Application Manual of Ventilator Weaning Assistant System (VWAS)

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The Ventilator Weaning Assistant System is a web application that give clinicians recommendations on whether patients on ventilators are eligible to wean them.

1 GENERAL FUNCTIONS

The system URL is https://github.gatech.edu/pages/xwang3010/VWAS/.

1.1 Two views of application

The application is composed of two views: population view and clinician view. These two views are shown as two tags at the upper left of the web page. Population view is the default user interface of the system. User can switch between the two views by clicking the two tags.

Figure 1— Population View/Clinician View Tags

1.2 Data update

At the upper right of the web page, you can find a "date" and a "Refresh" button.

The "date" shows the date of the data.

The system currently is not real-time data updated. User needs to click the drop-down list to choose a date to get the data.

Figure 2— Data Update Method

2 POPULATION VIEW

Population view provides the general correlations of ventilators using condition as well as patient demographic status.

2.1 Ventilator Usage

This pie chart shows the ventilator devices usage status.

- Total: The total number of devices.
- In Using: How many of the devices are in use.
- Available: How many of the devices are available.

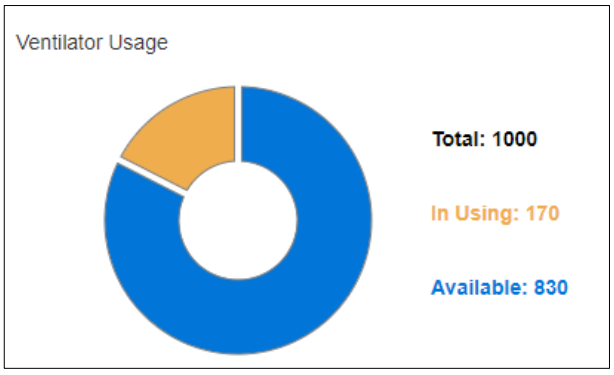


Figure 3— Population View—Ventilator Usage

2.2 Ventilator Time

The bar chart shows the aggregated patient numbers of on-ventilator days.

- Horizontal axis—Ventilating Period: Patient on ventilator time length in days.
- Vertical axis—Count: Patient amount

In the screenshot below, the highlighted bar means: There are 10 patients on ventilator for 7 days long.

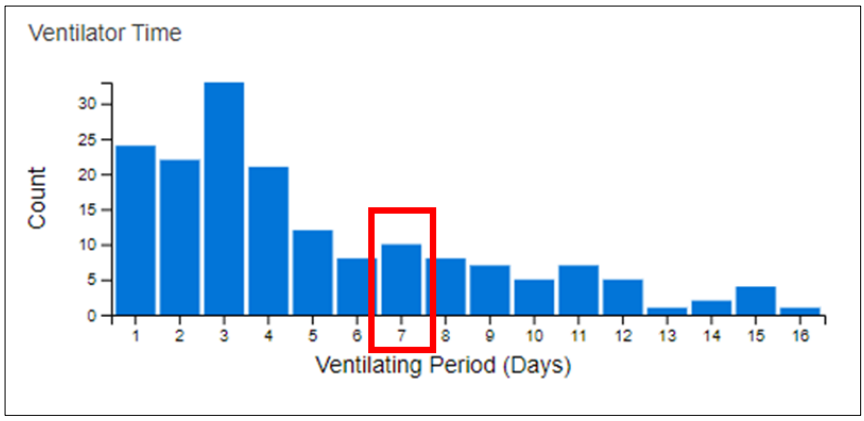


Figure 4— Population View—Ventilating Time (Days)

2.3 Age Distribution

This bar chart shows the number of patients' age range distribution status.

- Horizontal axis—Age Range: Patient Age Range
- Vertical axis—Count: Patient amount

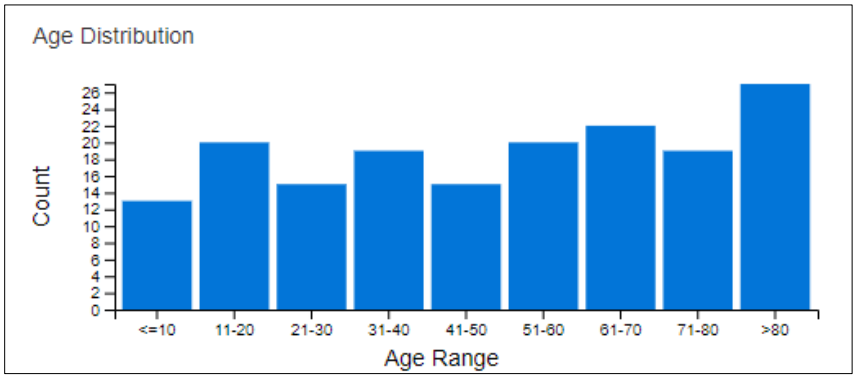


Figure 5— Population View—Age Distribution

2.4 Gender Distribution

This bar chart shows the number of patients' age range distribution status.

