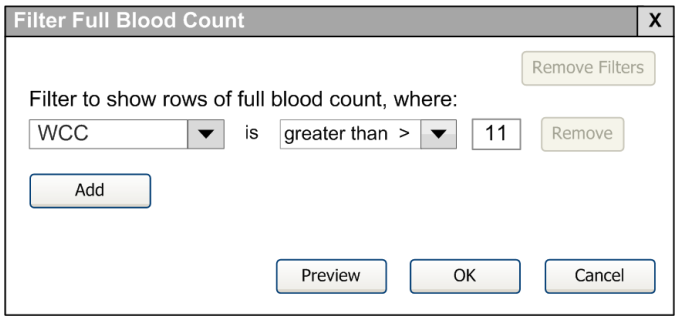
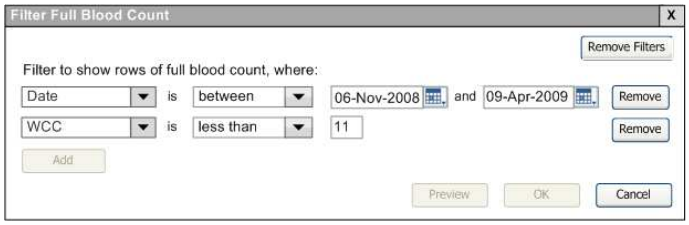
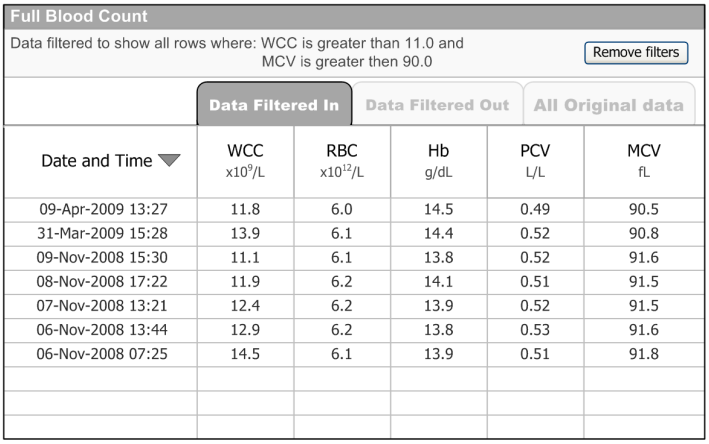
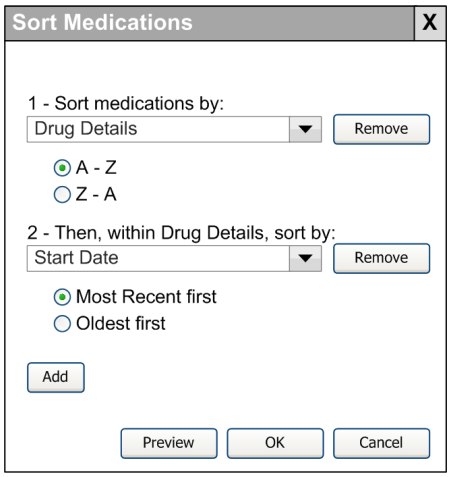
Table 3: Dependencies

2 GUIDANCE OVERVIEW,

2.1 Summary of Guidance

Table 4 provides excerpts of the guidance illustrations and identifies where in the guidance they are found:

Visual Summary	Areas of Guidance
	3.5 Guidelines – Controls
	3.6.1 Entering and Removing Filter Criteria 3.6.8 Removing Filters
	3.6.2 Entering Multiple Criteria
	3.6.3 Attribute Selection Control
	3.6.4 Operator Selection Control 3.6.6 Permitted Operators

Visual Summary	Areas of Guidance
	3.6.5 Value Entry Control
	3.6.7 Multiple Operators – Component Filter Expression
	3.6.9 Displaying Results 3.6.10 Filter Notification
	3.7.1 Display 3.7.4 Sort Order Manipulation 3.7.5 Removing Sort

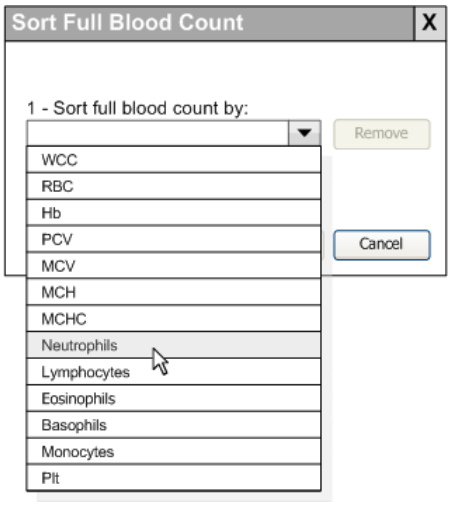
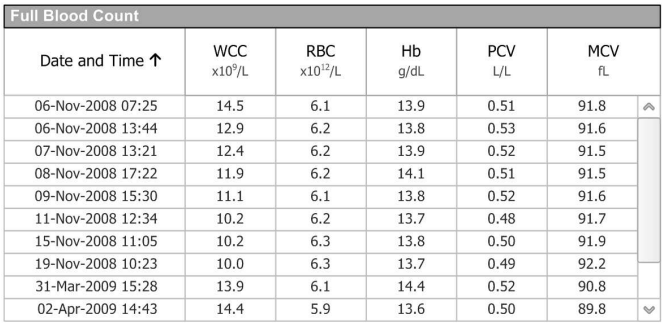
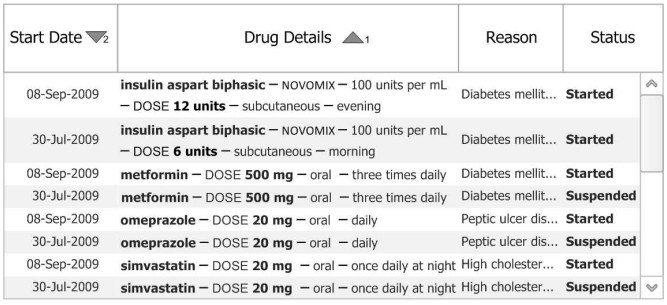
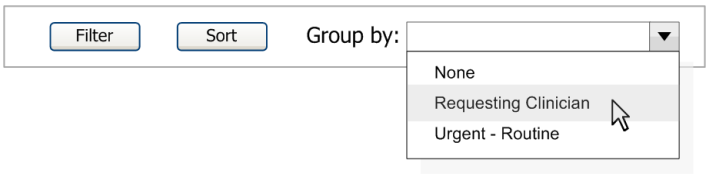
Visual Summary	Areas of Guidance
	3.7.2 Attribute Selection Control
	3.7.3 Sort Indicator
	3.7.6 Progressive Sort
	3.8 Guidelines – Grouping

Table 4: Summary of Guidance

3 GUIDANCE DETAILS

3.1 Introduction

The guidance provided in this document is based upon a programme of research, including:

- One-to-one interviews with six health care professionals
- An opening risk assessment with eight clinicians
- Discussions and consultations with health care professionals
- Evaluation of medications-related hazards
- A Web-based survey of 13 clinicians, administrative staff, and independent software vendors
- A closing risk assessment with six clinicians

3.2 Principles

The following key principles inform the guidance:

- Endeavouring to ensure the data manipulation functions of filtering, sorting and grouping are patient-safe
- Where appropriate, applying UI standards and conventions from non-clinical application software to the design of clinical applications
- Promoting consistent use of filtering, sorting and grouping for all users across clinical applications and care settings
- Grounding the development of generic guidance in clinically validated scenarios and data
- Minimising opportunities for human error

3.3 Common Features

This document provides guidance on the application of filtering, sorting and grouping. This section addresses those attributes common to each of those functions, namely data types, filtering operators and sort orders.

The different ways in which data can be filtered or sorted depends on the characteristics of the data being processed. This section:

- Describes the two classes of data values
- Lists the data types in each of these classes
- Identifies the permitted filter operators and sort orders for each data type

Data can be considered to have either discrete values or continuous values. Within these classes of values, data is classified into distinct data types. The relevance of these value classes and data types differs depending on whether you are performing filtering or sorting actions.

3.3.1 Filtering

When filtering data, the clinical requirement is to select a subset of data so as to focus on the data that is relevant to the task at hand. Therefore, the filtering task is one of framing a query that acts on the values of data (for example, whether a value is greater than a threshold or whether a reading was taken after a certain date). To facilitate the framing of unambiguous queries, a set of query operators is required for each class of data.

For filtering, Table 5 lists the different data types associated with discrete and continuous data values, and the permitted filter operators that can be safely applied to them:

Value Type	Data Type	Permitted Filter Operators
Discrete	Integers	less than less than or equal to equal to greater than or equal to greater than
	Ordered set of symbols	less than less than or equal to equal to greater than or equal to greater than
	Unordered set of symbols (such as diagnosis or problem)	equals
	String (free text)	equals
	Date	on before on or before after on or after between (to include both the stated dates)
Continuous	Real numbers	less than greater than
	Date and time	before after between (to include both the stated dates)

Table 5: Permitted Filter Operators by Data Type

> **Note**
>
> The operators permitted for discrete numbers and for continuous numbers differ:
>
> - Discrete numbers are whole numbers. They do not contain decimals or fractions. Therefore, this guidance permits the use of the equality operator on discrete numbers
> - Continuous numbers are numbers expressed using decimals, such as 6.5 and 6.499. The precision with which such numbers are stored on computers makes it mathematically inaccurate to ask whether a continuous value is exactly equal to another. Therefore, this guidance prohibits the use of the equality operator on continuous numbers

3.3.2 Sorting

For sorting, Table 6 lists the different data types associated with discrete and continuous data values and the sort orders applicable to them:

Value Type	Data Type	Sort Order	
Discrete	Integers	Implicit	Ascending Descending
	Ordered set of symbols	Explicit	Supplied by Independent Software Vendor (ISV) For example, severity values 'normal', 'mild', 'severe', 'fatal', or responsiveness values 'Alert', 'Responds to voice', 'Responds to pain', 'Unresponsive' (AVPU designations)
	Unordered set of symbols (such as diagnosis or problem)	Implicit	Alphabetic Reverse alphabetic
	String (free text)	Implicit	Alphabetic Reverse alphabetic
	Date	Implicit	Chronological Reverse chronological
Continuous	Real numbers	Implicit	Ascending Descending
	Date and time	Implicit	Chronological Reverse chronological

Table 6: Permitted Sort Orders by Data Type

3.4 Data Display

In this document, usage examples show data displays to demonstrate the application of the guidelines. These usage examples show elements of full blood count data. However, the examples present only a small number of attributes of the full blood count data on the basis that the user has already chosen to remove all other data for blood test results. The user can be regarded as having done this using a 'column chooser' function (such as that shown in Figure 3, which is provided for illustrative purposes only) resulting in the display of a table (such as shown in Figure 4):

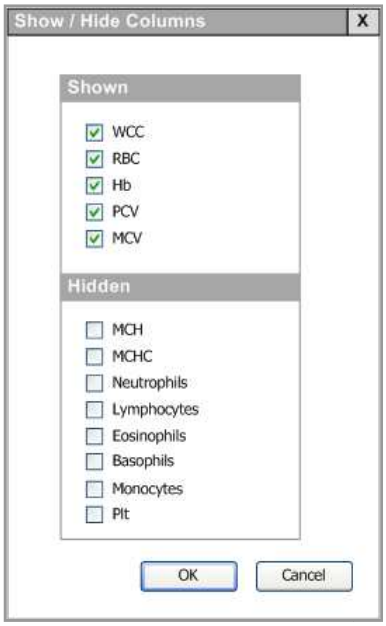
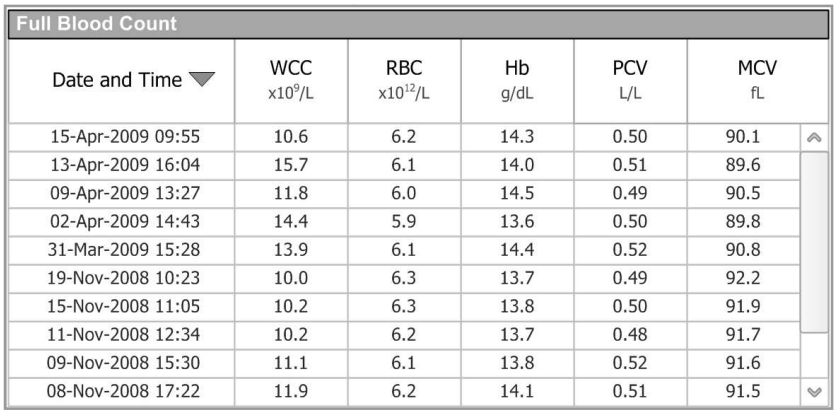


Figure 3: Using a 'Column Chooser' Dialog Box to Select the Blood Count Data to View



Full Blood Count

Date and Time	WCC x10^9/L	RBC x10^{12}/L	Hb g/dL	PCV L/L	MCV fL
15-Apr-2009 09:55	10.6	6.2	14.3	0.50	90.1
13-Apr-2009 16:04	15.7	6.1	14.0	0.51	89.6
09-Apr-2009 13:27	11.8	6.0	14.5	0.49	90.5
02-Apr-2009 14:43	14.4	5.9	13.6	0.50	89.8
31-Mar-2009 15:28	13.9	6.1	14.4	0.52	90.8
19-Nov-2008 10:23	10.0	6.3	13.7	0.49	92.2
15-Nov-2008 11:05	10.2	6.3	13.8	0.50	91.9
11-Nov-2008 12:34	10.2	6.2	13.7	0.48	91.7
09-Nov-2008 15:30	11.1	6.1	13.8	0.52	91.6
08-Nov-2008 17:22	11.9	6.2	14.1	0.51	91.5

Figure 4: Initial Data Display

Figure 4 therefore shows the initial data display that is the starting point for the examples of filtering, sorting and grouping described in this document.

> **Note**
>
> As discussed in section 1.3.3, table manipulation such as the 'column chooser' is out of scope of this guidance. It is referenced here to explain the context for later illustrations: namely, that the tabular data displayed in the usage examples has been selected by the user before filtering and sorting begins.

3.5 Guidelines – Controls

This section describes how to initiate the filtering, sorting and grouping functionality. Two methods for accessing the functions are described:

- Buttons in a toolbar accompanying the table
- Context menus

In addition to the buttons and context menus, compliance with Microsoft Health CUI accessibility guidance **{R10, R11}** requires that keyboard commands are also provided. These are also likely to be required by those users who make frequent use of the filtering, sorting and grouping functionality. Keyboard tab orders should apply to the constituents of a dialog box, but not to the toolbar.

Additional methods for accessing the functionality, such as using other application toolbars or the keyboard, are not described in this guidance.

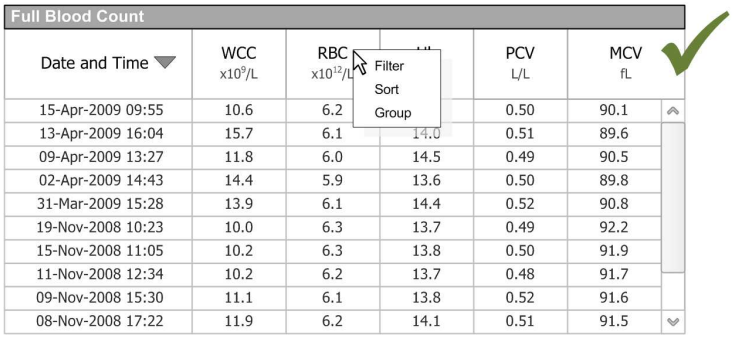
> **Note**
>
> The toolbar illustrations only show the controls that are discussed in this guidance, and therefore do not reflect all possible implementations of toolbar controls within clinical applications.

