



Clinical Insights Manager (CIM)

Release 1.0 Instructions for Use

PHILIPS

Notice

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Introduction

Clinical Insights Manager (CIM) is cloud-based data lake house solution that captures data from in-hospital Philips patient monitors, ventilators, and non-Philips bedside devices and stores that data into the HealthSuite cloud powered by AWS. It also provides two web-based applications: CIM Data Viewer and **Alarm Insights Manager (AIM)** Dashboard.

Intended Purpose

- The Clinical Insights Manager solution is not designed to drive real time clinical decisions on patients.
- Store patient monitoring data (including but not limited to physiologic waves, parameters, alarms and events) from multiple patients in a repository.
- Provide ability to analyze the stored data for quality improvement, clinical research, or operational improvements.
- Provide the customer a test bed for algorithms before it is deployed for real time clinical decisions
- Provide the customer a platform for retrospective analytics and prospective predictions based on multi-year, multi-patient data
- Provide the customer a platform for collaboration with other institutions on research or QI programs
- Enable Consulting Services: Consulting services will be delivered on top of the Clinical Insights Manager product. The consulting services might involve other tools that the clinical team deems relevant. The expectation is that the CIM product will provide a way to get the stored data available to the consulting team.
- Enable IT/Data Optimization Services: These services will be delivered on top of Clinical Insights Manager product. The services team will leverage available APIs and options from CIM to create interoperability
- The Clinical Insights Manager is intended for use in professional healthcare and research facilities by professionals working in the healthcare and related research areas.

On-Prem Data Collector

CIM collects data from multiple PIC iX systems, aggregates and sends the data every 5 minutes to the CIM software running in the Philips HealthSuite (HSDP) Cloud powered by AWS as shown in figure below.



CIM Collector software runs on an on-prem Windows Virtual machine (VM) provided and managed by the customer. For technical details on this VM, refer to CIM's technical data sheet (TDS).

Patients' ePHI

A configuration option is provided upon data export for automatic de-identification of ePHI information. If the user chooses to de-identify before data export, data is de-identified by removing all ePHI information and only unidentified data is exported.

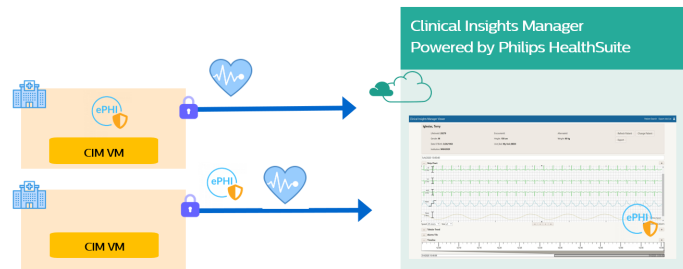
Cloud Connection Configuration For Tenant: MGH 2 of 2

*Gateway Base URL:

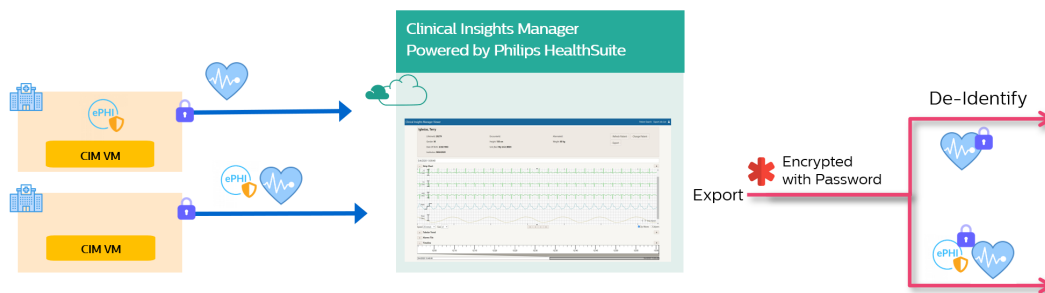
☐ Send Patient Info

Test Connection

< Back Next > Finish Cancel



Note: Changing the default configuration for “Sending Patient Info” results in the Patients ePHI information sent to CIM software running in the Philips HealthSuite Cloud. Sending ePHI information to the cloud provides the ability to search for patients using any ePHI identifier using the CIM Dashboard.



Store and Forward

In the event of a network failure between the on-prem collector and the HealthSuite Cloud or if the cloud services were unreachable, where data cannot be uploaded successfully from the on-prem Collector to the cloud, collected data is stored locally in a SQL Express database. Locally stored data is checked by the CIM collector software every 10 minutes and is automatically uploaded to the cloud when the cloud services are restored. The locally stored data is purged after it is successfully uploaded to the cloud.

