

Solution Design

NWAU Calculator

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1 Introduction

1.1 *Purpose*

This software design document describes the architecture and system design of The National Weighted Activity Unit (NWAU) Calculator.

1.2 *Scope*

The NWAU Calculator is a web application that allows users to:

- Create patient journeys;
- Add encounters to a patient journey;
- View the NWAU for an encounter and how it is constructed;
- View the price for an encounter;
- View a graphical representation of the NWAU construction;
- Modify the values for an encounter and see the results change in real time;
- View the rate change of the NWAU against length of stay for private and non-private encounters;
- View the sum of NWAUs for encounters within a patient journey;
- View three successive encounters in a journey side by side;
- Compare two patient journeys and their encounters.

The web application will be accessible using:

- A web browser via the NSW Health intranet;
- An iPad or iPhone via a web browser;
- An Android tablet or phone via a web browser.

Users of the system:

- Trainers;
- Clinicians;
- Nurses.

1.3 *Overview*

The Activities Based Funding (ABF) Task Force supports the implementation of the Activities Based Management (ABM) in NSW Local Health Districts (LHDs) and Specialty Health Networks (SHNs). Participants need to know the impact of ABM on available funding. ABM's core currency is the National Weighted Activity Unit (NWAU). ABM promotes efficiency and transparency in hospital based health care, primarily focusing on activity delivered, and its alignment with community

expectations as interpreted in annual agreements. It is important that clinical, financial, and performance management staff at the LHDs/SHNs understand the impacts of ABM on funding, planning, resource allocation, and service provision.

The ABF Task Force requires an interactive NWAU calculator that allows individuals to manipulate parameters in a theoretical environment, and observe any subsequent variations. It will provide a simple means of understanding how NWAUs are calculated, and how parameters can affect available funding.

The NWAU calculator is an educational tool that allows users to assess outcomes on total NWAU's, and compare theoretical patient journeys. The calculator will allow users to manipulate parameters and observe subsequent variations to the NWAU value, and the elements that make up that value.

To encourage user acceptance, the calculator will have a modern look and feel, and be easy to use. It will be accessible on desktop web browsers attached to the NSW Health Intranet, iPads, iPhones, Android tablets, and Android phones.

1.4 *Reference Material*

IHPA. (2014, February 19). *National Efficient Price Determination 2014-15*. Retrieved March 28, 2014 from IHPA: <http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nep-determination-2014-15-html>

IHPA. (2015, February 19). *National Efficient Price Determination 2015-16*. Retrieved June 18, 2015 from IHPA: <http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nep-determination-2015-16-html>

NSW Health ABF Task Force. (2014, January 22). Business Requirements - The NWAU Calculator. (1). Sydney, NSW, Australia.

1.5 ***Definitions and Acronyms***

Term	Meaning
NWAU	National Weighted Activity Unit
ABF	Activities Based Funding
Modern web browser	A web browser that is either updated automatically (Google Chrome, Firefox) or Internet Explorer 10+.
SPA	An abbreviation for Single Page Application. A website that fits on a single web page with the goal of providing a more fluid user experience through a desktop application. A common example of this functionality is the Gmail website.
Typeahead field	A user interface field that suggests values based on user input. As the user types text into the field, a list of possible values will appear below the field. The suggestions will be more accurate as the user enters more text. Selecting a suggestion will populate the field with that value.

2 System Architecture

This section describes the system architecture that is required to support the NWAU Calculator.

The viewpoints that will be described are the:

- Architectural design;
- Application Framework.

2.1 *Overview*

The NWAU Calculator is a HTML5 Single Page Application (SPA) that can be accessed using a web browser.

Responsive design techniques will be used to manage the screen size differences of computers, phones, and tablets.

When installed, the application will run without a network connection, although this functionality is only supported by modern web browsers.

2.2 *Architectural Design*

The NWAU Calculator is accessible through modern web browsers on all computers, tablets, and phones.