ID	Description	Conformance	Evidence Rating
FSG-0001	Provide controls for filtering, sorting and grouping, and lay out the controls or menu items in that order, (that is, first filtering, then sorting and finally grouping)	Recommended	Medium
FSG-0002	Label the controls 'Filter', 'Sort' and 'Group by' respectively	Recommended	High
FSG-0003	Provide keyboard commands to access the filtering, sorting and grouping functionality	Mandatory	High
FSG-0004	Provide multiple entry points to initiate filtering, sorting and grouping, such as through a toolbar, context menu (right mouse click), keyboard commands and direct mouse initiation through right click	Recommended	Medium

Usage Examples

The controls in the toolbar are displayed in the correct order. Additional optional items are not shown in this illustration

The controls in the toolbar are not displayed in the correct order



An example of a fragment of a context menu displayed on the click of a right mouse button, when positioned on a **header cell**

Figure 5: An Example of a Context Menu

Rationale

In this guidance we recommend the terms 'sort' and 'filter' because of user research with clinicians that has shown that the terms 'sort' and 'filter' are understood correctly and so may safely be used in clinical applications. While the term 'sorting' was preferred by 7 of the 13 respondents, 'ordering' was a close second, and 'organising' a poor third. User research also found that the term 'filtering' was preferred by 9 of the 13 respondents, 'removing' and 'searching' shared equal position for a distant second.

From the user research conducted during the development of this guidance, it became apparent that while familiarity with sorting was very high, this was less so with filtering. By placing the button that initiates filtering in a prominent position, users are more likely to employ this powerful technique.

Existing guidance, provided in the document *Design Guidance – Medications Management – Medications Views* **{R1},** has already mandated the label for the grouping control to be 'Group by'. The recommended layout reflects clinicians' usual workflow, which would be first to filter a long table of data, and then to sort or group it. Hence in this guidance, we recommend, but do not mandate, that the terms be listed in the order of 'filtering', then 'sorting', followed by 'grouping'. The respective controls are thus laid out in that order from left to right, which is also the natural reading pattern of clinical applications users in England (who have a cultural disposition to read from top-to-bottom and left-to-right) whether reading a printed page or a computer screen[1]. The same order is reflected in the context menu in Figure 7

[1] Koyani et al, Research-Based Web Design and Usability Guidelines, U.S. Department of Health and Human Services **{R6}**: http://www.usability.gov/pdfs/guidelines.html

3.6 Guidelines – Filtering

Filtering is the selection of a subset of data so as to focus on a subset of data that is relevant to the task at hand (in this case, the clinical task). The application of each filter criterion specifies a subset of data to keep in view. This section applies that action to clinical data.

3.6.1 Entering and Removing Filter Criteria

This section provides guidance relating to the entering and removing of filter criteria.

The filter dialog box, shown in Figure 6, facilitates the specification of both single and multiple filters. This section provides guidance on the layout and specification of the filter dialog box when applying a single filter criterion. Please refer to section 3.6.2 for guidance relating to building multiple filter criteria within the filter dialog box.

It is possible to set a single filter directly by use of the header cell's context menu (as shown in Figure 6).

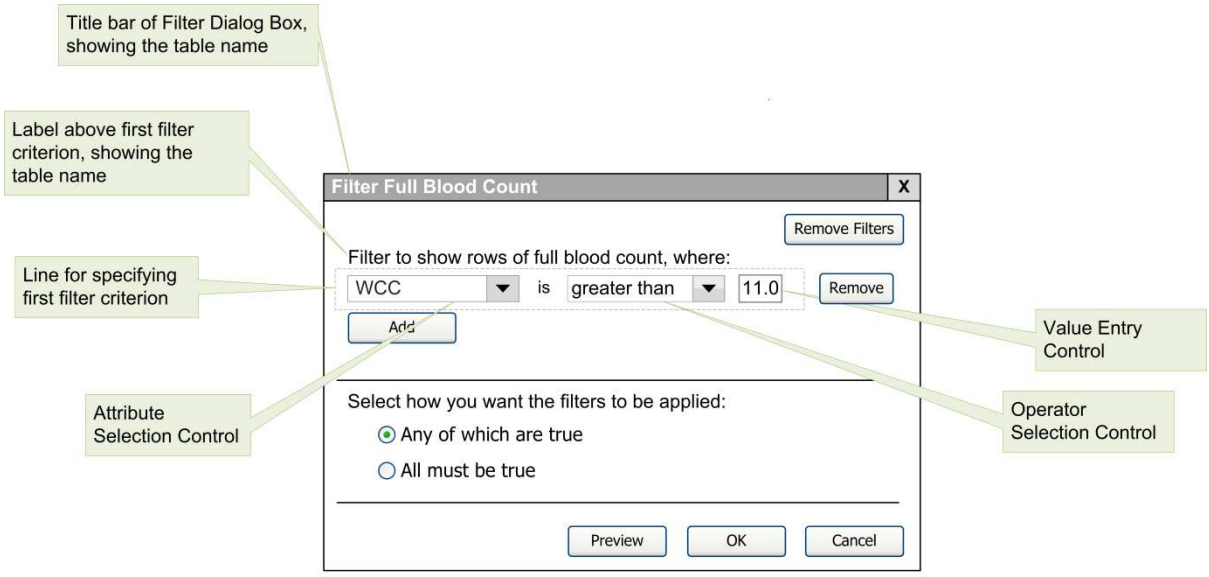


Figure 6: Filter Dialog Box

As Figure 6 illustrates, this guidance refers to a filter, or a filter criterion, as the combination of the following:

- An attribute (such as 'WCC') specified in an Attribute Selection Control (a control enabling the user to select a particular filter attribute)
- An operator (such as 'greater than') specified in an Operator Selection Control (a control enabling the user to select a particular filter operator)
- A value (such as '11.0') specified in a Value Entry Control (a control enabling the user to select a particular filter value)

ID	Description	Conformance	Evidence Rating
FSG-0005	Support the filtering of data according to user-specified filter criteria	Mandatory	High
FSG-0006	Avoid splitting the filter criterion line onto multiple lines	Recommended	Medium
FSG-0007	Split the filter criterion line only if absolutely necessary, splitting it in such a manner as to keep the operator entry control and the value input control together	Recommended	Low
FSG-0008	Include the name of the table on which the filters are to be applied, in the title of the filter dialog box	Recommended	Medium
FSG-0009	Display a label above the first filter criterion, concatenating the strings 'Filter to show rows of', *X* and 'where:' in which *X* is the name that can be applied to each row of data in the table, for example 'full blood count', and is likely to be the title of the table	Recommended	Medium
FSG-0010	Provide a label only above the first filter criterion	Recommended	Medium
FSG-0011	Permit filtering by any of the columns (that is, by attributes) displayed in the table whether in view or off screen	Mandatory	Medium
FSG-0012	Permit entry of a single filter criterion directly in an attribute's header cell, only permitting filtering by one attribute at a time	Recommended	Low
FSG-0013	Do not display data in mixed units, such as metric and imperial units, in the same table	Mandatory	Medium
FSG-0014	Display the unit measurement in the header row to provide clarity on the data presented in the column	Recommended	Medium
FSG-0015	Do not permit the filter dialog box to grow to a size beyond the size of the screen	Mandatory	Low
FSG-0016	In the default view of the filter dialog box, show one line for entry of a filter criterion consisting of a set of the following controls, in this order: ▪ Attribute Selection Control ▪ Operator Selection Control ▪ Value Entry Control	Recommended	Medium
FSG-0017	Provide the following buttons: 'Preview', 'OK' and 'Cancel'	Recommended	Medium
FSG-0018	Upon the user selecting 'Preview', execute the filters and update the data display accordingly, without any additional confirmation dialog box, and without closing the dialog box	Recommended	Low
FSG-0019	Upon the user selecting 'OK', close the dialog box, execute the filters, and update the data display accordingly, without any additional confirmation dialog box	Recommended	High
FSG-0020	Upon the user selecting 'Cancel', close the dialog box, and restore the display to show that data displayed when the filter function was initiated, without any additional confirmation dialog box	Recommended	High
FSG-0021	Pre-populate the fields in the dialog box with the current filter criterion in operation, where appropriate	Recommended	Low

Usage Examples

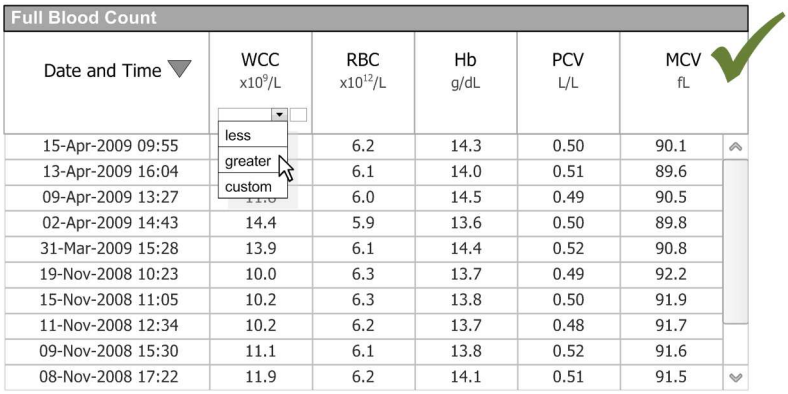
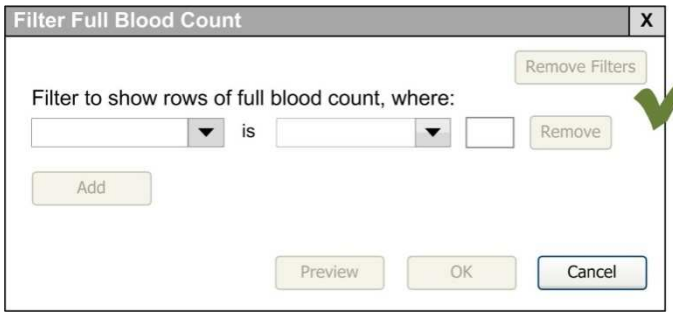
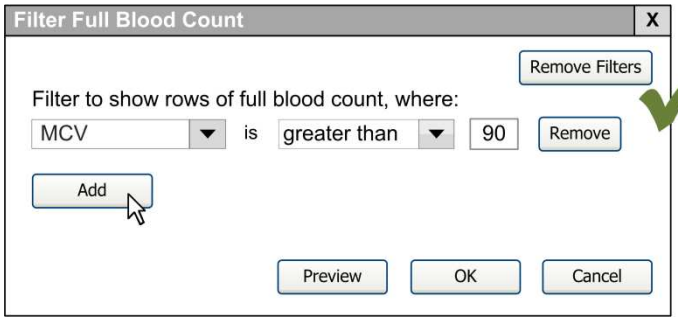


Figure 7: Entering a Filter Directly in a Header Cell

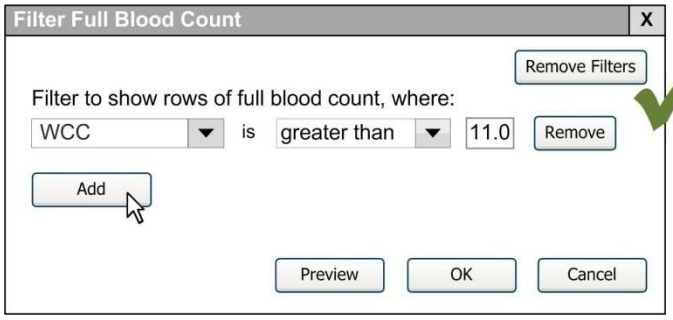
Initiating filtering by entering criteria directly in the header cell of the attribute by which data is to be filtered. The operator selection and Value Entry Controls are displayed on selecting the **Filter** option from the header cell's context-menu



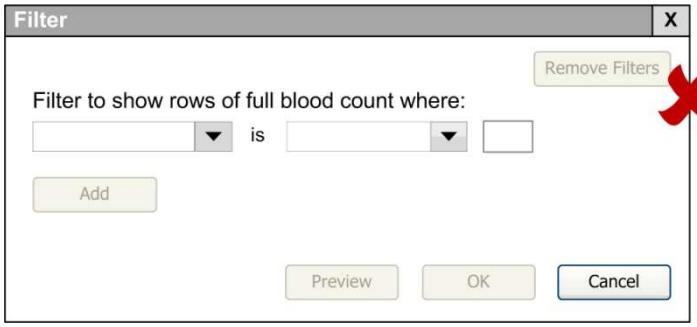
Initial display of the dialog box showing the default state of buttons when no criterion has been entered; only the **Cancel** button is enabled



All buttons become enabled when one filter criterion has been entered in full



Display a label above the first filter criterion



The title bar in this dialog box does not include the name of the table

Rationale

In user research, clinicians were asked whether, when specifying a filter, they wanted to specify what data should be kept in view or what should be removed from view. All the thirteen respondents said they would want to specify what data should be kept in view but eight said that, on occasion, they would want to be able to specify what data should be removed from view. The filter dialog box reflects this bias. It makes it straightforward to specify the data that should be kept in view. However, the converse can also be specified, though the user is burdened with framing the query appropriately. An alternative approach would be to provide the capability to specify how the clinical application should interpret the filter criteria, such as by providing two radio buttons. These could be labelled 'Filter to keep in view' and 'Filter to remove from view' respectively. Such an approach would remove the cognitive load required to frame the complementary query, but it would add to the complexity of the dialog box, arguably unnecessarily for an occasional task only needed by a few users.

Previewing Filtered Results:

Fewer users are familiar with filtering data than with sorting data. Yet, as it is an important technique available to the clinician already overloaded with patient data, it seems worthwhile to encourage its use in applicable circumstances. The 'Preview' function enables a user to explore the application of a filter, by applying temporary, that is exploratory, filters. The filter dialog box and table can be positioned so as not to overlap, and different filters can be applied to understand how they act to change the displayed data. Finally, the user can commit to a filter (by clicking the **OK** button), or can choose to leave the display unchanged (by clicking the **Cancel** button).

Data Units:

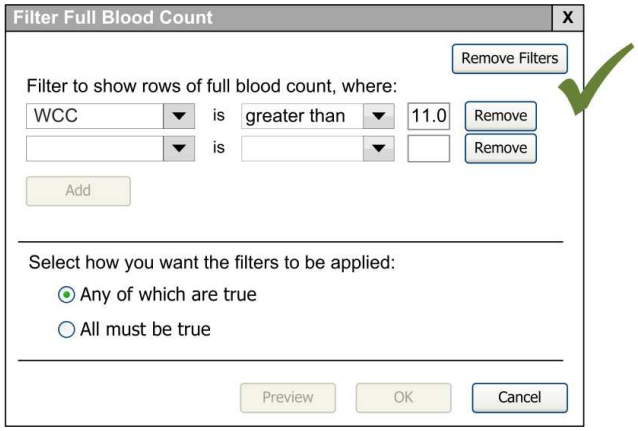
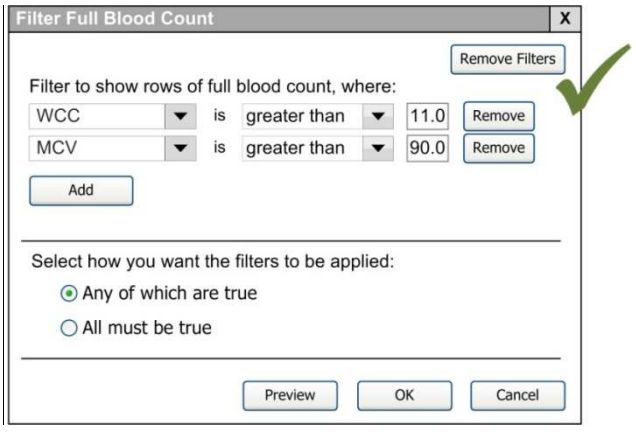
This guidance recommends including units within the column header row. However, it is also acknowledged that the inclusion of units requires space within the cell that is a limitation when subject matter text also appears within the same cell. The display of units arguably consumes screen space in a filter dialog box, where the name of the attribute and criterion are important not the units. A clinician knows the units, and does not need to see them for the task at hand, namely filtering. However, when specifying a filter criterion that must span a range (for example, 200 mg to 1 g), units may become necessary, though there is a risk with displaying data in mixed units in a column. There is also a risk with displaying unfamiliar units in a column (for example, 1000 mg instead of 1 g). As this has not been explored in the development of this guidance, we do not make recommendations on the display of units except to include a prohibition on mixing imperial and metric units in the same table column.