Note: In the event the VM gets compromised for example due to malware detection, the operating system along with the all the pre-requisites software such as SQL Express and the CIM software must be re-installed. As a result, the configuration settings and any locally stored data that was not yet uploaded to the cloud is lost. Also, note that there may be some interruption of cloud data during the CIM on-prem VM reinstallation process.

Roles and Responsibilities

Philips is responsible for installation, configuration and proper operation of the CIM collector software on the on-prem VM as well as in the Cloud. The customer is responsible for managing the operating System (OS) on the VM. This includes:

Regular Updates and Maintenance

1. Updating the OS including security patch management and updating installed third-party tools (e.g. Postman, Fiddler, Wireshark).
2. The backup and restore of the OS and VM software.
3. BitLocker disk encryption is permitted and is the responsibility of the customer.
4. Responsible for the Security Patch management and OS upgrades for the VM.

Security

5. Managing access control roles and local audit trail on the system.
6. Using user management best practices. For example: User accounts shall support complex passwords. By definition a complex password should:
 - a. Include at least 3 of the following 4 types of characters:
 - i. Uppercase characters
 - ii. Lowercase characters
 - iii. Numeric characters
 - iv. Special characters (e.g., #,\$%&)
 - b. Be a minimum of at least 8 characters
7. Securing the physical and network access to the system.
8. User identity and personal authentication information should be kept safe and should not be shared.
9. Installing the antivirus software to safeguard against malware. Refer to the supported **AV software** section in the System Administrator Guide.
10. Upon decommissioning of the VM, the customer is responsible for sanitizing the system in accordance with NIST SP 800-88. The data is located under C:\Program Files\Microsoft SQL Server\MSSQL15.MSSQLSERVER\MSSQL\DATA.
11. Installation and running of CIM services require admin privileges
12. CIM automatically sets the firewall for proper operation. Refer to the **Firewall** section in the System Administrator Guide for more detail. The customer is responsible for setting any additional Firewall rules per customer policies.

Specification

The on-prem VM must be a dedicated VM for the proper operation of the CIM software. This VM should not be shared with any other software. Refer to the On-Prem VM hardware and software specification in the TDS.

Troubleshooting

The CIM on-prem collector software logs various types of activities to help the Philips field service and the customer troubleshoot and easily pinpoint problematic areas within the system.

There are 2 types of log targets:

1. CIM Logging
2. Windows Event logging

CIM Logging

Each log has the following elements:

- Severity
- Time
- Host Name
- Category
- Message
- Process Name
- Thread Name

Severity

Each log entry has a severity associated with it. The severity can be:

- Error
- Warning
- Informational
- Verbose

Time

Each log entry has a severity associated with it. The Time is a date and time representing the on-prem time locale.

Host Name

This is the fully qualified hostname of the on-prem CIM Collector windows machine.

Category

Each log entry has a category associated with it. The categories are:

- General
- Export
- Database
- License
- Service Audit
- System Validation

Message

Each log entry has a message associated with it. The message is an English description of the log. It describes what happens and if it is an error, the log may contain action for correcting the error.

Process Name

Each log entry has a category associated with it. The process name represents one of 3 process that comprise the CIM on-prem collector software:

1. Philips.ACP.ConfigurationHost.exe: configuration app.
2. Philips.ACP.SystemSetupHost.exe: Initial Install and System Setup app.

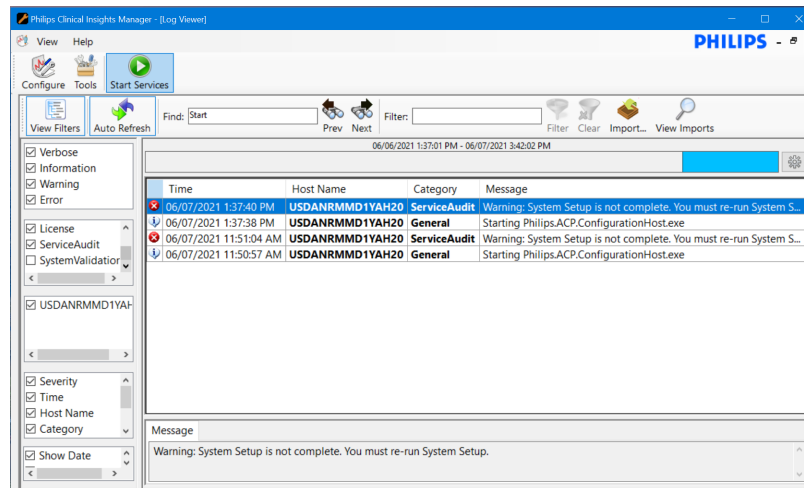
3. Philips.ACP.ServiceHost.exe: CIM Services that collect data and send data to cloud.