- Horizontal axis—Gender: Patient Gender
- Vertical axis—Count: Patient amount

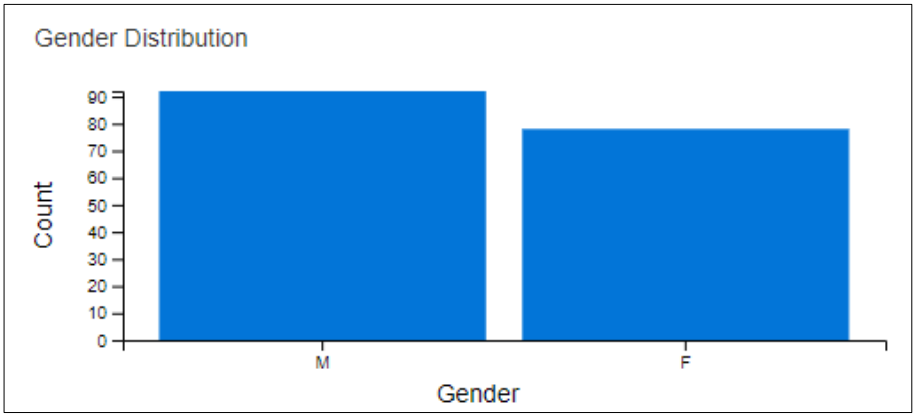


Figure 6— Population View—Gender Distribution

2.5 Race Distribution

This bar chart shows the number of patients' race distribution status.

- Horizontal axis—Race: Patient Race
- Vertical axis—Count: Patient amount

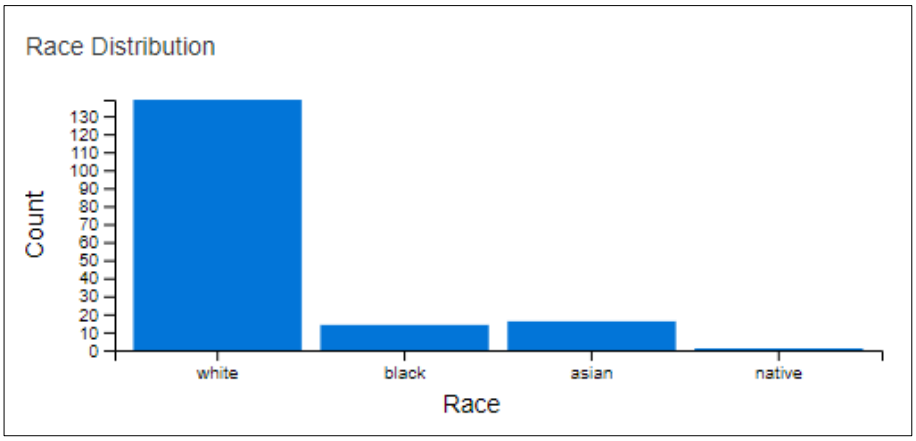


Figure 7— Population View—Race Distribution

3 CLINICIAN VIEW

Clinician View provides the detailed patient ventilator relevant status as well as system recommendations, including rule-based recommendation and machine learning recommendation.

Clinician View contains three main parts:

- List View: Patient list with general information
- Detail View: Detail patient status and recommendations for a single patient
- Patient Information: Patient demographic information