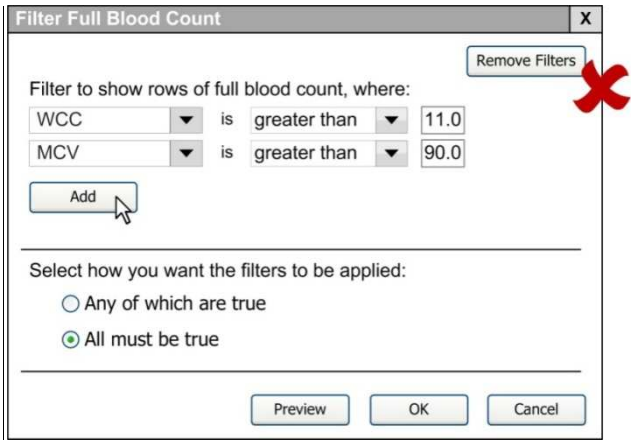
Previewing Filtered Data:

The 'preview' function enables a user to explore the application of a filter by applying temporary (that is, exploratory) filters. The filter dialog box can be positioned so as not to overlap the data and different sort orders applied to understand how they act to change the displayed data. Finally, the user can commit to a filter (by clicking the **OK** button), or can choose to leave the display unchanged (by clicking the **Cancel** button).

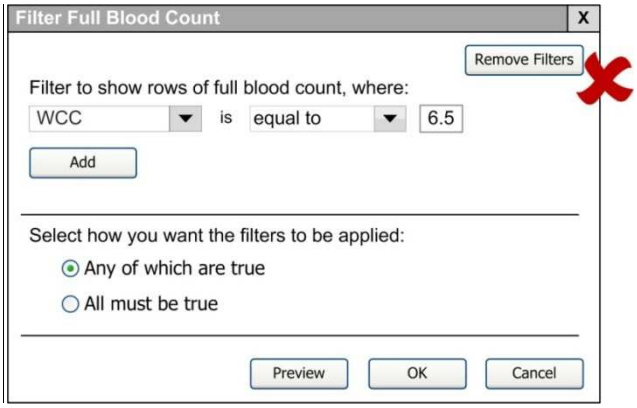
3.6.2 Entering Multiple Criteria

This section provides guidance on the entering of multiple filter criteria. Section 3.6.1 provides guidance on the layout and specification of the filter dialog box, together with the application of a single filter criterion. The filter dialog box design also enables a user to enter multiple filter criteria.

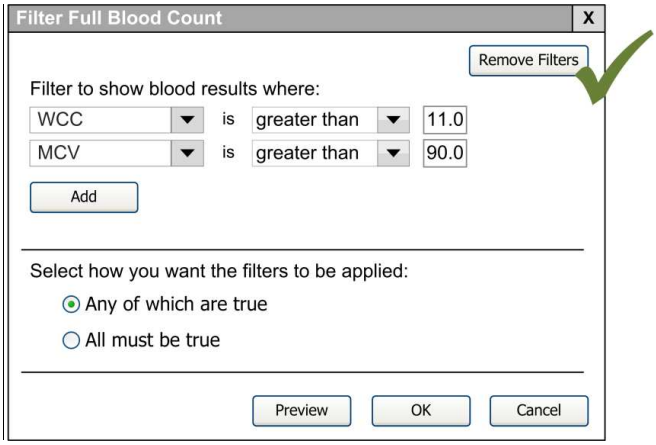
ID	Description	Conformance	Evidence Rating
FSG-0022	Permit multiple filters to be applied concurrently	Recommended	Low
FSG-0023	Provide a button to add an additional filter criterion, labelling this button 'Add'	Recommended	Medium
FSG-0024	Move the 'Add' button down one line when it is pressed, displaying the required boxes for entry of a filter criterion (as described in FSG-0008) in the line previously occupied by the 'Add' button	Recommended	Medium
FSG-0025	Display the 'Add' button immediately below the last filter criterion and left-aligned with it	Recommended	Medium
FSG-0026	Provide radio buttons to select between the two ways of applying multiple filters, namely between a logical AND and a logical OR	Mandatory	Medium
FSG-0027	Make the option for the logical OR the default selection and place this option first in the list of radio buttons	Mandatory	High
FSG-0028	Label the radio button denoting the logical AND: 'All must be true' or 'Match All'	Recommended	High
FSG-0029	Label the radio button denoting the logical OR: 'Any of which are true' or 'Match Any'	Recommended	High
Usage Examples			
		Shows correct use and location of 'Add' button used to insert additional filter criterion	
		Shows correct display of the radio buttons, which appear after two criteria have been entered in full	



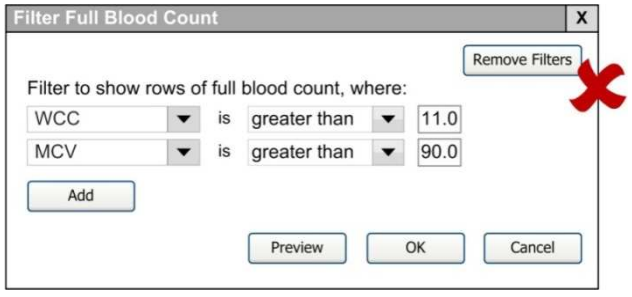
The default selection is on the incorrect radio button (the user has not changed the default selection, as the cursor is positioned on the **Add** button, indicating the user has just entered two criteria, and is about to enter a third)



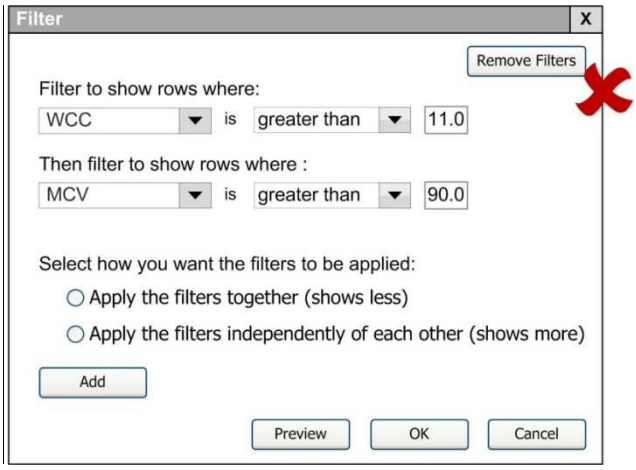
Radio buttons are incorrectly displayed when only a single criterion has been entered. Additionally, an invalid operator, namely 'equal to', has been selected whereas it should not have been offered to the user as it is not a valid operator for continuous values



The radio buttons are correctly labelled



This design does not provide the user with the capability to specify how multiple filters are to be applied as no radio buttons are present



This example shows the following incorrect uses:

1. The title is incorrect
2. The radio button labels are incorrect
3. Each filter criterion is incorrectly preceded with a label
4. Neither label is correct
5. The 'Add' button is in the wrong location

Rationale

Default Selection of a Radio Button:

In the user research, we asked respondents what data they would expect to see when multiple filters were applied, and no radio buttons were provided to choose between a logical OR and a logical AND operation. No respondent said that the behaviour would be a logical OR. One remarked that 'there is no AND before the second filter row', implying that this is what they expected, and another remarked that OR is the 'expected behaviour'. When shown a filter dialog box design that featured radio buttons to force a selection, health care staff said they preferred this as it made the behaviour 'much clearer'. Finally, all respondents interpreted the labels accompanying the radio buttons correctly, including those who had stated that filtering was not a task they had knowingly done before.

As the World Wide Web has become pervasive, Web standards and best practices relating to the UI have become the norm and set user expectations. It is instructive to be informed by these standards and comply with them, unless there are clear reasons from a patient safety perspective not to do so.

RFC 1866, on HTML 2[2], and the World Wide Web Consortium (W3C) on HTML 4[3], state:

> "At all times, exactly one of the radio buttons in a set is checked. If none of the <INPUT> elements of a set of radio buttons specifies `CHECKED', then the user agent must check the first radio button of the set initially."

The internationally recognised UI expert, Jakob Nielsen states on useit.com[4]:

> "Always offer a default selection for radio button lists. By definition, radio buttons always have exactly one option selected, and you therefore shouldn't display them without a default selection. (Checkboxes, in contrast, often default to having none of the options selected.) If users might need to refrain from making a selection, you should provide a radio button for this choice, such as one labelled "None". Offering users an explicit, neutral option to click is better than requiring the implicit act of not selecting from the list, especially because doing the latter violates the rule of always having exactly one option chosen."

This suggests that when using radio buttons, always provide a default. The decision on which radio button should be the default was made on the basis of which option is likely to display more data in most cases. This is the logical OR option.

[2] Berners-Lee & Connolly, Hypertext Markup Language - 2.0 **{R7}**: http://www.ietf.org/rfc/rfc1866.txt

[3] W3C Recommendations, Control types – radio buttons **{R8}**: http://www.w3.org/TR/html4/interact/forms.html#radio

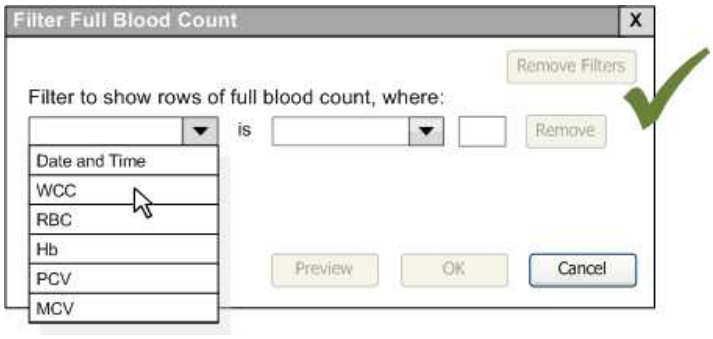
[4] Jakob Nielsen's Alertbox, Checkboxes vs. Radio Buttons **{R9}**: http://www.useit.com/alertbox/20040927.html

3.6.3 Attribute Selection Control

This section provides guidance on the use of the Attribute Selection Control. The Attribute Selection Control in the filter dialog box enables the user to select a particular attribute from the data set to which the filtering will be applied.

ID	Description	Conformance	Evidence Rating
FSG-0030	Only permit attributes displayed in the table to be entered in the Attribute Selection Control	Recommended	Low
FSG-0031	Display the attribute names as menu items in the Attribute Selection Control menu, listing them in the same order in the menu as they are displayed in the table	Recommended	Low

Usage Examples



Attribute Selection Control menu items listed in the same order as in the currently displayed table

Rationale

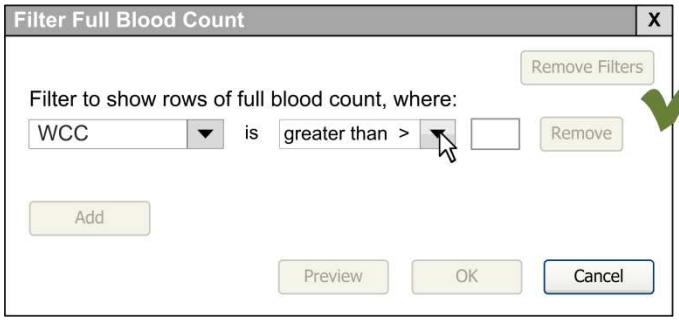
In the user research, we presented the respondents with some example filter dialog boxes populated with some sample data. The filter dialog box contained the Attribute Selection Control, as well as the Operator Selection Control and the Value Entry Control, as shown in the usage example. We asked the respondents to explain what results they would expect after the filter was applied. Only one respondent replied incorrectly which, given the number of correct responses, suggests that this method of setting out filter criteria assists a user in understanding what filter results will be achieved by using the filter dialog box.

3.6.4 Operator Selection Control

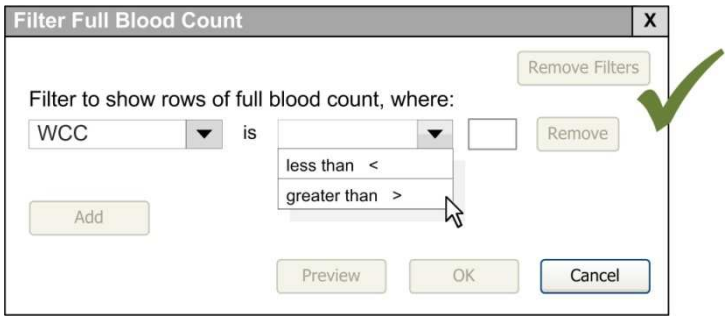
This section provides guidance on the use of the Operator Selection Control. The Operator Selection Control in the filter dialog box enables the user to select an operator relevant to the data to which the filter is being applied. The inclusion of the Operator Selection Control enables a user not only to search against an attribute, but to also narrow the filter to a value range.

ID	Description	Conformance	Evidence Rating
FSG-0032	Ensure that only operators relevant to the attributes are displayed	Recommended	Low
FSG-0033	Display an Operator Selection Control when the user selects the 'Filter' menu item from the header cell's context menu	Recommended	Low

Usage Examples



Operator Selection Control showing operator relevant to selected attribute



The valid operators are displayed for a real, that is, continuous data type. The optional mathematical symbols have also been added

Rationale

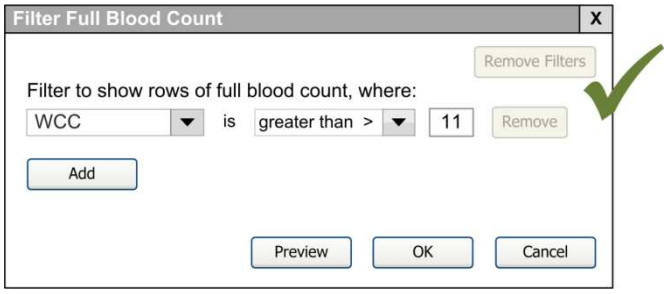
In the user research, we presented the respondents with some example filter dialog boxes populated with some sample data. The filter dialog box contained the Operator Selection Control, as well as the Attribute Selection Control and the Value Entry Control, as shown in the usage example. We asked the respondents to explain what results they would expect after the filter was applied. Only one respondent replied incorrectly which, given the number of correct responses, suggests that this method of setting out filter criteria assists a user in understanding what filter results will be achieved by using the filter dialog box.

3.6.5 Value Entry Control

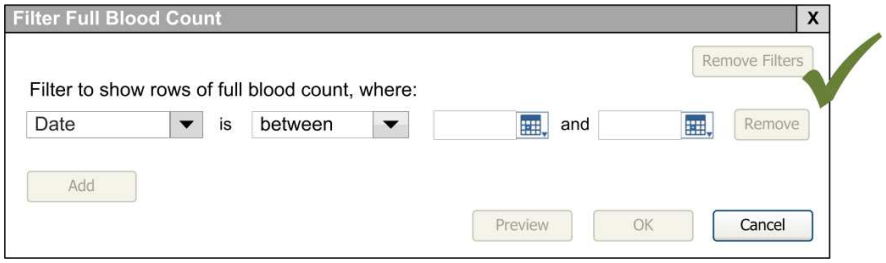
This section provides guidance on the use of the Value Entry Control within the filter dialog box. The Value Entry Control in the filter dialog box enables the user to select a particular filter value relevant to the attribute and operator previously selected within the filter dialog box. The value entry data is taken directly from the data upon which the filter is being applied.

ID	Description	Conformance	Evidence Rating
FSG-0034	Display a Value Entry Control when the user selects the 'Filter' menu item from the header cell's context menu	Recommended	Low
FSG-0035	Display a Value Entry Control that is appropriate to the selected attribute (for example, when filtering by date, display a date input control, or when filtering by an integer, display an integer input control)	Mandatory	Low
FSG-0036	Upon the user selecting 'between' in the Operator Selection Control, provide two Value Entry Controls that are appropriate to the attribute currently selected in the Attribute Selection Control, positioning the Value Entry Controls immediately after the Operator Selection Control	Mandatory	Low

Usage Examples



Value Entry Control showing data appropriate to the selected attribute



Value Entry Control showing two fields for completion due to inclusion of 'between' in the Operator Selection Control

Rationale

In the user research, we presented the respondents with some example filter dialog boxes populated with some sample data. The filter dialog box contained the Value Entry Control, as well as the Attribute Selection Control and the Operator Selection Control, as shown in the usage example. We asked the respondents to explain what results they would expect after the filter was applied. Only one respondent replied incorrectly which, given the number of correct responses, suggests that this method of setting out filter criteria assists a user in understanding what filter results will be achieved by using the filter dialog box.