Thread Name

Represents the internal process component that logged the message. This is mainly used by technical personnel to pin point the root cause of an issue.

Log Viewer

A Log Viewer application is provided within the **ConfigurationHost.exe** application. This viewer provides the following capabilities:



The Log Viewer's toolbar consists of the following:

- 'View Filters' button: This toggles the view of the left filter panel on and off.
- 'Auto Refresh' button: This toggles between auto refresh and manual refresh. When toggled to auto refresh, the logs are automatically refreshed every 30 seconds.

Keyword-based Search

- 'Find' edit box: This allows searching for key words within the Log message. The user must press enter or press "Next" or "Prev" to navigate through the log messages that contain the keyword.
 - Wild cards are not supported
 - Text is not case sensitive
- 'Prev' button: navigates to the previous occurrence of the entered keyword.
- 'Next' button: navigates to the next occurrence of the entered keyword.

Keyword-based Filter

The log viewer provides the ability to filter on keywords within the log message text.

- 'Filter' edit box: This allows filtering the log messages based on key words within the Log message text.
 - Wild cards are not supported
 - Text is not case sensitive
- 'Filter' button: pressing this button applies the keyword filter.
- 'Clear' button: clears the keyword filter.

Time-based Filter

A time slider (blue color) is provided above the log message. By default, the date range is set to the last 7 days, and the time span is the most recent day.

Using the mouse, the user can select the start and stop range by dragging either end of the Blue time bar. The logs within the new time range are displayed.

- When the right side of the slider is moved to the right, the ending time and date increases.
- When the right side of the slider is moved to the left, the ending time and date decreases.
- When 'Auto Refresh' is selected, each refresh will update the ending date and time.

The user can also, using the mouse, click anywhere within the blue bar and slide left or right to set a different time span.

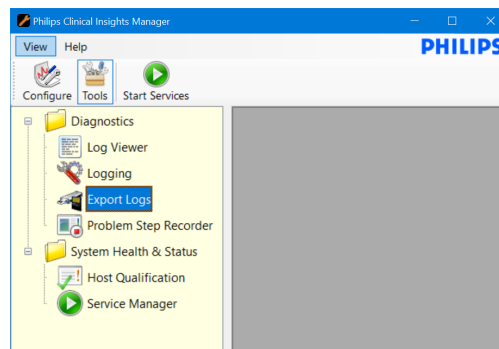
- When the left side of the slider is moved to the right, the starting time and date increases.
- When the left side of the slider is moved to the left, the starting time and date decreases.

Windows Event Logging

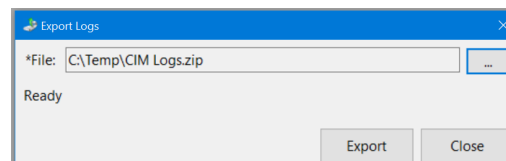
The windows event log is used only during the initial CIM install phase. Once the CIM software database is installed, logging switches to the CIM internal logging described [earlier](#) in this document.

Exporting Logs

The user can export the logs both CIM and Windows event logs using the CIM configurationHost.exe 'Export Logs' icon in the left side panel.



When the user clicks on this icon, the following window is launched. The user specifies a location for the storage of the logs file. The log file is a zip compressed file containing all CIM logs including the Windows Event Log.



The zip file contains 5 components:

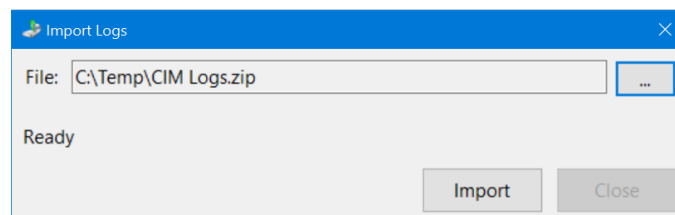
1. Windows Event Logs
2. CIM Internal Logs
3. CIM Configuration Settings.
4. Network settings on the CIM collector VM

5. Windows Update Logs.

Name	Type
_rels	File folder
EventLog	File folder
Philips.ACP.Configuration	File folder
Philips.ACP.Diagnostics	File folder
[Content_Types].xml	XML Document
NetworkSettings.txt	Text Document
WindowsUpdate.log	Text Document

Importing Logs

Exported logs can be imported for viewing using the “Import Logs” icon within ConfigurationHost.exe. When the user clicks on the “Import Logs” icon, the following window is displayed. The user navigates to the location and selects the exported zip file.