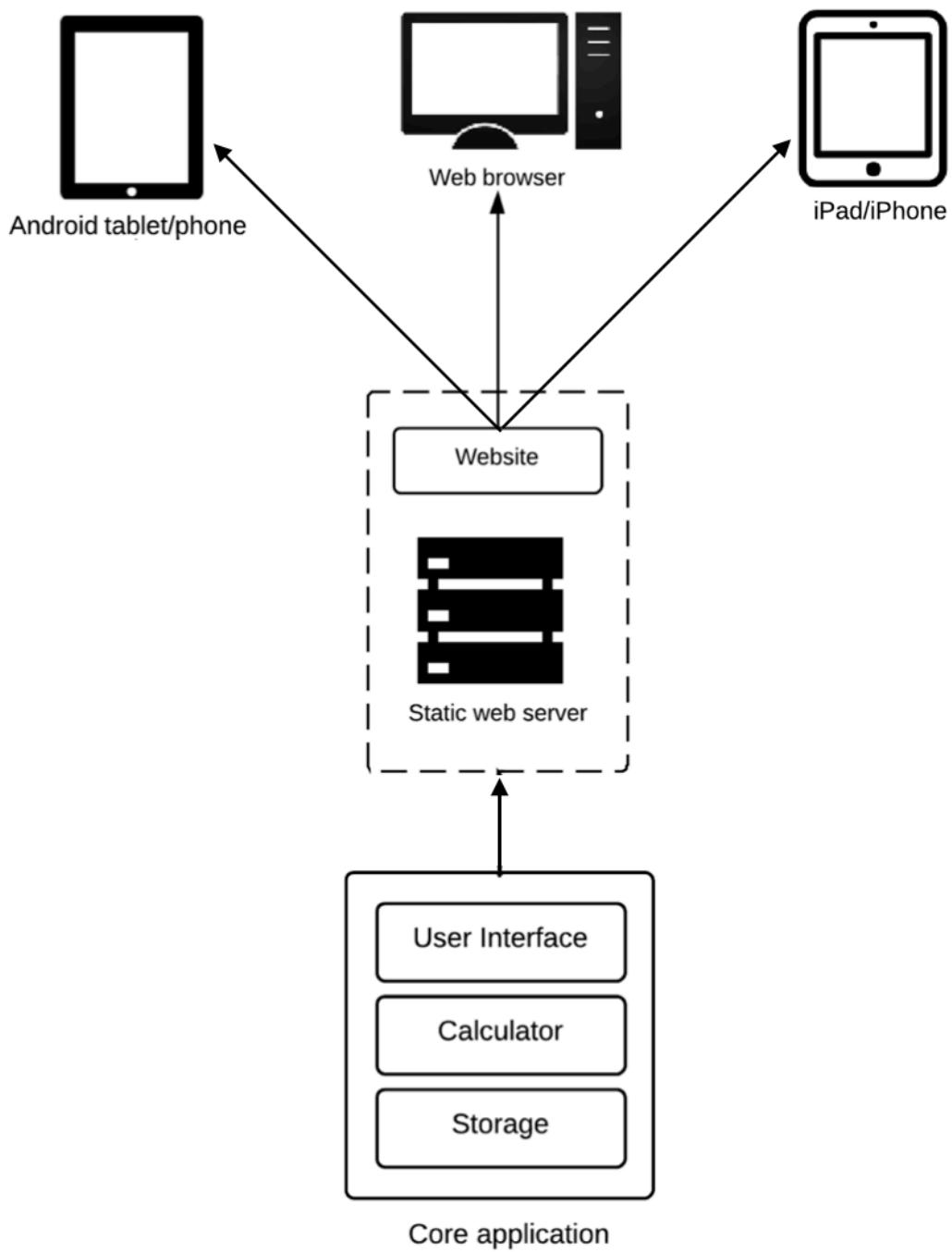


Figure 1: High level system architecture

Core Application

The core source code is used to compile the web site for all platforms. See section 2.3 below for more information on how this is structured.

Static Web Server

A static web server serves all requests made from a web browser. The web server will be a part of the NSW Health network, and only browsers that are connected to the NSW Health network will be able to use the application.

The web server is required to:

- Facilitate the serving of static files;
- Support gzip requests from the client.

Web browser

The browser application will need to be accessed via the Intranet. For offline access to the application, Google Chrome 10+, Internet Explorer 10+, or Mozilla Firefox 26 is required. Internet Explorer 9 can be used to access the application, but there is no offline access.

iPad/iPhone

Users can access the application via a web browser on IOS devices. Devices are required to run iOS 6 or higher.

Android

Users can access the application via a web browser on Android devices. Devices are required to run Android Jelly Bean or higher.

2.3 *Application Framework*

Implementation Pattern

The application will follow the MVVM (Model, View, View-Model) development pattern. This separates the user interface from business logic and enables real-time updates for values, calculations, and charts.

The MVVM pattern will be implemented using the AngularJS framework.

Caching data to run offline

The application will run while the user is offline.

The application will be cached in the user's browser when accessed for the first time. The user can then access the application while offline. If the user accesses the application while online, it will check to see if there are any updates for the application, and update the cache accordingly. This is accomplished by using HTML5's *Application Cache* features, and requires a modern browser to function.

Responsive Design

Responsive web design is a set of principles that ensure web applications are usable on all screen sizes. CSS3 enables us to implement these concepts in a single application, keeping it simple and maintainable, while still working everywhere.

The Bootstrap 3 front-end framework will be used to accomplish this requirement.

Testing

Testing of the applications business logic, particularly the NWAU calculations, will be implemented using the Karma testing framework.

Please refer to the NWAU Calculator test plan for further information on the testing approach and coverage.

Building the web application

To ensure high performance, the application's JavaScript and CSS will be bundled and minified. The Grunt task runner will provide the workflow for this build process.

Technologies

The web application will be built using the following technologies:

- HTML5 (semantic mark-up, offline storage);
- CSS3 (style and animations);
- AngularJS (MVVM development pattern);
- Bootstrap (responsive web pages);
- Yeoman (development workflows);
- Bower (client dependency management);
- Karma (testing);
- Grunt (compilation and minification of CSS and JavaScript).

3 Data Design

The NWAU calculator consists of two categories of data; 1) user entered, such as patient journey and encounters; and 2) reference data, which includes, but is not limited to, the IHPA NWAU calculation tables, classifications, facilities, and encounter suggestions.

3.1 *IHPA Reference Data*

The IHPA reference data provides all the information required to calculate an NWAU, and provides the data as Excel worksheets. The application requires the data to be in a JSON format, therefore Excel macros will be developed to perform this data conversion as part of the project development phase.

3.2 *Suggestions*

When a user is required to select a DRG, URG, UDG, AN-SNAP, or Tier 2 Clinic value, they will receive a list of suggested values based on the classification they have selected, and the previous encounter in the journey. The suggestions will be based on real patient journey data from previous years. The first encounter in a journey will not suggest values.

An example of a suggestion in JSON format:

```
{  
  "Suggestions": [  
    {  
      "nwau": "14",  
      "peer_group": "A1",  
      "from": "3-102",  
      "to": "E01A",  
      "from_type": "ANSNAPV3",  
      "to_type": "DRG70",  
      "encounters": "1",  
      "totals": "4",  
      "percent": 0.25,  
      "place": 1  
    }  
  ]  
}
```

```
},  
{  
    "nwau": "14",  
    "peer_group": "A1",  
    "from": "3-102",  
    "to": "H61A",  
    "from_type": "ANSNAPV3",  
    "to_type": "DRG70",  
    "encounters": "1",  
    "totals": "4",  
    "percent": 0.25,  
    "place": 2  
},  
}
```

4 User Interface Design

4.1 *Overview*

The following will show the user interface with an accurate overview of the application layout.

4.2 *Common elements and features*

Help button

Throughout the application, a help button is displayed next to fields and values. Pressing it will show a popup that contains help text or suggestions.