3.6.6 Permitted Operators

The filtering functionality can be applied on a number of different data types. Accordingly, the filter dialog box must be flexible enough to vary in layout according to the data type in question. When combining multiple filter expressions, logical operators are required to connect the filters being applied.

Before progressing to the guidance, it is important to clarify the use and impact of logical operators when combining multiple filter expressions. In particular, the role of the logical operators 'AND' and 'OR' needs to be understood. Table 7 defines their meaning:

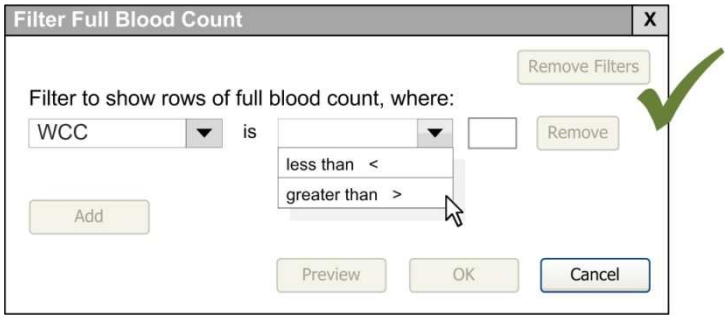
Logical Operator	Definition
AND	Returns True if all of its component filter expressions are true. Returns False if any of the component filter expressions are false
OR	Returns True if any of its component filter expressions are true. Returns False if all of its component expressions are false

Table 7: Definition of AND and OR

ID	Description	Conformance	Evidence Rating
FSG-0037	When the Operator Selection Control is selected from the header cell, permit the inclusion of 'custom' as an operator	Recommended	Low
FSG-0038	Display the filter dialog box when 'custom' is selected from the Operator Selection Control in the header cell	Recommended	Low
FSG-0039	Permit the following operators when filtering by date, labelling them with the same names: ▪ 'on' ▪ 'before' ▪ 'after' ▪ 'on or before' ▪ 'on or after' ▪ 'between'	Recommended	Medium
FSG-0040	Permit the following operators when filtering by 'date and time', labelling them with the same names: ▪ 'before' ▪ 'after' ▪ 'between'	Recommended	Low
FSG-0041	Permit the following filtering operators for all numeric data, labelling them with the same name: ▪ 'less than' ▪ 'greater than'	Recommended	Medium
FSG-0042	For numeric data of type integer, additionally permit the operator 'equal to', labelling it with the same name	Recommended	Medium
FSG-0043	For numeric data, optionally append the characters '<', '=' or '>' to supplement the menu items in the Operator Selection Control, as appropriate	Recommended	Low
FSG-0044	Support filtering of integers by providing the permitted filter operators: ▪ 'less than' ▪ 'less than or equal to'	Recommended	Medium

	▪ 'equal to' ▪ 'greater than or equal to' ▪ 'greater than'		
FSG-0045	Support filtering of ordered sets of symbols by providing the permitted filter operators: ▪ 'less than' ▪ 'less than or equal to' ▪ 'equal to' ▪ 'greater than or equal to' ▪ 'greater than'	Recommended	Medium
FSG-0046	Support filtering of unordered set of symbols (such as diagnosis or problem) by providing the permitted filter operator 'equals'	Recommended	Medium
FSG-0047	Support filtering of the strings data type (free text) by providing the permitted filter operator 'equals'	Recommended	Medium
FSG-0048	Support filtering of the date data type by providing the permitted filter operators: ▪ 'on' ▪ 'before' ▪ 'on or before' ▪ 'after' ▪ 'on or after' ▪ 'between'	Recommended	Medium
FSG-0049	Support filtering of real numbers by providing the permitted filter operators 'less than' and 'greater than'	Recommended	Medium
FSG-0050	Support filtering of the date and time data type by providing the permitted filter operators 'before', 'after' and 'between'	Recommended	Medium
FSG-0051	Permit the user to choose between two ways of applying multiple filter expressions, namely between a logical AND and a logical OR	Recommended	High
FSG-0052	Do not permit a logical NOT operator	Recommended	Medium
FSG-0053	Permit only one kind of logical operator to act between all the component filter expressions, at any one time	Recommended	High

Usage Examples



The valid operators are displayed for a real number data type in this instance, numeric data. The optional mathematical symbols have also been added

Rationale
Logical Connective Operators: When applying multiple filter expressions, a decision on how to apply the filters must be made. For example, should the data set resulting from the application of each filter be intersected, such as in a logical AND, and only the resulting data be displayed? Or, should the union of all the data be displayed, such as in a logical OR? Should the user be asked to make this choice? If so, how should these options be explained clearly? A further complexity is the difference between formal logic and everyday English. In conversational English, when someone says, for example, 'Show me books by author A and by author B' they intend the word 'and' to be interpreted as a logical OR. Filtering has been defined as the removal of data from view, and use of the NOT operator effectively introduces a double negative. Filters with multiple criteria in which one or more also included the NOT operator would be difficult for users to interpret and to predict the correct behaviour making it harder for the user to ensure it has been specified correctly. **Filter Operators:** The permitted filter operators were chosen after much discussion with clinicians, and with patient safety foremost in mind. The permitted operators differ for real and integer numbers. Real, or continuous, numbers are those numbers that are expressed using decimals, such as 6.5 and 6.499. The precision with which such numbers are stored on computers makes it mathematically inaccurate to ask whether a continuous value is exactly equal to another. In this guidance we therefore prohibit the use of the equality operator on real numbers. Integer, or discrete, numbers are whole numbers and do not contain decimals, nor do they describe fractions. The equality operator is permitted on integers. Table 5 indicates the permitted filter operators by data type.

3.6.7 Multiple Operators – Component Filter Expression

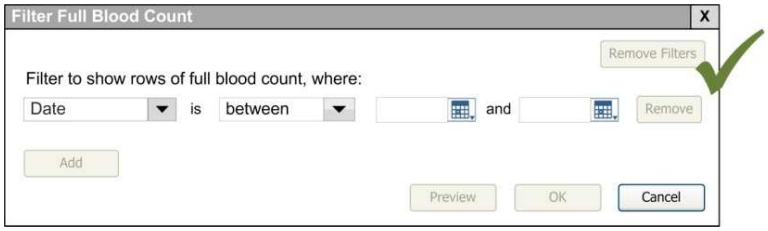
This section provides guidance on the combined use of operators within the filter dialog box. There are two instances when this may occur:

- For certain data (indicated through use of the Operator Selection Control), it may be necessary to create a single component filter expression with multiple values (for example, when the filter operator uses 'between' such as when selecting dates)
- It is also possible to use more than one component filter expression on the same attribute

This section provides guidance on presenting combined operators within the same dialog box using an example of date.

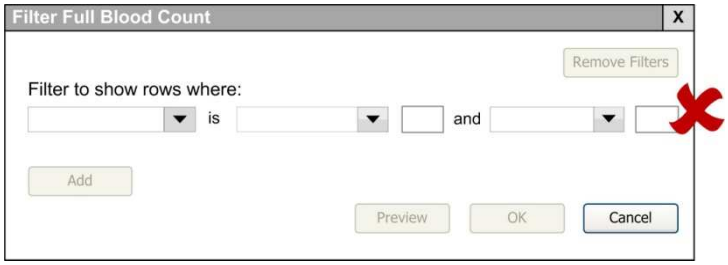
ID	Description	Conformance	Evidence Rating
FSG-0054	Permit the creation of a component filter expression with two values when the user selects a filter operator using 'between'	Recommended	Medium
FSG-0055	Permit the use of more than one component filter expression on the same attribute	Recommended	Low
FSG-0056	Provide the ability for a user to apply more than one filter criteria on the same attribute by adding another complete expression in the filter dialog and selecting the same attribute in both criteria	Recommended	Low

Usage Examples



Selecting 'Date' and then 'between' has correctly created a component filter expression with two value entry controls displayed

Correctly showing the inclusion of two component filter expressions as required



Two Operator Selection Controls have been incorrectly included on one line

Rationale

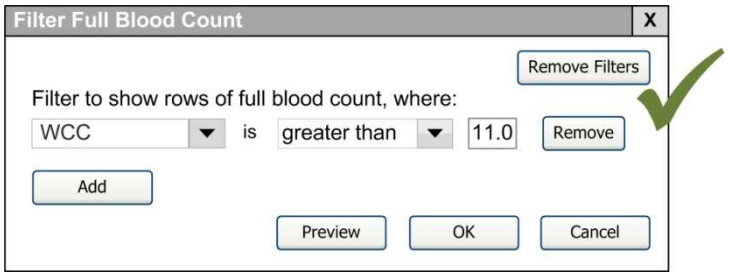
A user is able to set up this filter using the same filter dialog box presentation as tested in user research. At times, it is necessary to apply a filter against data within a particular range. This functionality may be achieved by creating a component filter expression using a range comparison operator, such as 'between', within the Operator Selection Control. Upon selection of the component filter expression, the user is automatically presented with two value entry controls that ensure a range is entered. It is possible to combine two or more filter component filter expressions within a filter. The ability to enhance the filter through use of the existing filter dialog box will avoid any confusion brought about by additional fields or functional requirements. When the user wishes to apply more than one filter expression on the same attribute, this is achieved by adding another component expression in the filter dialog and selecting the same attribute in both expressions.

3.6.8 Removing Filters

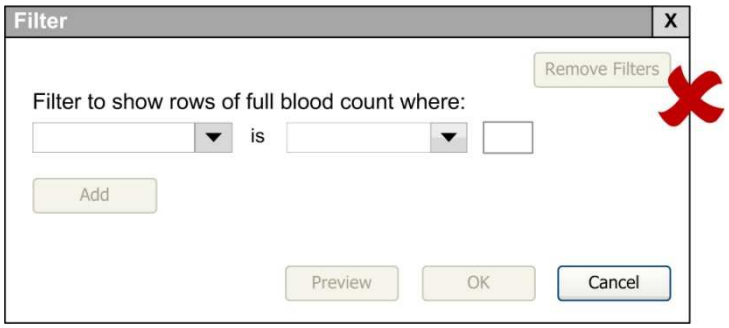
This section provides guidance on the functionality requirements behind removing a filter criterion, or all filter criteria, from the filter dialog box.

ID	Description	Conformance	Evidence Rating
FSG-0057	Provide the capability to remove all filters in one action	Recommended	High
FSG-0058	Provide a dedicated button on each filter criterion line adjacent to the data entry points to remove filters individually in the dialog box	Mandatory	Low
FSG-0059	Label the button to remove an individual filter: 'Remove'	Recommended	Medium
FSG-0060	Label the button to remove all filters in one action: 'Remove All filters'	Recommended	Medium
FSG-0061	During single filter operation, clear the attribute and Operator Selection Controls and the Value Entry Control when the corresponding 'Remove' button on the same filter criterion line is pressed	Recommended	Low
FSG-0062	During the application of multiple filters, remove the controls when the corresponding 'Remove' button on the same filter criterion line is pressed	Recommended	Low
FSG-0063	Clear all attribute and Operator Selection Controls and all Value Entry Controls when the 'Remove filters' button is pressed	Recommended	Low

Usage Examples



In addition to being able to remove all filters in one action, it is possible to remove filters individually



There is no button to remove an individual filter

Rationale

User research evaluated candidate terms for removing a filter, namely 'remove', 'clear', 'default', 'reset', 'empty' and 'undo'. There was no particular preference amongst 'remove', 'clear', and 'default' but a spread across all three. As 'default' can imply system defaults or prefilled values, it was rejected. None of the thirteen respondents found 'reset', 'empty' and 'undo' acceptable.

The placement of the button to remove all filters was also evaluated, and feedback was divided between placing it adjacent to the **Filter** button in the toolbar, and placing it in the filter notification area. No respondent wanted to see the function in the context menu, suggesting that this should never be provided as the only way to access a function. All filters can also be removed in the place where they were originally specified, namely the filter dialog box, which also provides a means for selectively removing individual filters.

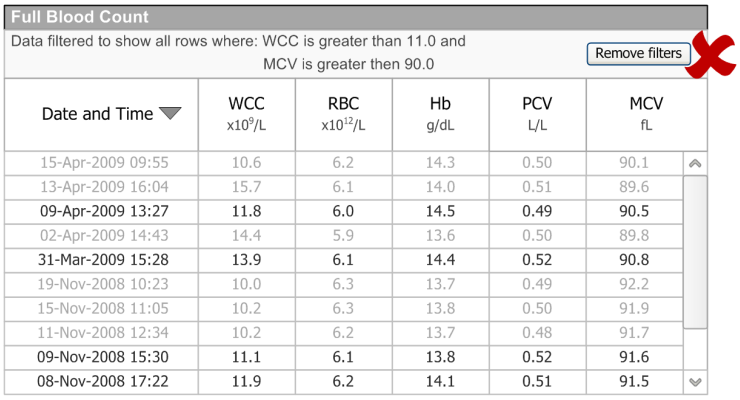
3.6.9 Displaying Results

This section provides guidance on the display of filtered data. The guidance relates to filtered-in and filtered-out data.

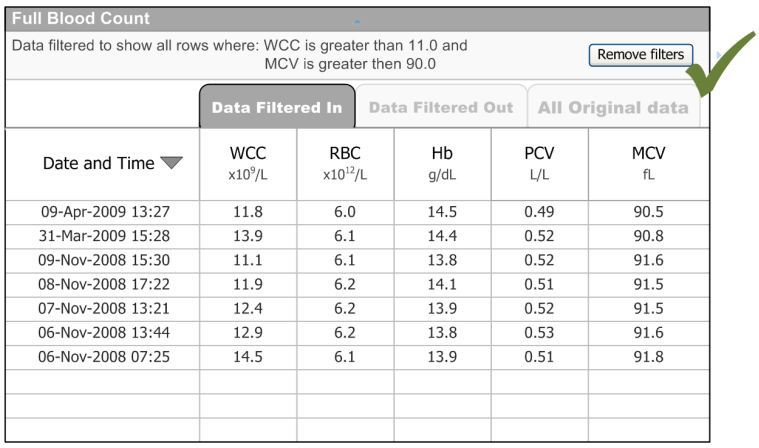
In addition to displaying the filtered data, there is a need to display the criteria on which the filtered data are based. The user will have entered these criteria in the filter dialog box, or in the operator entry control directly in an attribute's header cell, as described in section 3.6.3.

ID	Description	Conformance	Evidence Rating
FSG-0064	On filtering, do not display filtered-out data in the filtered view	Mandatory	Medium
FSG-0065	Provide access to the data filtered in, data filtered out and all original data following the application of the filter criteria	Recommended	Medium
FSG-0066	Provide access to the data that has been removed from view upon filtering	Recommended	Medium
FSG-0067	Provide access to the complete data originally displayed before filtering	Recommended	Medium
FSG-0068	Provide access to categories of filtered data using a set of tab headers across the top of the data set	Recommended	Medium
FSG-0069	Do not support access to categories of filtered data using a set of links from a panel or tabs on the left-hand-side of the table	Recommended	Medium

Usage Examples

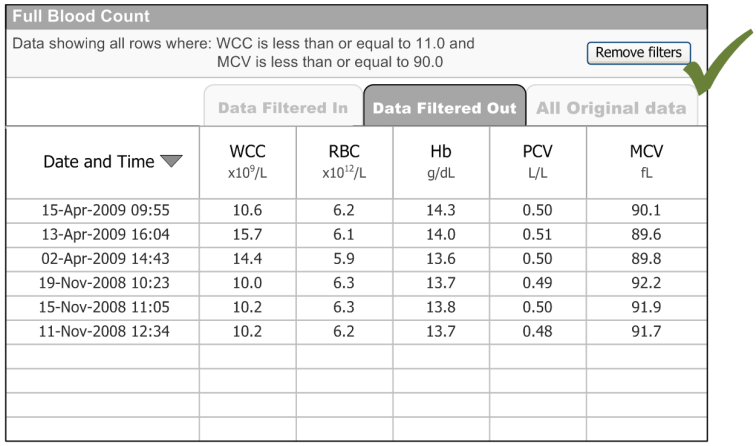


Data that should have been removed is incorrectly displayed as grey text

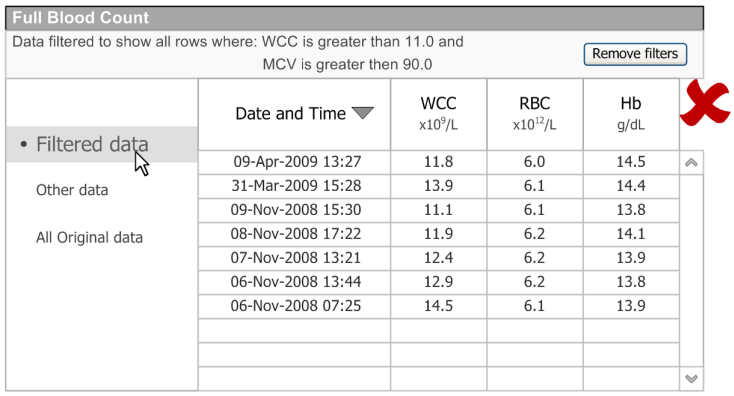


Access to categories of data is correctly provided by the use of tabs across the top of the data.