When the user presses export, the logs are imported and can be viewed within the log Viewer.

CIM Applications

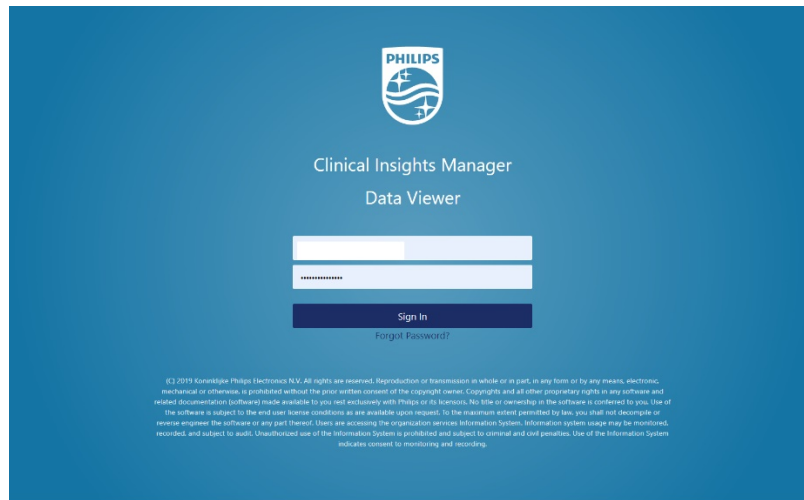
There are two main applications in CIM:

- 1- [CIM Data Viewer](#): It also provides a web-based application that provides patient search and data visualization of the captured data. In addition, it provides data export functionality to industry standard formats.
- 2- Alarm Insight Manager Dashboard: **AIM** dashboard is a web-based interactive application that provides visualization of alarms using a multitude of alarm queries, “view-by” and filter controls.

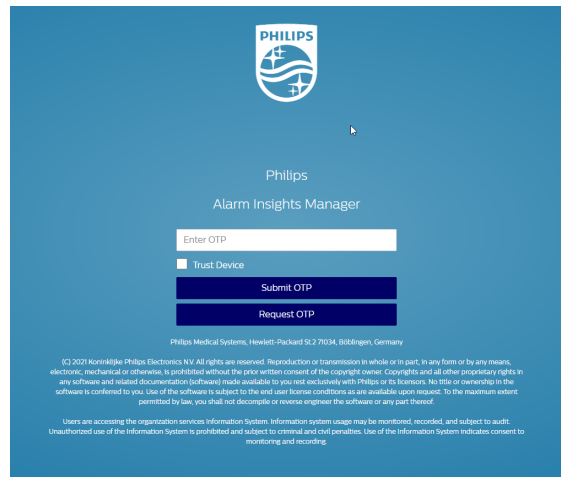
CIM Data Viewer

CIM viewer is a web-based application that provides visualization of CIM’s captured data. Microsoft Edge or Google Chrome are both supported. To navigate to CIM viewer, use the URL that was provided as part of your onboarding process. Entering the URL in a browser navigates you to the login page for CIM.

Login

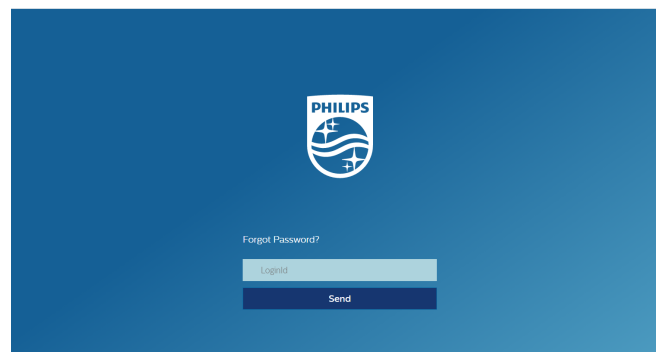


The CIM and AIM Viewers use Multi Factor Authentication (MFA) for additional security. User is challenged with a One Time Password (OTP) that is sent to the email address on successful password authentication. User is logged in upon successful authentication of the OTP. The user can trust the device for future use which will not use MFA for the device user combination.