Saving

Every change that a user makes to a journey or encounter is saved immediately to the local storage of the web browser.

4.3 *Splash Screen*

The splash screen will be visible while the application is loading, and will feature Leonardo da Vinci's Vitruvian Man.

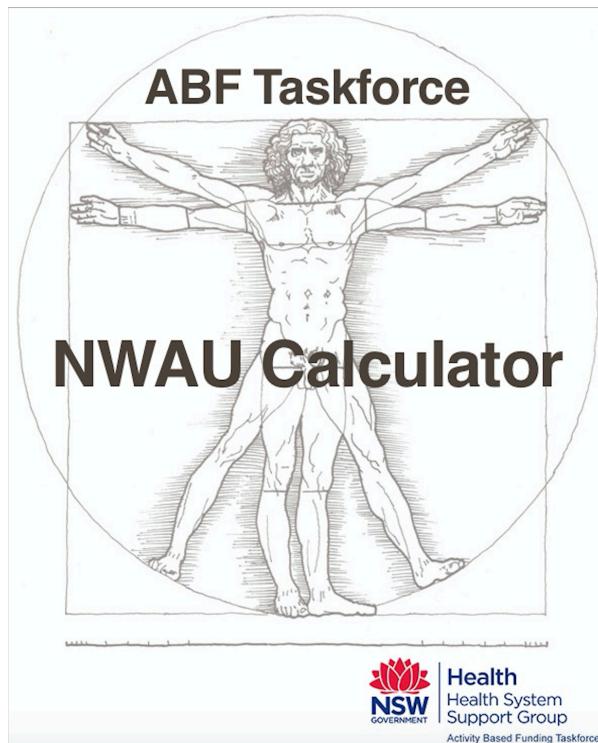


Figure 2: NWAU Calculator splash screen

4.4 *Disclaimer*

The disclaimer will become visible once the application has done its initial load. The disclaimer gives a general overview of the NWAU Calculators purpose.

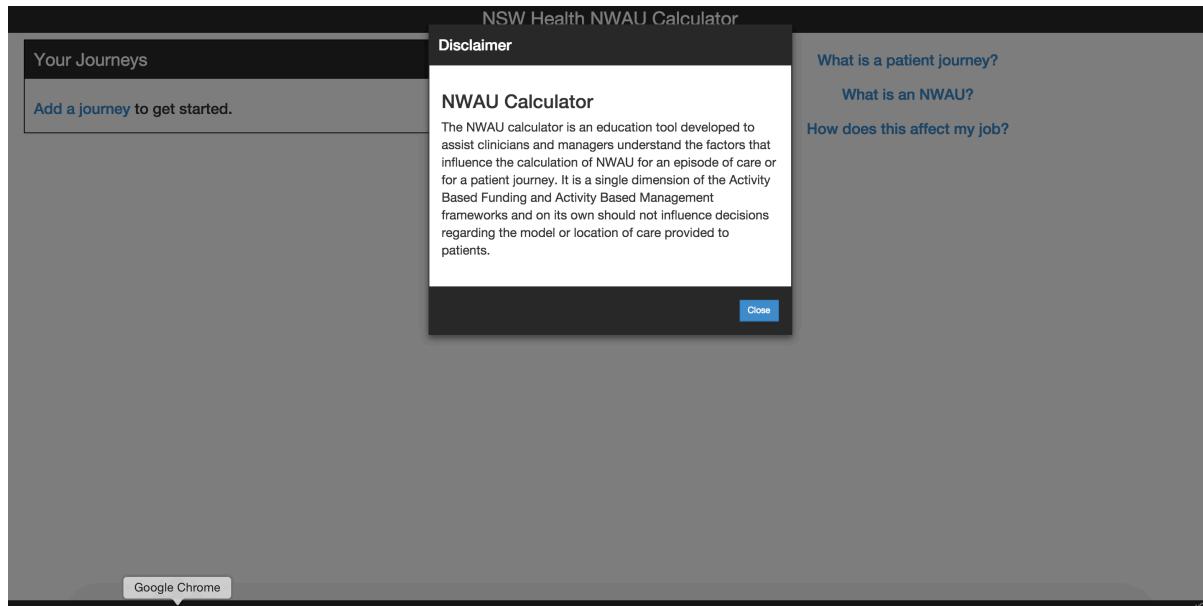


Figure 3: NWAU Calculator disclaimer

4.5 *First Time Access/No Patient Journeys*

When the user accesses the application for the first time, or they have no patient journeys stored, they will be presented with this screen. Pressing the (+) button will create a patient journey.