The filter results are correctly shown in a tab labelled 'Data Filtered In'



The data removed by the action of the filters is easily accessible in the tab labelled 'Data Filtered Out'



Categories of filtered data are incorrectly accessed using a set of links from a panel on the left-hand side. Additionally, the links are labelled incorrectly

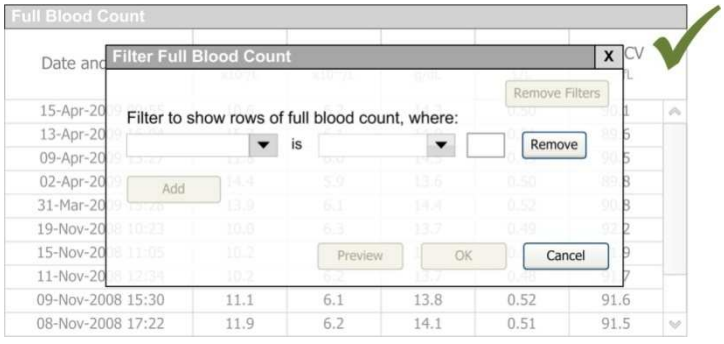
Rationale
Data Display: There was no clear consensus amongst survey respondents as to how the outcome of filtering should be displayed. None of the clinicians who responded to the survey thought it safe from a patient safety perspective to remove data entirely from view; either preferring to see it in a fainter text, or separately such as in another tab. Hence, in this guidance, we recommend that access be provided to the data removed from view. One clinician also commented that it was "useful to have original data present". Guidance partially mitigates the risk that the user may act on incomplete data by ensuring users always have access to the data removed and to the original data. We evaluated a design which included filtered out data in grey text, and one user remarked "What's the point in applying the filter if you then show everything?" whereas another said it was "useful to have all the data present on the same page". Interview data from three users also suggest that none wanted to see the data in a fainter grey text. We also evaluated a tabbed design to provide access to filtered-out data and the original data in addition to the filtered data. This facilitates easy perusal of both the filtered in and filtered out data and helps the user understand the outcome of filtering. One respondent was noted to say "...it should be easy to get back to the full list of results to ensure patient safety". The tabbing function also provides a tab to return to the original data set that assists this respondent's concern. None of the respondents liked the design showing the links to the different tabs on the left-hand side, as this design consumes disproportionately more screen space than other designs at the expense of displaying data.

3.6.10 Filter Notification

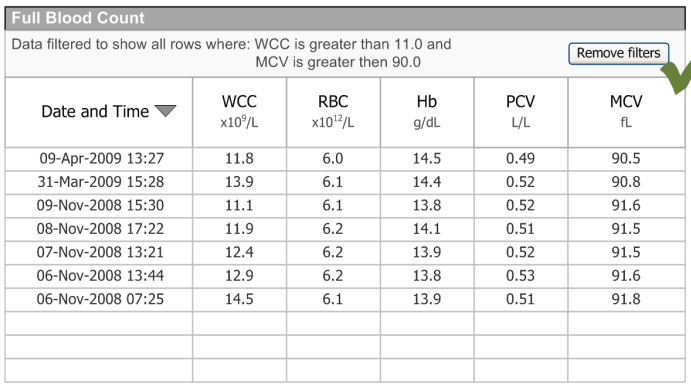
This section provides guidance on the notification to be present within the filter results. The notification provides a user with detail about the filter criteria that has been applied to the data leading to the results shown.

ID	Description	Conformance	Evidence Rating
FSG-0070	Display notification of the filters in operation in a prominent position, using visual design to ensure the notification is seen by the user	Mandatory	High
FSG-0071	Ensure the filter notification area is always attached to the corresponding table	Recommended	Low
FSG-0072	Do not display notification of the filters in operation below the table	Mandatory	High
FSG-0073	Prefix the filter notification with the text: 'Data filtered to show'	Recommended	High
FSG-0074	Provide visual indication that data is being occluded by the dialog box, if appropriate, for example, by giving the dialog box a translucent background	Recommended	Low

Usage Examples



The filter dialog box has the primary focus on-screen and has a translucent background to indicate the presence of information it is occluding



Full Blood Count

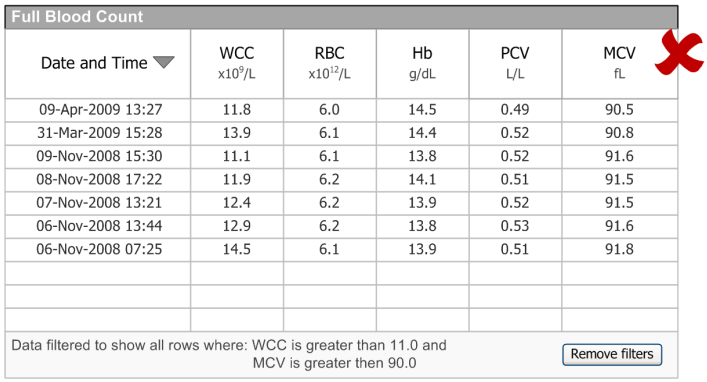
Data filtered to show all rows where: WCC is greater than 11.0 and MCV is greater then 90.0 — Remove filters

Date and Time	WCC x10⁹/L	RBC x10¹²/L	Hb g/dL	PCV L/L	MCV fL
09-Apr-2009 13:27	11.8	6.0	14.5	0.49	90.5
31-Mar-2009 15:28	13.9	6.1	14.4	0.52	90.8
09-Nov-2008 15:30	11.1	6.1	13.8	0.52	91.6
08-Nov-2008 17:22	11.9	6.2	14.1	0.51	91.5
07-Nov-2008 13:21	12.4	6.2	13.9	0.52	91.5
06-Nov-2008 13:44	12.9	6.2	13.8	0.53	91.6
06-Nov-2008 07:25	14.5	6.1	13.9	0.51	91.8

The filter criteria are correctly displayed:

1. In a notification area
2. In a prominent position, adjacent to the table
3. Including the capability to remove all filters is provided in the same notification
4. Notification starts with the text 'Data filtered to show'

Figure 8: Filtered-In Data Displayed with Correct Features



Full Blood Count

Date and Time	WCC x10⁹/L	RBC x10¹²/L	Hb g/dL	PCV L/L	MCV fL
09-Apr-2009 13:27	11.8	6.0	14.5	0.49	90.5
31-Mar-2009 15:28	13.9	6.1	14.4	0.52	90.8
09-Nov-2008 15:30	11.1	6.1	13.8	0.52	91.6
08-Nov-2008 17:22	11.9	6.2	14.1	0.51	91.5
07-Nov-2008 13:21	12.4	6.2	13.9	0.52	91.5
06-Nov-2008 13:44	12.9	6.2	13.8	0.53	91.6
06-Nov-2008 07:25	14.5	6.1	13.9	0.51	91.8

Data filtered to show all rows where: WCC is greater than 11.0 and MCV is greater then 90.0 — Remove filters

The filter criteria notification is incorrectly positioned below the table

Rationale

Notification:

We evaluated alternative designs that displayed the criteria in a notification area that was placed either above or below the table.

Figure 8 correctly presents filter criteria in a notification area in a prominent position adjacent to the table. Additionally, the same notification provides the capability to remove all filters. This meets stated user needs, as noted by a respondent, who said that it "seems to be most universally useful application, when thinking about trying to apply this function to a diverse range of scenarios". Another respondent noted that "it should be evident that the filter is applied". Therefore, when displaying data after filters have been applied, there is a need to ensure that the user is always aware that the displayed data is a filtered subset.

To mitigate the risk that the notification is not seen, it must not be placed in peripheral view but in a prominent position. All respondents to the survey were in agreement that a notification below the table was not acceptable. Whereas clinicians were divided between displaying the notification above the table or in the tab labels, all the ISVs were against the latter, probably due to valid implementation concerns. There is also a risk that the filter criteria in the notification area are mistaken for the normal range of an attribute. To mitigate this risk, ensure that the notification states clearly that the information displayed in the notification area refer to filter criteria, such as by using the text 'Data filtered to show' (as recommended in FSG-0055).

There is a risk that the user may be called away after having applied filters. On returning to view the data, they may have forgotten that they are looking at a filtered subset of patient data, and furthermore they may not notice the status notification, subconsciously blanking it out of their mind. To mitigate this, we discussed the use of animation, triggered after a period of inactivity. In this approach we discussed animating the filter animation area. Any user activity such as a mouse movement, mouse click or key press would stop the animation. Another option, which was not evaluated but which is likely to be implemented in clinical systems, is to close the user session without saving the filter criteria and filtered views. Animation was perceived to be acceptable to the users we consulted.

Occluding Information:

A risk with dialog boxes is that by occluding part of the screen, they hide patient data. Furthermore, the clinician may not be aware that this is occurring, especially when only part of the data is occluded. This risk is mitigated partially in this guidance by the recommendation that the dialog box is translucent. The clinician is then provided with a visual cue of information under the dialog box, directly in the focus of their attention and not in a peripheral area of the screen.

3.7 Guidelines – Sorting

Sorting is the action of arranging elements of a sequence of data through the use of a sort operation applicable to the data set. This section describes guidance on sorting clinical data (for example, showing a list of medications prescribed to a particular patient within a specified timeframe). Single and multiple (that is, progressive) sorts are discussed.

The section also describes the sort dialog box in which the user-specified sort operation is performed, as shown in Figure 9:

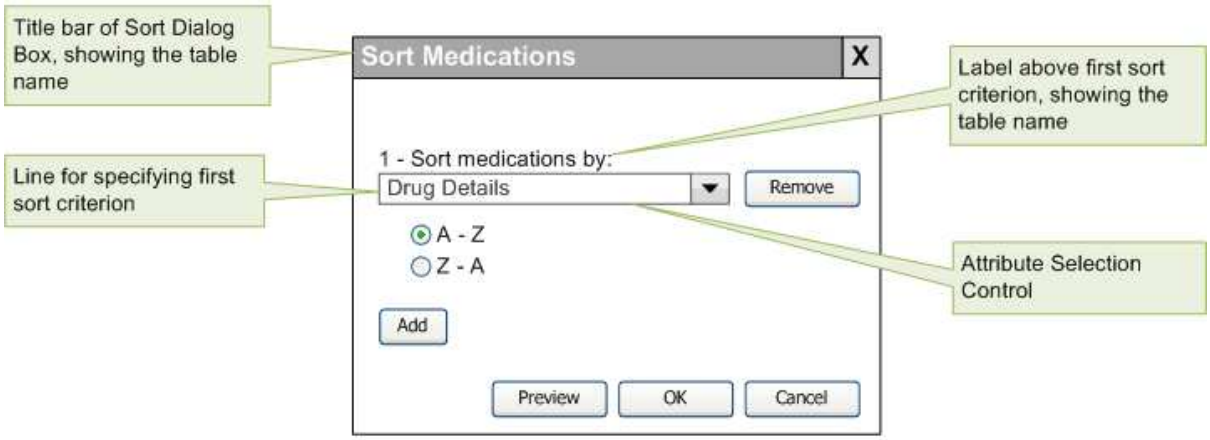


Figure 9: Sort Dialog Box

3.7.1 Display

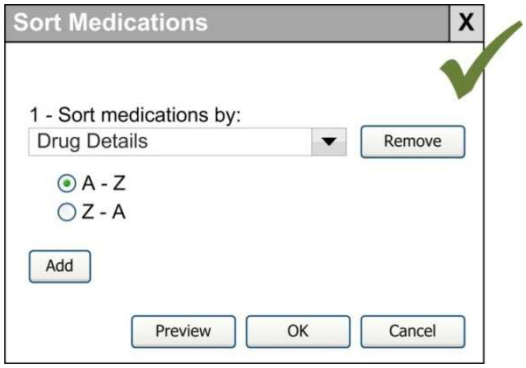
This section provides guidance relating to the presentation of the sort dialog box and initial data presentation.

ID	Description	Conformance	Evidence Rating
FSG-0075	Support the sorting of data according to a user-specified sort operation	Mandatory	High
FSG-0076	Display a sort dialog box for entry of one or more attributes by which data is to be sorted	Recommended	Medium
FSG-0077	Display a label above each sort operation (for example, 'sort X by…' in which X is the name that can be applied to the particular sort operation)	Recommended	Medium
FSG-0078	Include the name of the table from which data is to be sorted in the title of the sort dialog box	Recommended	Medium
FSG-0079	Do not permit the sort dialog box to grow to a size beyond the size of the screen	Mandatory	Low
FSG-0080	Avoid splitting the sort operation line	Recommended	Medium
FSG-0081	Provide the following buttons: 'Preview', 'OK' and 'Cancel'	Recommended	Medium
FSG-0082	Upon the user selecting 'Preview', execute the sort and update the data display accordingly without any additional confirmation dialog box and without closing the dialog box	Recommended	Low
FSG-0083	Upon the user selecting 'OK', close the dialog box, execute the sort and update the data display accordingly without any additional confirmation dialog box	Recommended	High
FSG-0084	Upon the user selecting 'Cancel', close the dialog box, and restore the display to show that data displayed when the sort function was initiated without any additional confirmation dialog box	Recommended	High

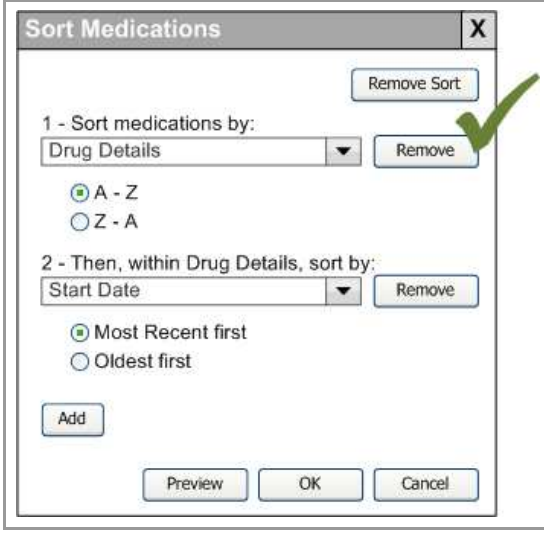
FSG-0085	By default, where date is present within the dataset, the data should be sorted and displayed using the most recent data first (that is, at the top of the table)	Recommended	Medium
FSG-0086	Pre-populate the fields in the sort dialog box with the current sort operation in use	Recommended	Low
FSG-0087	Permit applying sort order by clicking directly in an attribute's header cell, only permitting sorting by one attribute at a time	Recommended	Low
FSG-0088	Do not display data in mixed units, such as metric and imperial units, in the same table	Mandatory	Medium
FSG-0089	Display the unit measurement in the header row to provide clarity on the data presented in the column	Recommended	Medium