3.1 List View

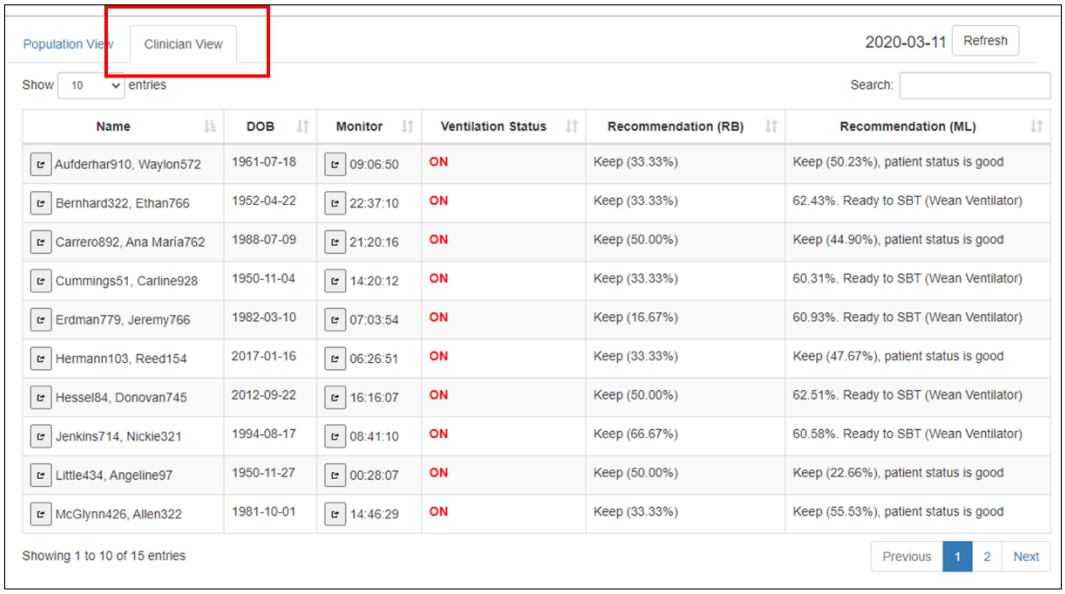


Figure 8 — Clinician View — List View

List view is a list of patient general information and system recommendations.

It includes the following information:

- Name: The patient's name,
- DOB: Date of born,
- Monitor: Patient observation time,
- Ventilation Status: whether ventilator is on or off,

- Recommendation (RB): rule-based algorithm recommendation for whether to wean the ventilator. The percentage is the ventilator weaning criteria satisfaction percentage. The weaning criteria are shown in the detail view.
- Recommendation (ML): Machine learning algorithm recommendation for whether to wean the ventilator. The percentage is the ventilator weaning criteria satisfaction percentage. The patient status is the prediction for the patient's future health condition.

3.2 Detail View

To investigate the patient's details, including the vital signs, observations and the system recommendation, we need to click the "expand" button under the "Monitor" column.

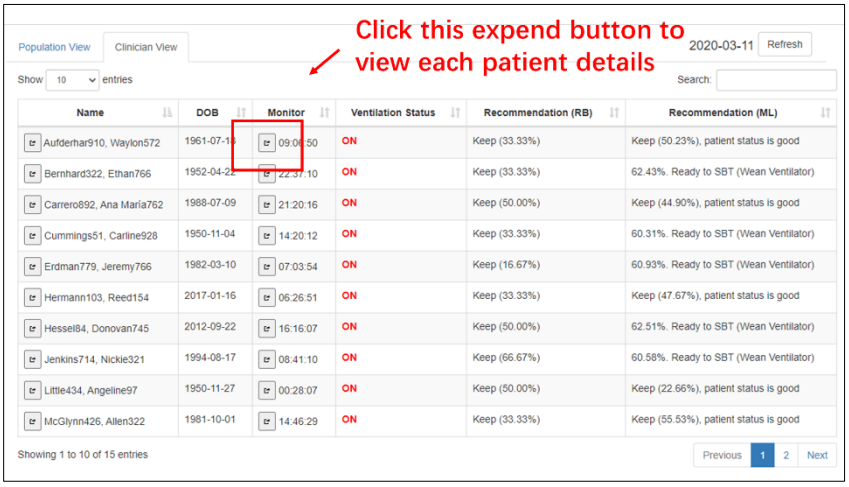


Figure 9— Clinician View—Expand Button to open Detail View

Figure 10— Clinician View—Detail View

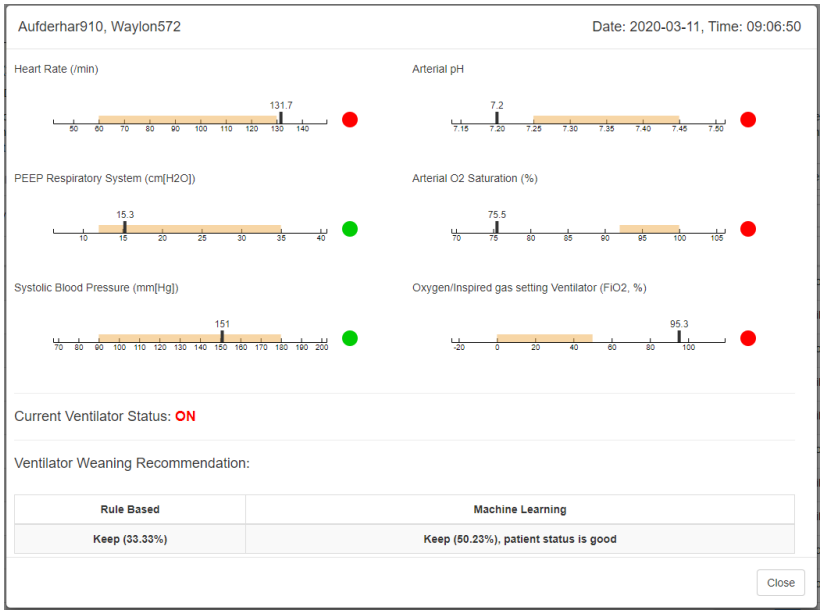
The Detail View is composed of four sections.