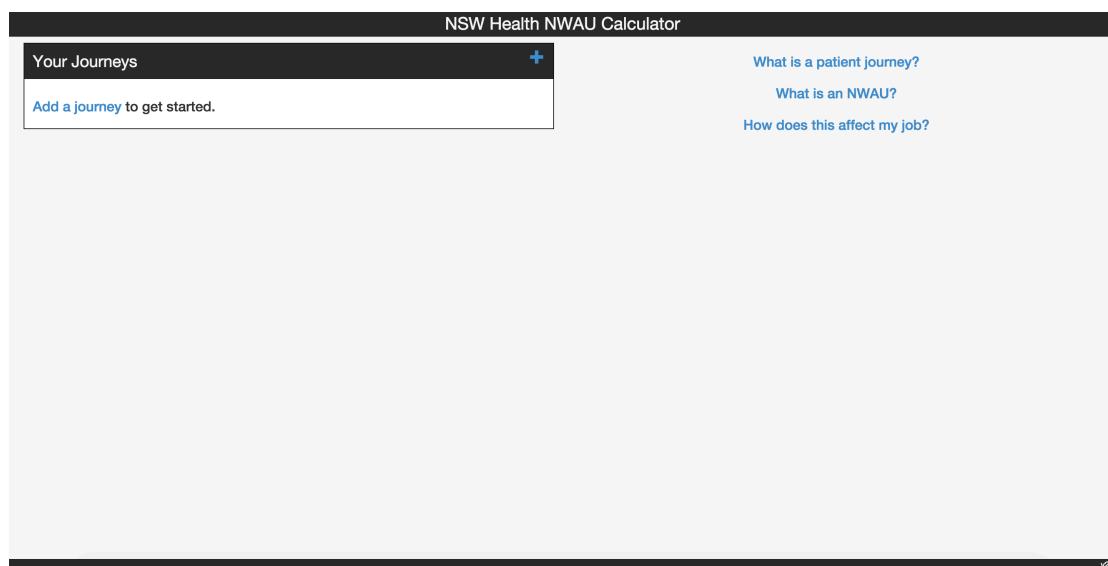


Figure 4: Journey page with no journeys

4.6 *New/Edit Patient Journey*

Users access this screen when they are adding a new journey, or editing a previously created journey. It allows them to enter journey and patient specific details.

Description

The description field allows users to name the journey. This has no bearing on the NWAU calculation, but allows users to choose meaningful names to help identify their journeys.

Facility

This is a typeahead field, and allows the user to enter the name or ID of the facility for this journey.

Age

This field is for entering the age of the patient. Either the text field or slider can be used to enter the age. The ticks on the slider show the different age ranges that change an NWAU calculation.

Postcode

This is a typeahead field, and allows the user to enter the name, postcode, or region of their locality.

Private

This toggle allows the user to specify if the patient is private.

Indigenous

This toggle allows the user to specify if the patient is Indigenous.

NWAU Version

This toggle allows the user to select the NWAU version that will be used in the calculations for all encounters.

Cancel Button

Pressing *Cancel* will cancel the creation of the journey.

Next/Done Button

This button will perform a different function depending on context.

If this is a new encounter, the text will display '*Next*', and pressing it will take the user to the *Add Encounter* page.

If the user is editing a previously entered journey, the text will display '*Done*', and pressing it will take the user back to the previous page.



Figure 5: New/edit journey page

4.7 **New Encounter**

Once the user is inside a journey, the user will be prompted to enter the encounter details. Once a *Classification* is selected, the required fields to create an encounter for that classification will appear. For example, if *Emergency Department* is selected, the *URG* and *Length of stay* fields appear.

Once the required fields have been populated, the fields will move to the bottom of the screen to form part of the *Edit Encounter* page.

If an encounter already exists in the journey, when going to add a new encounter, the user may be prompted with suggestions as shown in figure 6. The user can choose one of the suggestions which will auto-populate information, or choose to create their own manually.

Classification

This is a drop down list that allows the user to select the classification for this journey.

URG/UDG/DRG/AN-SNAP/Tier 2 Clinic

Once a classification is selected, the user is presented with a typeahead field that changes depending on the selected classification. As the user enters text into this field, the list is filtered based on the input to narrow down the list. In figure 8, the entered text 'T3' has filtered the list to show only values that have 'T3' in them.

Length of Stay

This field allows users to set the Length of Stay by either manually entering the number into the text box or moving the slider. The ticks on the slider represent the inlier range.

ICU hours

This field is displayed only if required, and allows users to set the number of ICU hours by either manually entering the number into the text box, or by moving the slider.

Service Events

This field is displayed only if required, and allows users to set the number of service events expected over the course of treatment by either manually entering the number into the text box, or by moving the slider.

Psychiatric

This field is displayed only if required, and allows users to toggle between yes/no to indicate whether the patient had psychiatric care during the encounter.

Radiotherapy

This field is displayed only if required, and allows users to toggle between yes/no to indicate whether the patient had radiotherapy during the encounter.

Dialysis

This field is displayed only if required, and allows users to toggle between yes/no to indicate whether the patient had dialysis during the encounter.

Non-Admitted Multidisciplinary Clinic

This field is displayed only if required, and allows users to toggle between yes/no to indicate whether the patient had three or more health care providers (each of a different specialty) present during the encounter.