Usage Examples

The initial display of the sort dialog box

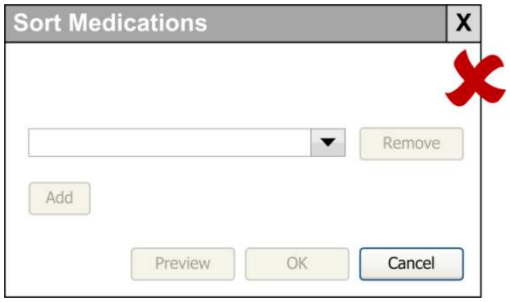


Sort dialog box with one attribute entered

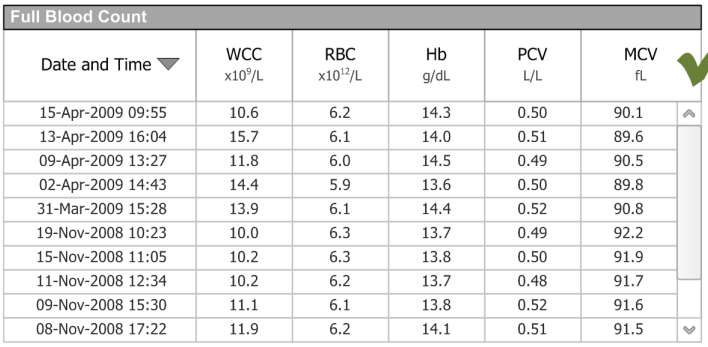


Sort dialog box with two attributes entered

Incorrect presentation of the sort dialog box as no radio buttons are present below the first attribute



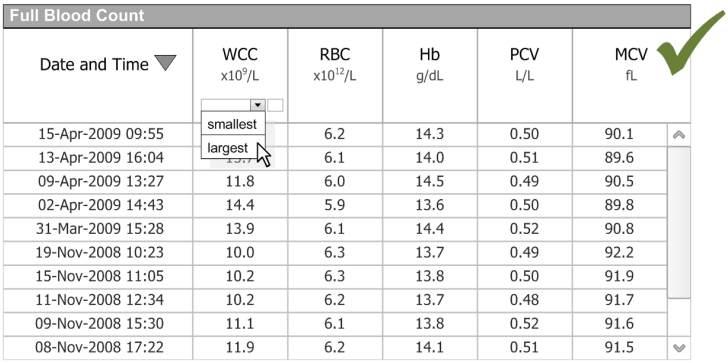
Incorrect presentation of the sort dialog box as no label is present above the attribute being sorted



Full Blood Count

Date and Time	WCC x10⁹/L	RBC x10¹²/L	Hb g/dL	PCV L/L	MCV fL
15-Apr-2009 09:55	10.6	6.2	14.3	0.50	90.1
13-Apr-2009 16:04	15.7	6.1	14.0	0.51	89.6
09-Apr-2009 13:27	11.8	6.0	14.5	0.49	90.5
02-Apr-2009 14:43	14.4	5.9	13.6	0.50	89.8
31-Mar-2009 15:28	13.9	6.1	14.4	0.52	90.8
19-Nov-2008 10:23	10.0	6.3	13.7	0.49	92.2
15-Nov-2008 11:05	10.2	6.3	13.8	0.50	91.9
11-Nov-2008 12:34	10.2	6.2	13.7	0.48	91.7
09-Nov-2008 15:30	11.1	6.1	13.8	0.52	91.6
08-Nov-2008 17:22	11.9	6.2	14.1	0.51	91.5

The attribute, namely 'Date and Time', correctly showing the default position, where date should be sorted and displayed using the most recent data first



The attribute 'WCC' header row is correctly shown with the right click sort option selected

Rationale

Sorting:

We asked respondents to imagine that they wanted to see a patient medications list with the most recently prescribed medication at the top of the list and the other medications listed sequentially underneath, based on the time they were prescribed. Most respondents recognised the term 'sorting' as being applied to this functionality.

Previewing Sorted Data:

The 'preview' function enables a user to explore the application of a user-specified sort order by applying a temporary (that is, exploratory) sort operation. The sort dialog box can be positioned so as not to overlap the data and different sort orders applied to understand how they act to change the displayed data. Finally, the user can commit to a sort operation (by clicking the **OK** button) or can choose to leave the display unchanged (by clicking the **Cancel** button).

Data Units:

This guidance recommends including units within the column header row. However, it is also acknowledged that the inclusion of units requires space within the cell that is a limitation when subject matter text also appears within the same cell. The display of units arguably consumes screen space in a sort dialog box, where the name of the attribute and operation are important not the units. A clinician knows the units, and does not need to see them for the task at hand, namely sorting. However, when specifying a sort operation that must span a range (for example, 200 mg to 1 g), units may become necessary, though there is a risk with displaying data in mixed units in a column. There is also a risk with displaying unfamiliar units in a column (for example, 1000 mg instead of 1 g). As this has not been explored in the development of this guidance, we do not make recommendations on the display of units, except to include a prohibition on mixing imperial and metric units in the same table column.

Direct Manipulation in a Header Cell:

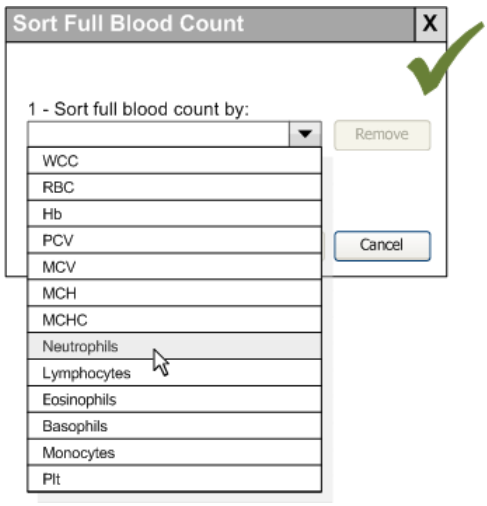
All respondents to the survey knew to click in a column's header cell to sort (and reverse sort) the table. A small number of respondents said they expected to have to click on the sort indicator itself, whereas most thought they could click anywhere inside the header cell.

3.7.2 Attribute Selection Control

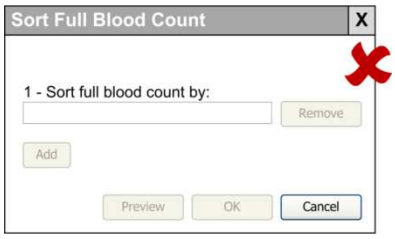
This section describes the Attribute Selection Control. The Attribute Selection Control in the sort dialog box enables the user to select a particular sort attribute.

ID	Description	Conformance	Evidence Rating
FSG-0090	Display the label '1 - Sort *X* by:' above the first Attribute Selection Control, where *X* is the name that can be applied to each row of data in the table, for example 'medications', and is likely to be the title of the table	Recommended	Medium
FSG-0091	Display the label '*N* – Then, within *Y*, sort by:' above the second and subsequent Attribute Selection Controls, where *N* is the number of the Attribute Selection Control in the list of controls in the dialog box, and *Y* is the name of the attribute selected in the immediately preceding control	Recommended	Medium
FSG-0092	Pre-populate the Attribute Selection Controls in the sort dialog box with the current attributes governing sorting, where appropriate	Recommended	Medium
FSG-0093	Display the attribute names as menu items in the Attribute Selection Control menu, listing them in the same order in the menu as they are displayed in the table, and then adding any attributes that are not displayed	Recommended	Medium
FSG-0094	Provide a button to add an additional Attribute Selection Control, labelling this button 'Add'	Recommended	Medium
FSG-0095	Move the 'Add' button down one line when it is pressed, displaying a new Attribute Selection Control in the line previously occupied by the 'Add' button	Recommended	Medium
FSG-0096	Display the 'Add' button immediately below the last Attribute Selection Control and left-aligned with it	Recommended	Medium
FSG-0097	Permit sorting by any of the columns displayed in the table (that is, by attribute) whether in view or off screen	Mandatory	Medium
FSG-0098	Permit a user to add a column not previously displayed	Mandatory	Medium

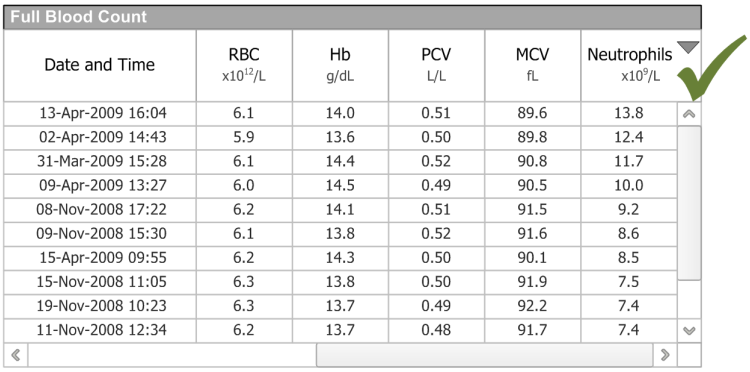
Usage Examples



The attribute selection menu showing menu items formed by first listing the attributes in order as displayed in the data table (namely WCC to MCV), and then listing the items not displayed in the table (MCH and onwards)



The Attribute Selection Control incorrectly showing a free text field for completion



A new column, **Neutrophils**, has been added to the right side of the table (through the sort dialog box), causing the **WCC** column to scroll off the left side. A horizontal scroll indicator has appeared below to indicate these changes to the display and the scroll bar is positioned on the right side. Finally, the rows have been sorted by the values in the new column (**Neutrophils**), as correctly indicated by the sort indicator

Figure 10: Data Display After Sorting by a Hitherto Undisplayed Attribute

Rationale

During user testing, respondents indicated that they would like to be able to sort against data shown on screen and also against data not currently on screen. Therefore, we recommend including all attributes within the sort dialog box to assist the user with this requirement.

Sorting by an Attribute not Currently Displayed:

The survey asked users whether they would need to sort the table by an attribute that was not currently displayed. In our example, we proposed sorting by Neutrophils. When asked how they would go about performing such a sorting operation, half the respondents said they would first add the required Neutrophils column (using a mechanism as set out above). They went on to say that it would be acceptable for the new column to be added to the table, displayed at one end and for a horizontal scroll bar to appear (if appropriate) indicating that a column had been added. One user commented that this was acceptable "as long as it is obvious you need to scroll to see more data". Another user commented that this "blocks other data being seen on the screen", alluding to a patient-safety concern, as can be seen in Figure 10 where the **WCC** column has scrolled off the screen.

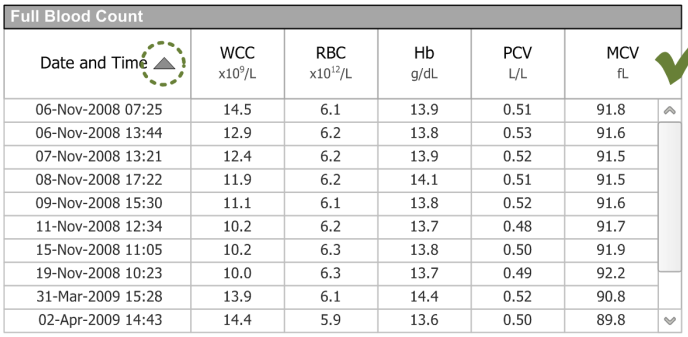
This guidance does not mandate that a horizontal scroll bar must be provided, leaving it open to the developers of clinical applications to provide suitable visual indication of the appearance of data and of the removal of other data. Scrolling vertically is unavoidable for most medical data sets and the mitigation of the associated hazards using the Look-Ahead Scroll Bar has been discussed in the document *Design Guidance – Medications Management – Medications Views* **{R1}**). An additional horizontal scroll bar tends not to be looked upon favourably by users of non-clinical applications. However, it may well be unavoidable for certain data sets that normally contain many attributes that it is not possible to collapse or merge (such as blood results).

3.7.3 Sort Indicator

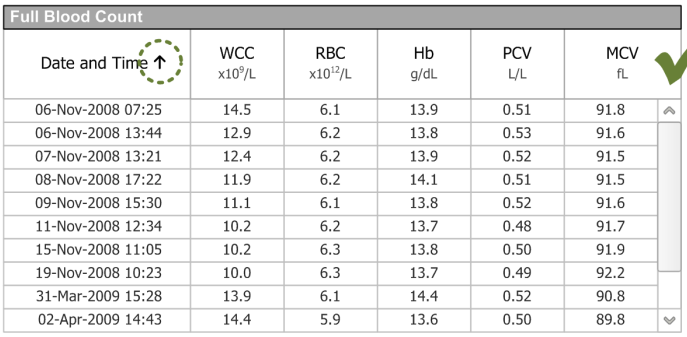
This section describes guidance on the sort indicators, including guidance relating to the location of, and detail on, their presentation.

ID	Description	Conformance	Evidence Rating
FSG-0099	Display a sort indicator in the header cell of the column(s) by which data is sorted, to indicate the attribute(s) by which the data is sorted, and the relevant sort order	Mandatory	High
FSG-0100	The sort indicator must have an up-down direction indicator, so it may be displayed in two different orientations as appropriate	Mandatory	High
FSG-0101	Provide a definition and a means to access the definition (for example, by a tooltip), explaining the meaning of the sort indicator	Recommended	Medium
FSG-0102	Display the sort indicator in a fixed position in relation to the other contents of the column's header cell	Recommended	Medium

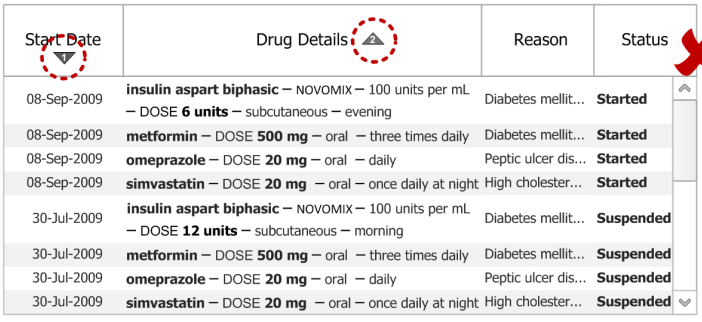
Usage Examples



An example sort indicator (shown in green circle)



An example showing an alternative sort indicator (shown in green circle)



This shows the inconsistent positioning of the sort indicators (that is, one underneath the field header and the other to the right of the field header, as shown in red circles)

Rationale
During user testing, respondents stated that the presence of a triangle within the attribute header cell denoted a particular sort order present. We asked respondents how they would reverse a sort order in the sample data and received positive responses that this would be achieved by clicking directly on the “arrow in the date box” and “click on the triangle icon”. It is therefore recommended to include a sort indicator to provide an immediate visual indication of a sort order. Section 3.7.6 provides detail on Progressive Sort using the sort indicator.

3.7.4 Sort Order Manipulation

This section describes guidance on sort order manipulation.

ID	Description	Conformance	Evidence Rating
FSG-0103	Do not use the following labels for sort orders in a sort dialog box: ■ ‘Ascending’ ■ ‘Descending’ ■ ‘Chronological’ ■ ‘Reverse Chronological’	Recommended	High
FSG-0104	Use the following words in labels in the sort dialog box when describing sort orders, as appropriate: ■ ‘Newest’ ■ ‘Latest’ ■ ‘Most Recent’ ■ ‘Oldest’ ■ ‘Largest’ ■ ‘Greatest’ ■ ‘Smallest ■ ‘First’ ■ ‘on top’	Recommended	High
FSG-0105	Support the sorting of integers by providing the implicit sort orders: ■ Ascending ■ Descending	Recommended	High
FSG-0106	Support the sorting of ordered sets of symbols by providing explicit sort orders as provided by the ISV (for example, by severity values or by AVPU designations). Severity values: ■ Normal ■ Mild ■ Severe ■ Fatal AVPU designations: ■ Alert ■ Responds to voice ■ Responds to pain ■ Unresponsive	Recommended	High

FSG-0107	Support the sorting of unordered sets of symbols (such as diagnosis or problem) by providing the implicit sort orders: ▪ Alphabetic ▪ Reverse alphabetic	Recommended	High
FSG-0108	Support the sorting of strings (free text) by providing the implicit sort orders: ▪ Alphabetic ▪ Reverse alphabetic	Recommended	High
FSG-0109	Support the sorting of dates by providing the implicit sort orders: ▪ Chronological ▪ Reverse Chronological	Recommended	High
FSG-0110	Support the sorting of real numbers by providing the implicit sort orders: ▪ Ascending ▪ Descending	Recommended	High
FSG-0111	Support the sorting of date and time by providing the implicit sort orders: ▪ Chronological ▪ Reverse Chronological	Recommended	High
FSG-0112	Provide an ISV specified sort order for ordinal data types, where appropriate	Recommended	High
FSG-0113	Provide an ISV specified sort order for continuous data that includes symbolic values (for example, '<10')	Recommended	Low
FSG-0114	Use an alphabetic sort order where a data type does not have an intrinsic sort order and where none has been provided	Recommended	Low
FSG-0115	Use the following labels in the sort dialog box when describing sort orders for textual data: 'A – Z' or 'Z – A', as appropriate	Recommended	High

Usage Examples

Example correctly supporting the sorting of medications and date by radio buttons setting out sort orders

Rationale

Sorting Control and Labels:

When asked which terms best described sort orders for dates, 'most recent' and 'least recent' were rated highly by health care staff, while 'chronological' and 'reverse chronological' was rated highly by independent software vendors. Other sets of terms such as 'newest and oldest' and 'ascending and descending' were marginally less popular. For numerical data, the two most popular labels for sort orders were 'ascending and descending' and 'highest to lowest'. In addition to user preference, there is a need to select a label that is likely to be widely understood by health care staff and that is not wasteful of screen space.