3.2.1 *Section One: Name & Date/Time*

The first section shows the patient's name and the date-time information.

3.2.2 *Section Two: Health indicators Visualization*

This section shows the visualization information of the patient observations, including vital signs and lab results. Six indicators are shown, which are also the



criteria to evaluate whether to wean the ventilator. The six indicators include: heart rate, arterial pH, PEEP respiratory system, arterial O2 saturation, systolic blood pressure, and oxygen/inspired gas setting ventilator (FiO2).

Each indicator is composed by its name, a range chart, and a traffic light.

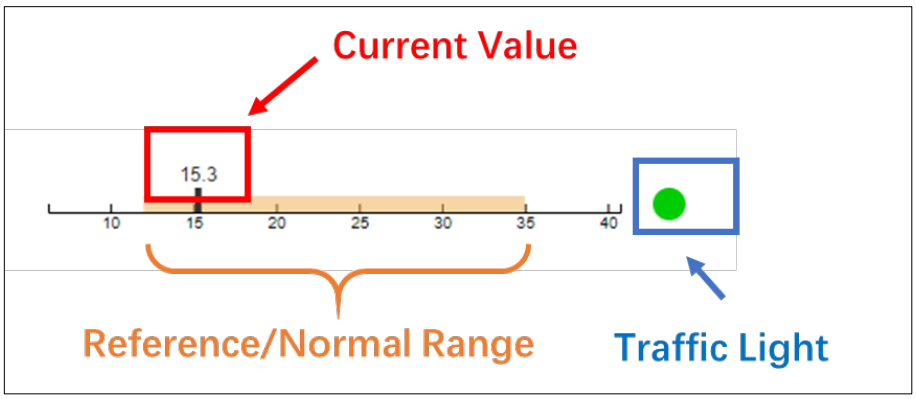


Figure 11 — Clinician View — Detail View: Range chart and Traffic Light

The range chart shows the **current value** of the indicator as well as the **reference/normal indicator** range. The reference indicator range is shown as an amber line in the range chart.

The **traffic light** beside the range chart shows whether the current indicator value satisfies the rule-based ventilator weaning rules. There are two conditions.

- **Green** traffic light: The rule-based ventilator weaning condition is satisfied.
- **Red** traffic light: The rule-based ventilator weaning condition is not satisfied.

3.2.3 *Section Three: Current Ventilator Status*

There are two status of this section:

- ON: The patient is currently on ventilator.
- OFF: The patient is currently not on ventilator.

3.2.4 *Section Four: Ventilator Weaning Recommendation*

Rule-Based Algorithm Recommendation

Rule Based algorithm calculated the above six indicators in section 2 (Health indicators Visualization) satisfaction percentage.

If at least five indicators are satisfied (five green traffic lights), the rule-based algorithm will recommend the medical staff to wean the ventilator from patients.

Figure 12— Rule-based algorithm recommends starting SBT and wean the ventilator.

Else, the rule-based algorithm will recommend keeping the ventilator on the patient.

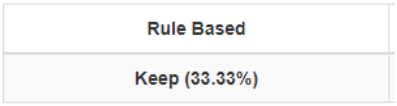


Figure 13— Rule-based algorithm recommends keeping the ventilator.

Machine Learning Algorithm Recommendation

The machine learning algorithm also calculates the six indicators satisfaction percentage.

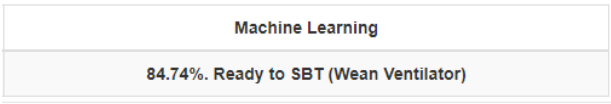


Figure 14— Machine learning algorithm recommends starting SBT and wean the ventilator.