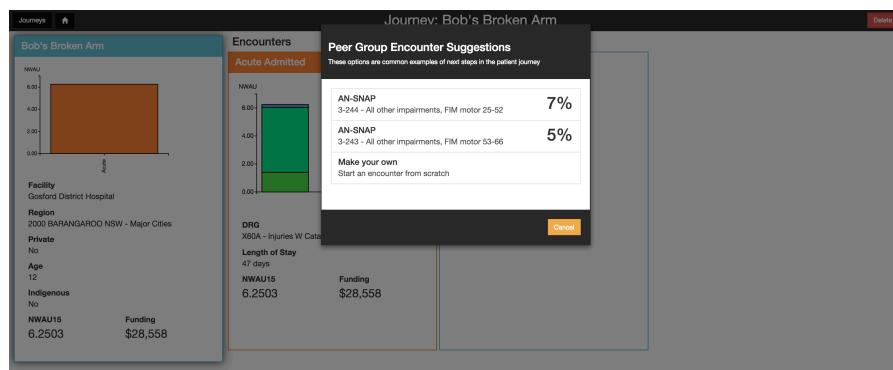


Figure 6: New encounter suggestions

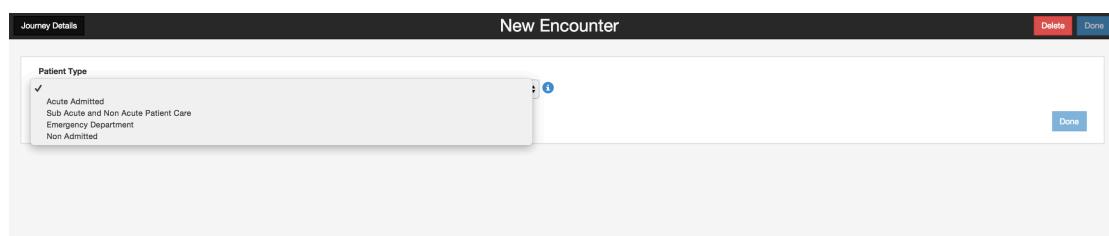


Figure 7: Selecting classification from new encounter page

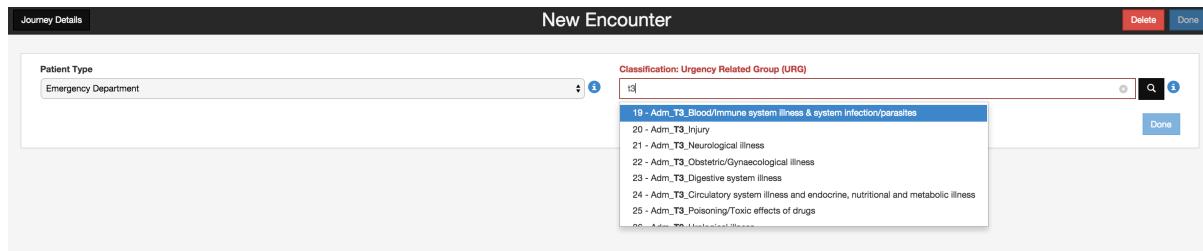


Figure 8: New encounter classification list filtered

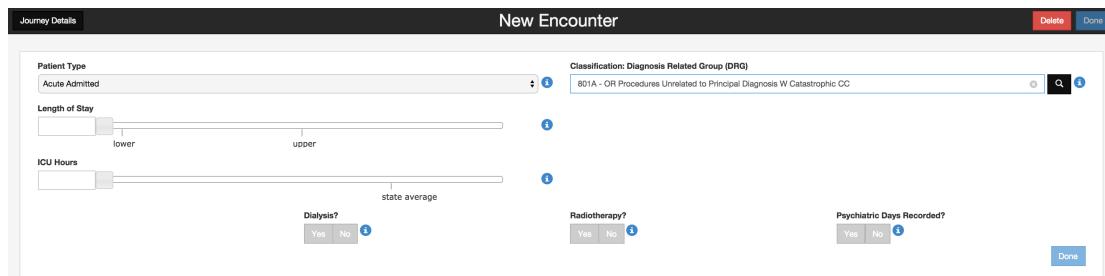


Figure 9: New encounter page after selecting classification

4.8 *Edit Encounter/View Encounter*

Once an encounter is added, users can edit the values of an encounter and its journey, whilst being able to instantly see the changes to the NWAU value, chart, and breakdown.

The fields at the bottom of the screen are the same as *New Encounter*. Please refer to section 4.6 and 4.7 for descriptions of these fields.

NWAU Chart

The NWAU chart shown in figure 10 displays a visual breakdown of what has been applied to calculate the NWAU value.

NWAU Breakdown

The values to the right of the chart shown in figure 10 displays a breakdown of the NWAU along with a key for reading the chart. As users add or remove adjustments to/from the encounter or journey, (e.g. private patient adjustment) the adjustments will be added or removed from the NWAU breakdown.

Length of Stay

Pressing the *Length of Stay* button will show the Length of Stay plot shown in figure 12, while still allowing users to change encounter and journey values.

This plot visually displays the effect that Length of Stay has on an NWAU for both private and non-private encounters.

The blue line represents a non-private encounter and the red line represents a private encounter.

The orange vertical line shows the National Average Length of Stay for the encounter, while the purple vertical line shows the State Average Length of Stay for the encounter.

The dotted grey vertical lines show the inlier range for the encounter.

To the right of the Length of Stay plot are State statistics relating to the encounter, displaying the averages for each Length of Stay Band.

Formula

Pressing the Formula button will show the Formula breakdown page. As with the NWAU breakdown page, the formula breakdown helps users further understand how an NWAU is calculated. The formula sits at the top of the page, with a key below. When a value is applied to an NWAU, the key for that value will change colour, a value will be displayed next to the key, and the value in the formula will light up to show that it is being applied. As users add or remove adjustments to/from the encounter or journey, (e.g. private patient adjustment) the adjustments will be added or removed from the NWAU formula breakdown.

Revenue Notification

When a patient is selected as private, a notification will be shown to inform the user that while the NWAU value is reduced for private patients, there is an increase in revenue from the patients third party payers.

Paediatric Notification

When a patient is selected as 17 or under and a non-paediatric classification is selected, or if a patient is selected as older than 17 and a paediatric classification is selected, a notification will be displayed to inform the user that they have selected an invalid classification, and that there is no NWAU value for the entered variables. The NWAU and all associated charts will return nothing until eligibility is met.

Journey Button

Pressing the *Journey* button will slide in the current journey details shown in figure 11. These fields are editable, and allow the user to see the impact that patient level values have on an NWAU value for an encounter.

Done Button

The done button will close current page.