Therefore, this guidance recommends these labels when describing sort orders in the sort dialog box:

- 'Most Recent' and 'Oldest' for dates
- 'Largest' and 'Smallest' for numerical data
- 'A – Z' and 'Z – A' for textual data
- An appropriate label for a range of numerical data (for example, '0 – 9' and '9 – 0')

Sort Orders and Ordinal Data:

Numerical data, and dates, can each be easily arranged by their inherent order. Numerical data can be sorted in increasing and decreasing order, and dates in chronological and reverse chronological order. An example of ordinal data is 'AVPU', designed for use in paediatrics. It is used similarly to the Glasgow Coma Score (GCS) to assess patient responsiveness. The letters A, V, P and U indicate a patient's condition as follows:

- A = Alert
- V = Responds to voice
- P = Responds to pain
- U = Unresponsive

As can be seen, the letters have an inherent order, from most alert to least alert. This is an example of ordinal data where alphabetical ordering would not be acceptable but where a sort order has to be provided to the clinical application. Table 6 lists sort orders for various data types.

3.7.5 Removing Sort

This section provides guidance on how to remove a sort order. This functionality relates to the removal of both individual and all sort operations from the sort dialog box.

ID	Description	Conformance	Evidence Rating
FSG-0116	Provide a capability to remove an individual operation from the sort dialog box	Recommended	Medium
FSG-0117	Provide a capability to remove all of the sort operations entered in the sort dialog box in one action	Recommended	High
FSG-0118	Label the button to remove an individual sort operation 'Remove'	Recommended	Medium
FSG-0119	Label the button to remove all sort operations in one action: 'Remove All'	Recommended	Medium
FSG-0120	During single sort operation, clear the Attribute Control and related operators when the corresponding 'Remove' button on the same filter operation line is pressed	Recommended	Low

Usage Examples

In addition to being able to remove all sort operations in one action, it is possible to remove a sort operation individually

There is no button to remove an individual sort operation

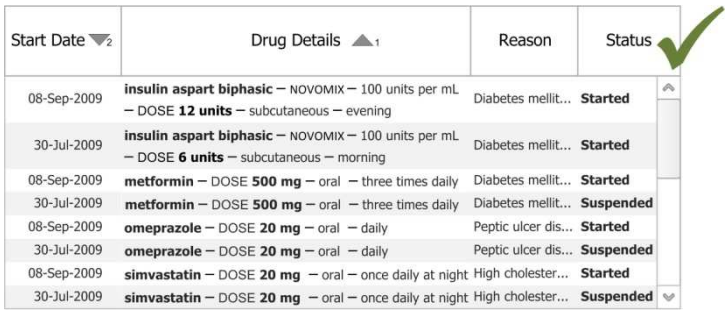
Rationale
User research evaluated candidate terms for removing a filter, namely ‘remove’, ‘clear’, ‘default’, ‘reset’, ‘empty’ and ‘undo’. There was no particular preference amongst ‘remove’, ‘clear’, and ‘default’ but a spread across all three. As ’default’ can imply system defaults or prefilled values, it was rejected. None of the thirteen respondents found ‘reset’, ‘empty’ and ‘undo’ acceptable. We recommend that this respondent data is also applied to the sorting function. The placement of the button to remove all filters was also evaluated, and feedback was divided between placing it adjacent to the **Filter** button in the toolbar, and placing it in the filter notification area. No respondent wanted to see the function in the context menu, suggesting that this should never be provided as the only way to access a function. All filters can also be removed in the place where they were originally specified, namely the filter dialog box, which also provides a means for selectively removing individual filters. Again, we recommend that this respondent feedback is applied to the sorting function.

3.7.6 Progressive Sort

This section describes guidance on the progressive sort function (that is, where data is sorted by more than one attribute at the same time).

ID	Description	Conformance	Evidence Rating
FSG-0121	Permit progressive sorting	Mandatory	Medium
FSG-0122	In the case of a progressive sort, in addition to displaying the sort indicator in the appropriate header cells, also display the number for the rank of each attribute in the set of attributes by which the data is sorted, displaying ‘1’ for the primary attribute, ‘2’ for the secondary attribute, and so on	Recommended	Medium
FSG-0123	Ensure display of the number for the rank in a progressive sort indicator is not accidentally visually associated with other information displayed in the same cell or in adjacent cells	Mandatory	Medium

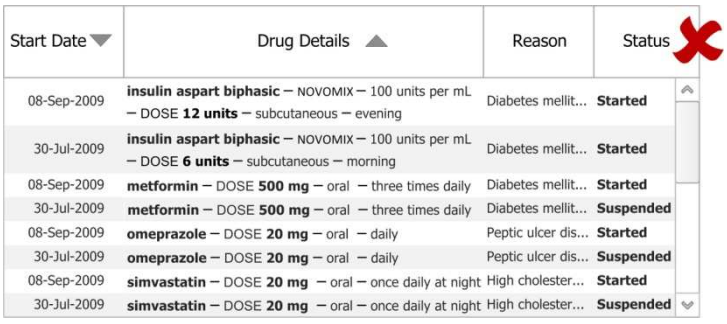
Usage Examples



Start Date ▼2	Drug Details ▲1	Reason	Status
08-Sep-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **12 units** – subcutaneous – evening	Diabetes mellit...	**Started**
30-Jul-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **6 units** – subcutaneous – morning	Diabetes mellit...	**Started**
08-Sep-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Started**
30-Jul-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Suspended**
08-Sep-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Started**
30-Jul-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Suspended**
08-Sep-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Started**
30-Jul-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Suspended**

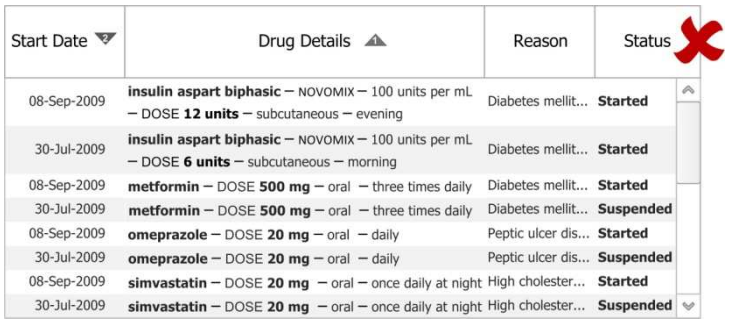
Figure 11: A Progressive Sort of a Medications List

This illustrates the correct display of the outcome of a progressive sort, showing the sort indicator **with** a number that indicates the sequence of the attributes in the application of the progressive sort



Start Date ▼	Drug Details ▲	Reason	Status
08-Sep-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **12 units** – subcutaneous – evening	Diabetes mellit...	**Started**
30-Jul-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **6 units** – subcutaneous – morning	Diabetes mellit...	**Started**
08-Sep-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Started**
30-Jul-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Suspended**
08-Sep-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Started**
30-Jul-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Suspended**
08-Sep-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Started**
30-Jul-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Suspended**

This illustrates the incorrect display of the outcome of a progressive sort, showing the sort indicator **without** a number that indicates the sequence of the attributes in the application of the progressive sort



Start Date	Drug Details	Reason	Status
08-Sep-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **12 units** – subcutaneous – evening	Diabetes mellit...	**Started**
30-Jul-2009	**insulin aspart biphasic** – NOVOMIX – 100 units per mL – DOSE **6 units** – subcutaneous – morning	Diabetes mellit...	**Started**
08-Sep-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Started**
30-Jul-2009	**metformin** – DOSE **500 mg** – oral – three times daily	Diabetes mellit...	**Suspended**
08-Sep-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Started**
30-Jul-2009	**omeprazole** – DOSE **20 mg** – oral – daily	Peptic ulcer dis...	**Suspended**
08-Sep-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Started**
30-Jul-2009	**simvastatin** – DOSE **20 mg** – oral – once daily at night	High cholester...	**Suspended**

This shows the incorrect display of the outcome of a progressive sort: the number indicating the sequence of the attributes in the application of the progressive sort is incorrectly shown inside the sort indicator

Rationale

Progressive Sort:

'Progressive sort' is applied where multiple rows contain a column with the same value present (for example, all on the same date). It is then possible to sort those rows with a sort operation applied to another column. One respondent commented that "compound sort orders are too complex for the average user". Progressive sort is useful in those limited cases where application of the first sort does not adequately differentiate the data. When the Medications List View is sorted by 'Drug Details', medication lines with the same drug details would be displayed in no particular date order.

If one were instead to sort first by 'Drug Details' and then, within those results, by 'Start Date', the resulting display shows the medications sorted alphabetically and then by date, as shown in Figure 11. Here, 'Drug Details' can be considered the primary sort, and 'Start Date' the secondary sort:

Progressive Sort Indicator:

When data is sorted by more than one attribute, display as many sort indicators as attributes used to govern the sort. Additionally, it is important to indicate the position each attribute occupied in the sorting sequence. For the example shown in Figure 11, the correct numbers are '1' for the primary sort (Drug Details) and '2' for the secondary sort (Start Date). User research found that an equal number of health care staff wanted to see a number in the header cell as those that did not. One participant remarked: "This kind of 'double sort' is completely new for clinicians....I am not sure which would be safer. But somewhere it needs to state clearly this data is sorted first by date and then the medication is sorted alphabetically". The sort number represents the position of an attribute in the sorting sequence and there was a marginal, but not statistically significant, preference for the number to be placed adjacent to, but not within, the sort indicator. Because the header cell may have other numeric information, such as the normal range, it is important to ensure that there is no confusion causing misreading of either the sort indicator or the normal range.

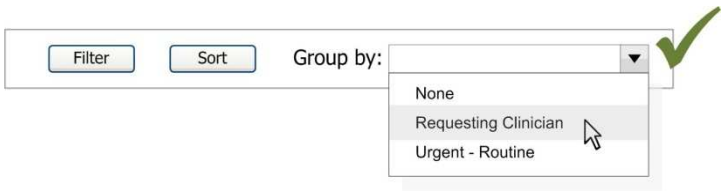
3.8 Guidelines – Grouping

This section describes guidance on grouping. This is a sorting operation, where data is organised primarily into clusters instead of a sequential order.

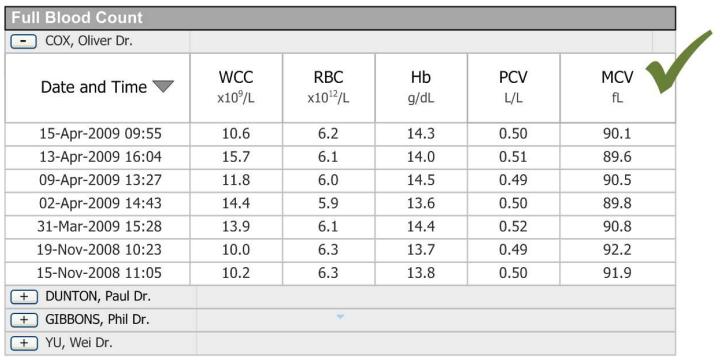
Grouping is particularly useful where one wants to view all data sharing the value of a certain attribute, such as all tests ordered by a certain clinician. Grouping is initiated by use of the grouping control on the toolbar, as discussed in section 3.5.

ID	Description	Conformance	Evidence Rating
FSG-0124	Display clear and prominent headings for each group within the table	Recommended	High
FSG-0125	When the user scrolls data, maintain a visible display of the current group heading that applies to the data on screen and avoid the heading scrolling out of view	Recommended	Low
FSG-0126	Do not display groups in separate tabs	Recommended	Low
FSG-0127	Permit each group to be expanded and collapsed individually	Recommended	High
FSG-0128	Provide an icon to indicate the state of the group, that is, whether it is expanded or collapsed	Recommended	High
FSG-0129	Permit the user to swap between the expanded and collapsed states by clicking on the icon	Recommended	High
FSG-0130	Initially, display all groups in the expanded state	Recommended	Low
FSG-0131	Provide the capability to remove grouping by selecting the menu item 'None' from the grouping control	Recommended	Medium
FSG-0132	Provide the capability to initiate grouping by selecting the required group from a menu displayed in the grouping control	Recommended	High
FSG-0133	Retain the column sort order (if any) when grouping is applied	Recommended	Medium
FSG-0134	Provide 'null' groups (where necessary) to support the display of data that does not have a value for the attribute being used for grouping	Recommended	Low

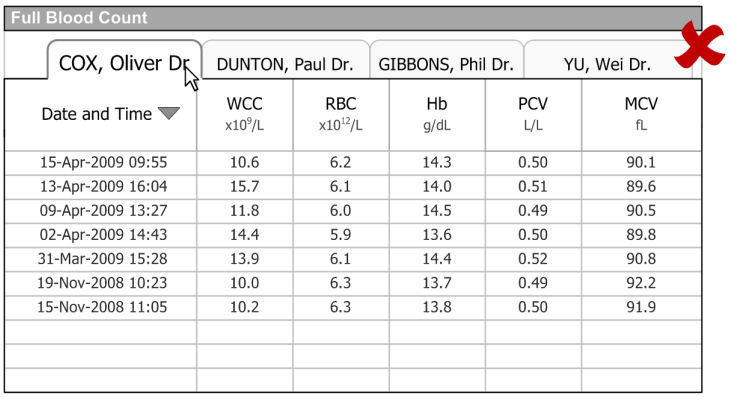
Usage Examples



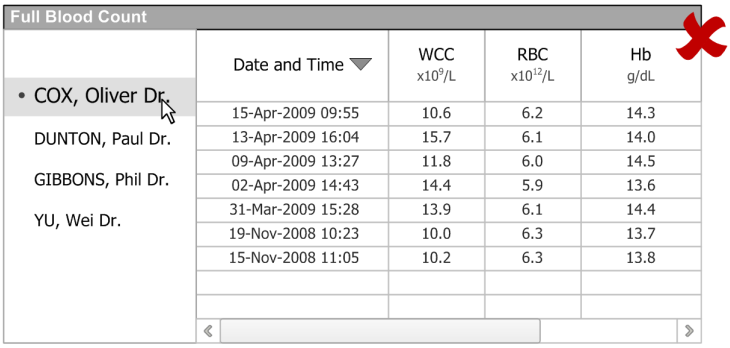
Initiation of the grouping functionality from the toolbar



Groups are displayed correctly within the table. Each group has a title and an accompanying icon. The icons clearly show which groups can be expanded and which can be collapsed



Groups are displayed in tabs. This prohibits all data being viewed together and potentially necessitates much movement between tabs. Additionally, this is a non-standard UI style for displaying groups



Groups are displayed with links on the left-hand side wasting valuable screen space that could be better utilised to display patient data

Rationale

The display of groups in individual tabs has the advantage that, where a data set comprises different lists that cannot be displayed vertically, they can be easily displayed alongside each other. For example, medications fall into classes and could be presented by class type. These lists have different column headings, therefore they cannot easily be laid out vertically because new column headings would need to be inserted as required. Also, where data in each of the lists are for the same time point, the lists need to be seen alongside each other and not one above the other. The tabbed approach partially facilitates this desired view. Additionally, as reported by one respondent to the survey, the tabs “resemble how the results are stored in paper files”.