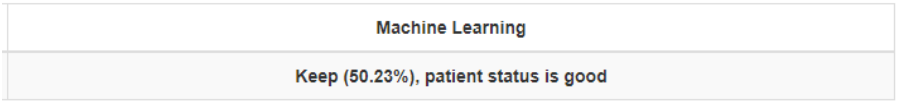


Figure 15— Machine learning algorithm recommends keeping the ventilator.

Except from the ventilator weaning recommendation, the machine learning algorithm also predicts the patient future health condition. If the ventilator is recommended to keep, there will be two kind of health condition predictions:

- The patient status is good: The patient is forecasted to be recovered.
- The patient's status is bad: The patient is forecasted to be hardly recovered or survive.

Based on classes of the artificial dataset, (Weaned, Die, On ventilator) and the requirement of the project (Displaying ventilators usages), it is chosen to display the percentage of the third class as display and use the rest two as advice.

3.3 Patient Information

To investigate the patient demographic information, we need to click the "expend" button under "Name" column in List View.

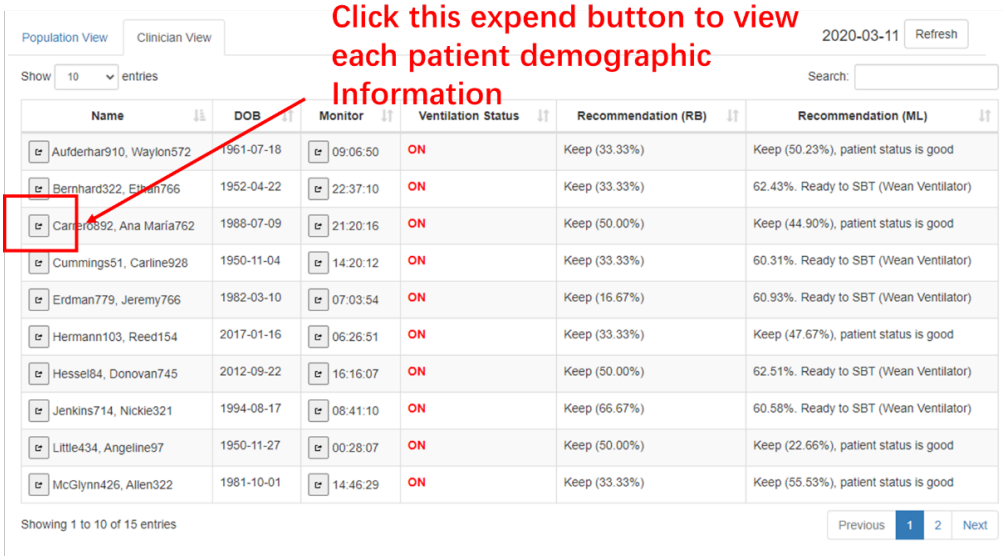


Figure 16— Clinician View—Expend Button to open Demographic Information.

The Patient Information includes patient ID, first name, last name, marital status, birth date, gender, SSN number, passport number, driver license number, ethnicity, race, and address.

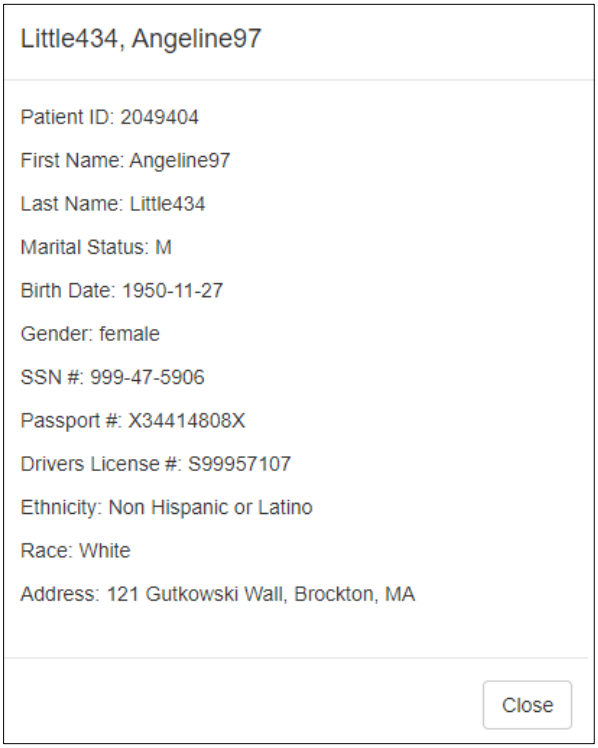


Figure 17 — Clinician View — Patient Information