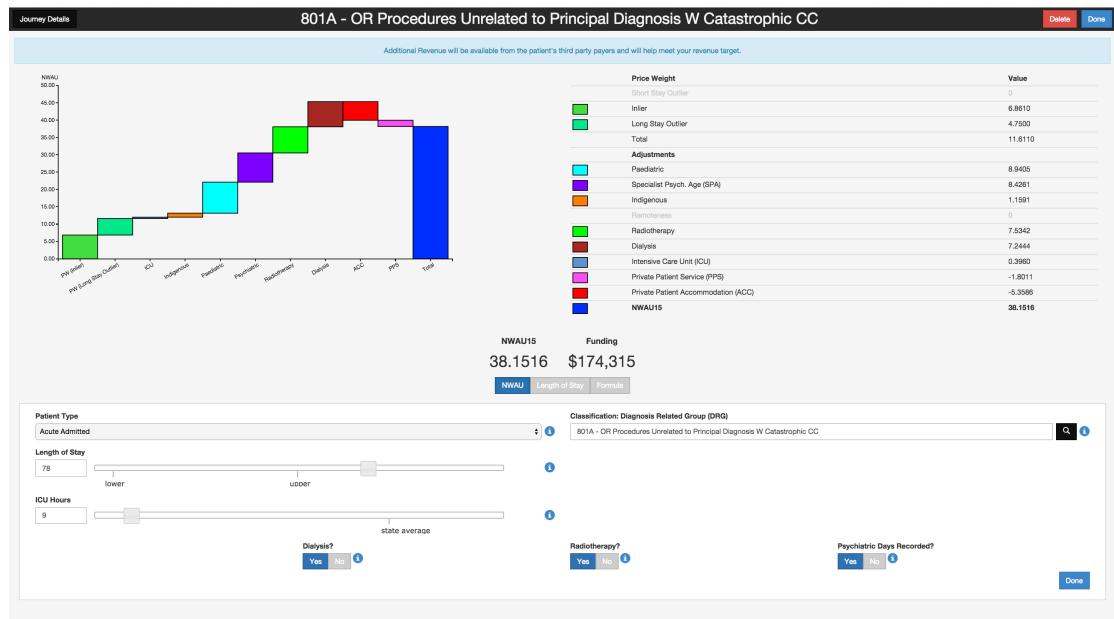


Figure 10: NWAU chart for an encounter

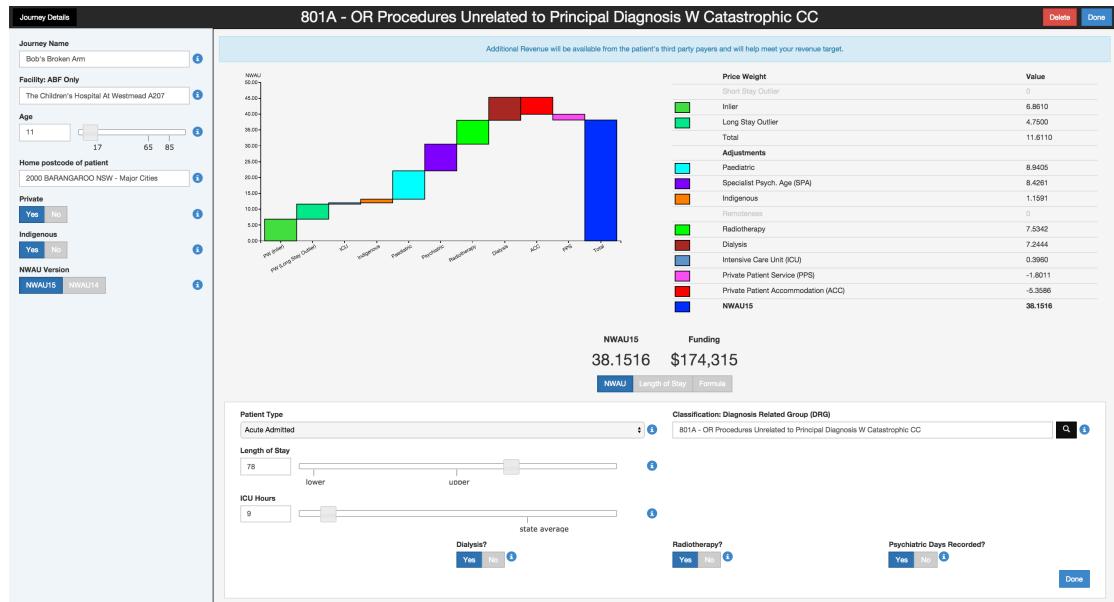


Figure 11: Displaying journey details on the encounter page

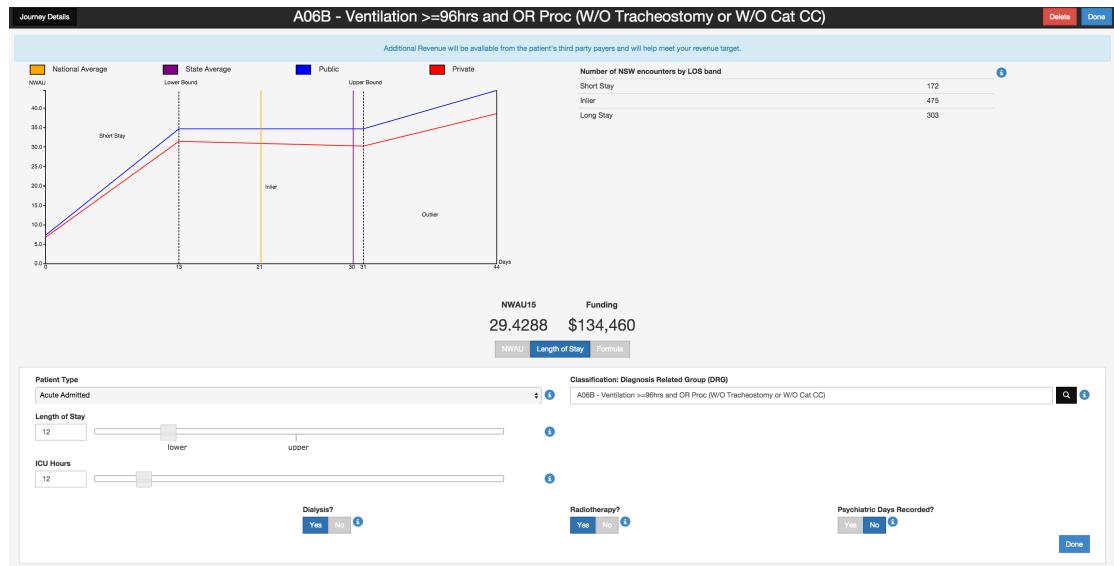


Figure 12: Length of stay plot for an encounter

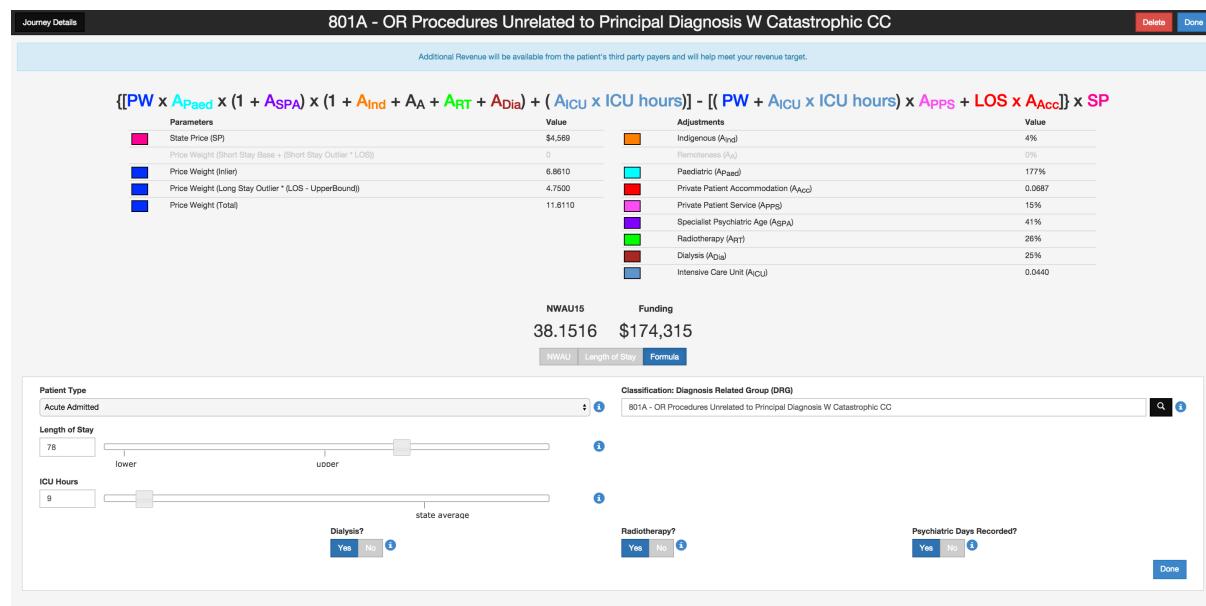


Figure 13: Formula breakdown for an encounter

4.9 *Journey overview*

This page shows the total NWAU for the journey along with a summary for each encounter.

Journey Summary Values

The summary shows the values the user has entered for the journey. Selecting the journey details or pressing the *Edit* button will take the user to the *New/Edit Journey* page.

Journey Summary Chart

The journey summary chart shows the total NWAU for each encounter. Each classification has its own colour, and is reflected in the bar at the top of each encounter.

Encounter List

All encounters for a journey are shown after the journey summary. Figure 14 shows the page with a single encounter, and figure 15 shows the page with multiple encounters. The page scrolls horizontally as shown in figure 16.

Encounter Summary

Each encounter summary shows the NWAU chart and pertinent information relating to that encounter.

Selecting an encounter will take the user to the *Edit Encounter* page, allowing them to see the encounter in greater detail.

The coloured bar on the top of the encounter is a visual cue to the classification of the encounter. Orange represents Acute, purple represents SNAP, maroon represents Emergency Department, and pink represents Non-Admitted.

Add Encounter

Pressing *Add Encounter* will take the user to the *New Encounter* page, where they can add another encounter to this journey. Depending on the last entered encounter, the user may be prompted with suggestions as shown in figure 6, which the user can select to auto-populate some of the information.

Journeys Button

Pressing the *Journeys* button will slide in the list of previously created patient journeys. Selecting one will load it on the *Journey Overview* page as shown in figure 17.

Compare Button

Pressing the *Compare* button allows users to compare this journey with another previously created journey. When pressed, a list of other journeys saved in the application is displayed. Selecting one of these journeys will take the user to the *Journey Comparisons* page.