However, while supporting a user’s familiar pattern of use is a desirable aim, the tabbed approach has disadvantages. It does not permit all the data to be seen in one list, limiting the application of additional functions (such as filtering on the complete data set). If, in the tabbed approach, the user were to apply a filter when looking at one tab, it is not clear how the other tabs should be changed. If filtering was applied before grouping, and the outcome displayed in tabs, the subsequent grouping would create an additional set of tabs. Also, if the application itself was using tabs, there could be multiple levels that would potentially be very confusing for a user.

4 Document Information

4.1 Terms and Abbreviations

Abbreviation	Definition
AVPU	Alert, Voice, Pain, Unresponsive
CAPS	Clinical Applications and Patient Safety`
CUI	Common User Interface
GCS	Glasgow Coma Score
GP	General Practitioner
Hb	Hemoglobin
HCP	Health Care Professional
ISV	Independent Software Vendor
ITP	Information Technology Professional
ITU	Intensive Therapy Unit
MCH	Mean Corpuscular Hemoglobin
MCHC	Mean Corpuscular Hemoglobin Concentration
MCV	Mean Corpuscular Volume
NHS	National Health Service
NHS CFH	NHS Connecting for Health
NPfIT	National Programme for Information Technology
PCV	Packed Cell Volume
Pit	Platelet
RBC	Red Blood Cell
UI	User Interface
WCC	White Cell Count

Table 8: Terms and Abbreviations

4.2 Definitions

Term	Definition
AND	Returns True if all of its component filter expressions are true. Returns False if any of the component filter expressions are false
Attribute Selection Control	A control in the filter dialog and sort dialog boxes that enables the user to select a particular filter or sort attribute.
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.
Component filter expressions	Selected criteria built around a logical operator.

Term	Definition
Filtering	The removal of data from view, so as to focus on a subset of data that is relevant to the task at hand (in this case, the clinical task). The application of each filter criterion specifies a subset of data to keep in view.
Filter Operators	Operators that can be applied to both discrete and continuous data values in the filter dialog box.
Grouping	To arrange elements of a collection into different categories. A clinical example is: 'Show me all of the patient's current and past medicines, grouped separately by Type such as Antibiotics and so on'.
Logical Connective Operators	These operators are provided to unite logical data sets within the filter or sort criterion.
Operator Selection Control	A control in the filter dialog box that enables the user to select a particular filter operator.
OR	A logical operator. Returns True if any of its operands are true. Returns False if all of its operands are false.
Progressive Sort	A type of sort where data is sorted by more than one attribute at a time.
Sorting	To arrange elements of a sequence according to some criterion, such as alphabetically (A to Z), or numerically (1, 2, 3...). A clinical example is: 'Show me all the medications this patient has ever been prescribed, in alphabetic order of medicine name'.
Value Entry Control	A control in the filter dialog box that enables the user to select a particular filter value.

Table 9: Definitions

4.3 Nomenclature

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

4.3.1 Body Text

Text	Style
Code	Monospace
Script	
Other markup languages	
Interface dialog names	**Bold**
Field names	
Controls	
Folder names	Title Case
File names	

Table 10: 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	*Italics* and possibly a footnote
Publicly available documents	*Italics* with a footnote
External Web-based content	*Italics* and a hyperlinked footnote

Table 11: Cross Reference Styles

4.4 References

Reference	Document	Version
R1.	Design Guidance – Medications Management – Medications Views	2.0.0.0
R2.	Design Guidance – Date Display	2.0.0.0
R3.	Design Guidance – Time Display	2.0.0.0
R4.	Design Guidance – Date and Time Input	2.0.0.0
R5.	Design Guidance – Displaying Graphs and Tables	2.0.0.0
R6.	Research-Based Web Design and Usability Guidelines – Koyani et al – U.S. Department of Health and Human Services http://www.usability.gov/pdfs/guidelines.html	
R7.	Hypertext Markup Language - 2.0 – Berners–Lee & Connolly – Network Working Group http://www.ietf.org/rfc/rfc1866.txt	1995
R8.	17.2.1 Control types – radio buttons – HTML 4.01 Specification – W3C Recommendations http://www.w3.org/TR/html4/interact/forms.html#radio	1999
R9.	Checkboxes vs. Radio Buttons – Jakob Nielsen's Alertbox http://www.useit.com/alertbox/20040927.html	2004
R10.	Design Guidance – Accessibility Checklist	1.0.0.0
R11.	Design Guidance – Accessibility Principles	1.0.0.0

Table 12: References

APPENDIX A USER RESEARCH EXECUTIVE SUMMARY

PART I ABSTRACT

The UK National Health Service (NHS) Common User Interface (CUI) programme is a partnership between Microsoft® and NHS Connecting for Health (NHS CFH), which is part the NHS National Programme for Information Technology (NPfIT).

As part of CUI, the Clinical Applications and Patient Safety (CAPS) project has the goal of ensuring that software applications used by the NHS enhance patient safety. To achieve this, CAPS provides software developers with user interface design guidelines derived through a user-centric development process that includes explicit patient-safety evaluations.

This summary describes the results of an online survey completed by 13 people including six Health Care Professionals (HCPs) and seven Health Care Information Technology Professionals (ITPs). All respondents were experienced with current computer based sorting behaviours. Two of the HCPs were not experienced with computer based filtering.

Purpose: to assess first iteration static wireframe design options for filtering, sorting and grouping lists within patient records. Method: to elicit user preferences, understandings and patient safety expertise through multiple choice questions.

Sorting results:

- Preference for labelling date and numeric sort orders
- Having the sort order of progressive sorts labelled with a number
- Adding sort variables to show in the list display
- Scrolling the screen to show recently added sort variables

Filtering results:

- More respondents found filter-in rather than filter-out useful
- Most respondents want to choose how filter criteria are combined (AND/OR)
- No clearly preferred design for filter results display
- More HCPs identified a tab-based filter results display design as patient safe
- Respondents preferred models for feedback that a filter is applied where the feedback is placed above the list and close to the filter remove mechanism.

Grouping results: a within-lists display of group was more popular than other designs.

PART II RESEARCH OBJECTIVES

This research study was designed to gather HCP preferences and patient safety assessments of low fidelity wireframe design options for filtering, sorting and grouping lists within patient records.

The specific objectives were to identify:

1. Appropriate UI terminology for referring to sorting and filtering activities.
2. An effective design to convey the outcomes of progressive sorts.
3. User expectations and preferences for sorting by variables within a software application data-model that are not displayed on screen by default.
4. A design that effectively conveys the impact of combining filter criteria.

5. How to safely enable the user to know what data has been filtered out and how to re-access that data.

PART III RESEARCH DESIGN

An on-line survey was used to collate responses to gray-scale wireframe static designs. Survey questions were piloted and refined during 3 consecutive interviews with 3 HCP. These interviews ensured that the designs, data and questions were sufficiently realistic and could be understood by HCP. Multiple choice questions were used to collect clear quantitative data. Choice options were systematically randomised per respondent to remove any response biasing due to option ordering. Each multiple choice question was accompanied by an open-text box inviting the respondent to describe the reasons for their choice. CFH distributed the survey to NHS employees that had signed-up to participate via the CFH Events Management System. Recipients were able to forward the survey to colleagues. No remuneration supplied for completing the survey. The survey took 20-40 minutes to complete.

PART IV RESULTS

Respondent description

Thirteen people completed the survey between and Friday the 18th and Monday 27th October. Respondents had worked for the NHS for diverse time-frames from less than 1 year to between 25 and 19yrs and were based in diverse geographical locations. Respondents were predominantly Hospital based employees (8/13) and included four Junior Doctors, no nurses, no General Practitioners, no community based HCP and no health care administrative staff. Seven respondents were Information Technology Professionals (ITP), three of whom had no direct experience of employment within the NHS. Table 13: Respondent Descriptions, below, provides a summary of individual respondents job roles, NHS employment, workplace and main work location.

Respondent Identifier	Job Role	Years employed in the NHS	Workplace	Location
p1	Anaesthetist	20-24 years	Hospital	South West England
p2	Junior Doctor	1-4 years	Hospital	London
p3	Junior Doctor	1-4 years	Hospital	London
p4	Junior Doctor	1-4 years	Hospital	London
p5	Junior Doctor (Specific Audience)	1-4 years	Hospital	London
p6	Medical Consultant	5-9 years	ISV, also clinician	South West England
p7	Healthcare IT manager	25-29 years	Hospital	Yorkshire and Humber
p8	Senior Information Manager	20-24 years	Hospital	Yorkshire and Humber
p9	Software - analyst / advisor	10-14 years	ISV	Nationwide
p10	Software - analyst / advisor	Less than 1 year	Microsoft ISV	London
p11	Software - analyst / advisor	Not applicable	ISV	Other
p12	Software - UI designer / researcher	Not applicable	Hospital IT	South West England
p13	Software - Technical Architect	Not applicable	ISV	North West England

Table 13: Respondent Descriptions

A set of standardised CUI project questions to assess respondents' computer skills indicated that all respondents had installed or downloaded a program onto a computer. Two of the six HCP (p5 and p6) had experience of installing an operating system and changing a registry key. Three of the six HCP had written software code (p1, p5 and p6).

UI terminology for sorting and filtering activities

Sorting and filtering are appropriate terms for referring to the planned UI activities. Respondents were experienced with computer based sorting and filtering and identified preferences for sort-order descriptors.

All respondents reported having previously sorted a list on a computer, were able to identify which criteria (date) a list was sorted by and described a successful way to reverse the sort order, for example:

click on date and see if it would reverse for me (p2)

Click on the date arrow and it would arrange the list from least to most recent. (p3)

The term 'Sorting' was selected by respondents as the most popular word to describe a clinically based definition of sorting. Two other words were selected, 'Ordering' by 4 or the IT professionals and 'Organising' by 2 of the HCP.

When selecting from nine pairs of options the two most popular date sort order descriptors are

1. 'Most recent' and 'Least recent' (6/13).
2. 'Chronological' and 'Reverse chronological' (6/13) including one HCP.

The two most popular numeric sort-order descriptors are

1. 'Ascending and Descending' (8/13), and
2. 'Highest to Lowest' (7/13) including half of the HCP (3/6).

Eleven respondents reported having experience of using a computer to filter information. Respondents predominantly selected the word 'Filtering' (9/13) from a list of 9 options to describe the act of filtering. The three people that did not select the word filtering were one HCP that selected the word 'Removing' and two ITPs that selected the word 'Showing'.

Conveying the outcome of progressive sorts

Respondents (7/13) preferred design options that indicated the sort-order with a number. **Error! Reference source not found.** was the most popular design (4/13). Several (3/13) respondents indicated that the sort order would be obvious from the table contents and selected Figure 1.

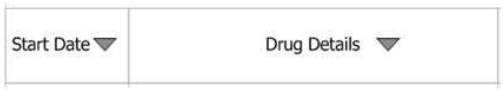


Figure 12: Sort columns are indicated by a triangle in the column header

Figure 13: Sort columns are indicated by a triangle in the column header. The order of the sort is indicated by a number adjacent to the triangle

Figure 14: Sort columns are indicated by a triangle in the column header. The order of the sort is indicated by a number within the triangle

Expectations and preferences for sorting by variables not currently displayed

All the HCP (6/13) expected data relevant to their current analysis to already be displayed in the list. Two HCP explicitly stated that they would not try to sort by a variable that was not already showing in the list. The majority (10/13) of respondents wanted the variable that is used to sort the list to be displayed in a column within the list. In cases where the sort-order selected was based on data not currently shown in the list respondents (9/13) considered it acceptable to add the column and shift the view of the table to show the just-select sort-order.

Conveying the impact of combining filter criteria

The majority of respondents preferred the design to provide them with a choice of combining filter criteria using a logical AND or a logical OR.

All 13 respondents agreed that it is useful to filter a list within a patient record by specifying the items of interest that they want to keep in the view. The majority of respondents (8/13) agreed that it is useful to filter a list within a patient record by specifying the information that they want to remove from view. Specifying what a filter should remove was viewed as a less frequently needed activity than specifying what a filter shows.

No respondents expected the combined filter in **Error! Reference source not found.** to show esults that include either a Urea value greater than 6.5 or a CRP value greater than 15. i.e. a logical OR was not expected. No respondents wanted the filter to show results to combine filters with a logical OR.

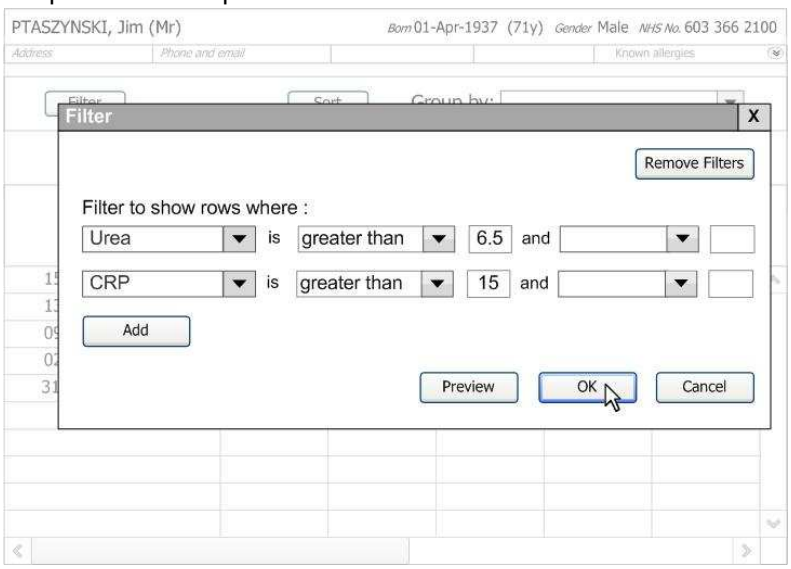


Figure 15: Filter Criteria Dialog Box (indicative illustration of study materials, not guidelines)

When subsequently shown **Error! Reference source not found.** all respondents were able to predict that the result of selecting an 'all must be true' filter was that the filter showed both a Urea value greater than 6.5 and a CRP value greater than 15. Most respondents (8/13) preferred the **Error! Reference source not found.** design because it made the action '*much clearer*' (p3) and provided them with a choice on how to combine the individual filters.

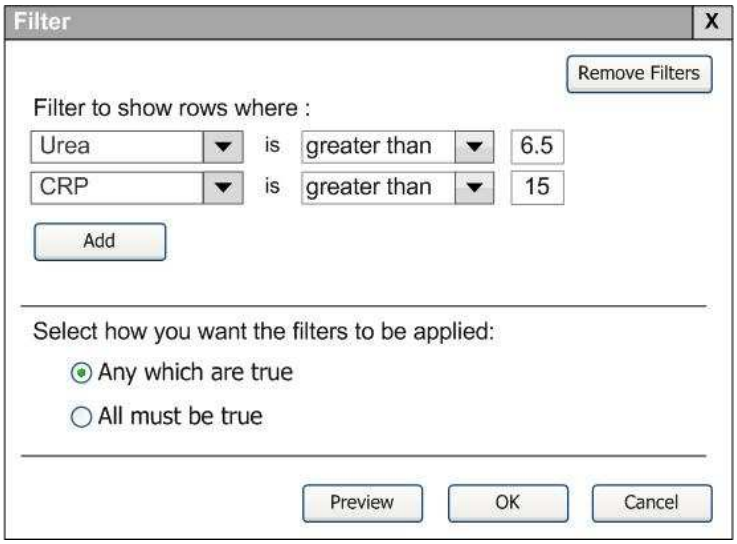


Figure 16: Filter Criteria Dialog Box (indicative illustration of study materials, not guidelines)

Safely indicating the existence of filtered-out data and how to re-access it

Respondents preferred designs where an indicator that data has been filtered-out, a status message, is above the data list columns headers.

There was no clear design option preferred by the HCP for safely indicating the existence of filtered-out data. None of the HCP believed that completely removing the data from view was a patient safe option while this was the option preferred by some ITPs (3/7).

No-one wanted a status message at the bottom of the application window. The most popular locations for a status message were a text-message placed above the column headings or using 3 horizontal tabs above the column headings one showing the results of applying the filter, one showing the remaining list contents, ’ and one showing all the original list contents.

The most popular design option to remove a filter was the use of a button either within a status message or adjacent to the ‘Filter’ button in the toolbar.