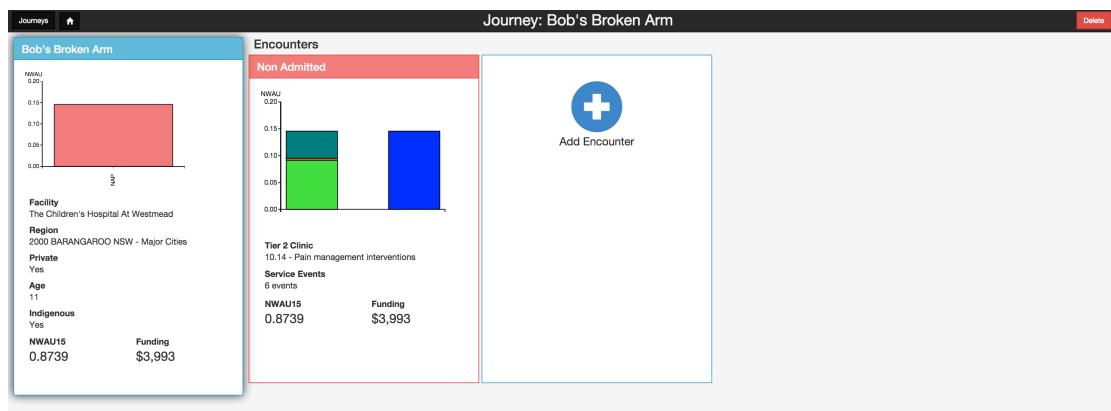


Figure 14: Journey overview for a single encounter

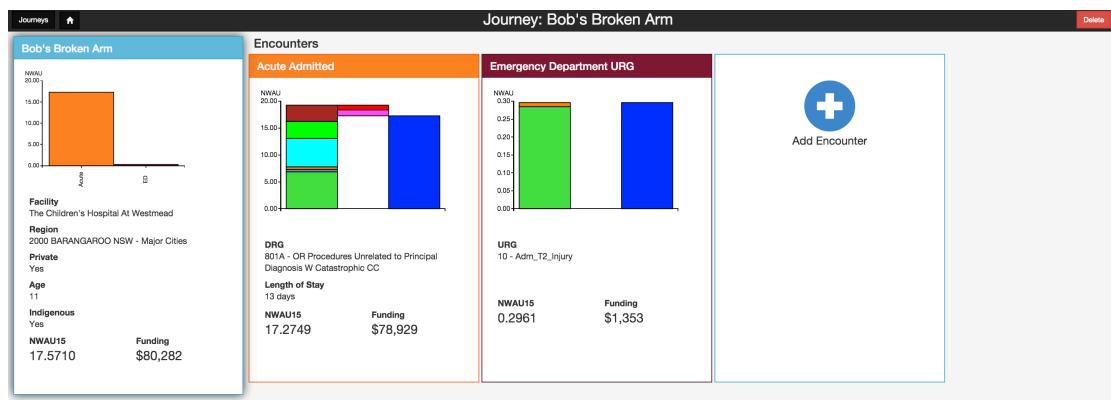


Figure 15: Journey overview for multiple encounters

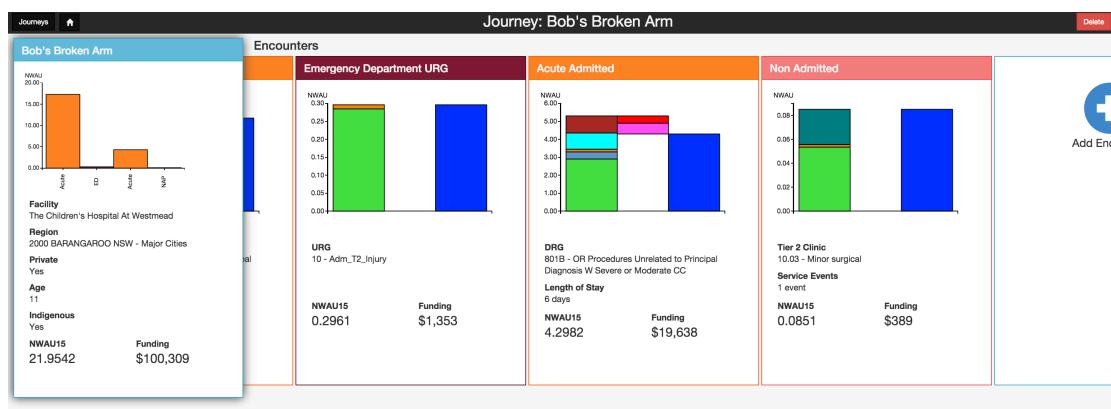


Figure 16: Journey overview scrolling horizontal

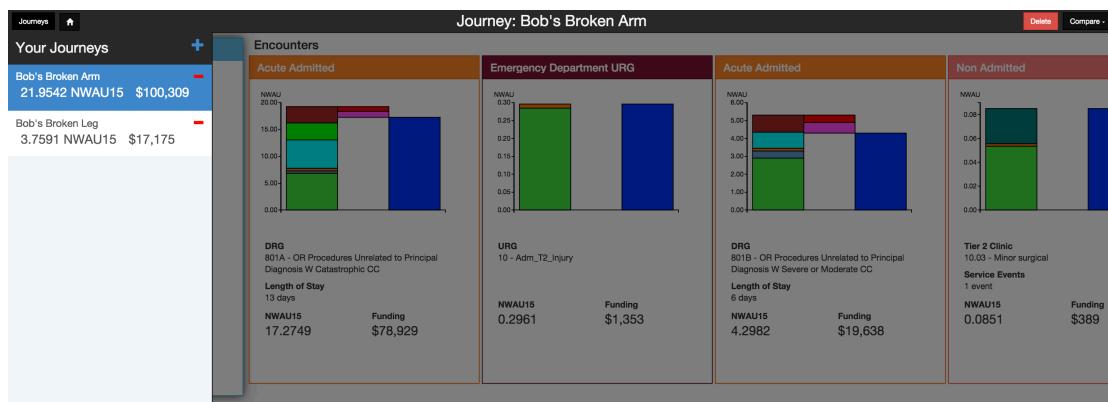


Figure 17: Selecting a different patient journey

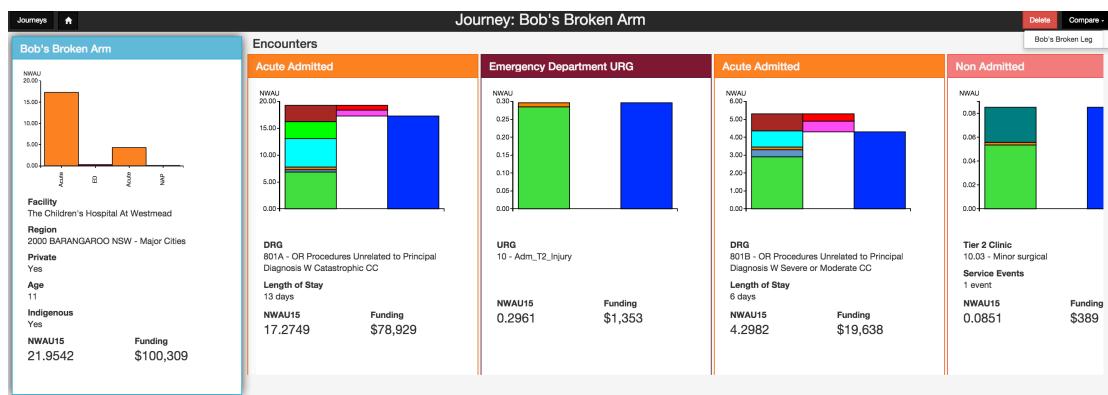


Figure 18: Selecting a journey to compare

4.10 Journey Comparisons

Journey comparisons show two journeys side by side so the user can easily see the differences.

This page uses elements that are very similar to the journey overview page, but with vertical scrolling.

Pressing the *Done* button takes the user back to the journey overview page.



Figure 19: Journey comparison