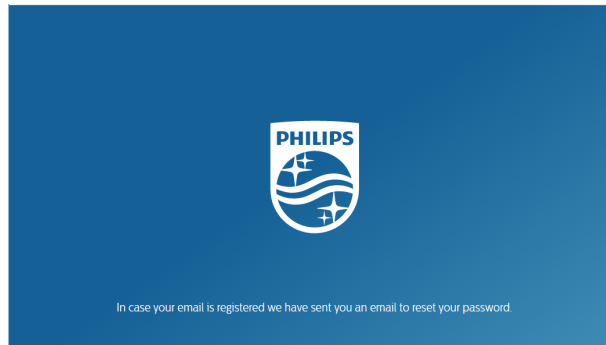


Enter your credentials that you chose as part of your onboarding process and Press Sign In. If you forgot your password, use the “forgot password” link as follows:

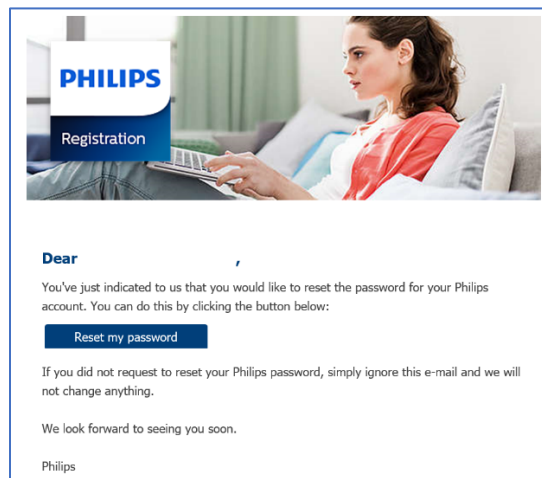
- 1- Enter your login ID (Usually this is your e-mail) and press “Send”



- 2- An e-mail will be sent to your registered e-mail



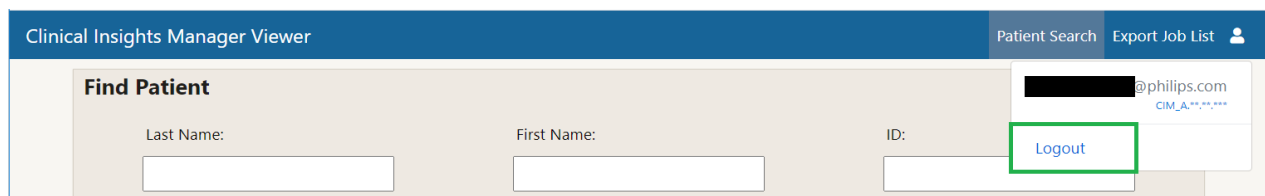
3- Look for the e-mail from Philips in your inbox. If you cannot locate that e-mail, check your junk folder. Once you have located the e-mail, press on the “Reset my password” link provided within that e-mail as follows:



4- Chose a new password, confirm and now you should be able to login to CIM.

Logout

The user can click on the  in the viewer’s title bar next to the Export Job list to logout. The user’s e-mail address/username is displayed along with a logout link. Pressing on the “Logout” link logs out that user.



Once logged in, the following landing “Find Patient” page is displayed.

Patient Search Screen

The user can search for a patient using any or all or none of the following fields:

- First Name
- Last Name
- ID
- Unit
- Bed Label
- Gender
- Start Date of Birth
- End Date of Birth
- Start of Available Data
- End of Available Data
- Institution

Depending on your role and access permissions, you may see one or more institutions in the institution list. Institution is a multi-select list allowing selection of multiple institutions, if available. Note: At least one institution needs to be selected.

Text fields (name, unit and bed label) will allow searching by partial text (e.g. searching for a first name of “mil” will include “Emily”, “Milton,” etc.).

Searching by ID will search for partial and full matches within any ID field (lifetime, encounter or alternate ID). Searches will match against the latest values first.

The **Start Available data** and **End available data** filters send the date for search however the search result contains results that have start and end available times in tenant’s time zone i.e. the search will not search for patient’s in tenant time zone whenever the search criteria contain start available data and end available data.

Wildcard % is accepted to search for partial matches (e.g. % returns all patients; j% would return jones, Jim, Jennifer; J%e would return jones, Jennifer).

Date of Birth field entries are limited to dates 125 years in the past up to the present date. They may be of any duration.

Available Data dates are limited to dates 125 years in the past up to the present date. They are further limited by the Viewer to a maximum of 1 month in duration and are automatically adjusted in the Viewer if a range greater than 1 month is selected.

Searches for a patient based on the above fields and populates the results table with up to **100** possible matches. If there are more than 100 results, only the first 100 based on patient admit time (latest first) are shown

Search Results

Displays the following information for all search results depending on user permissions.

The following patient data elements are shown:

- 1- Patient Name
- 2- Date of Birth
- 3- Unit_Bed
- 4- Institution
- 5- Lifetime Id
- 6- Encounter Id
- 7- Alternate Id
- 8- Start Available Data
- 9- End Available Data

In the result table, all historical Clinical Units and Bed Labels are shown under **'Unit_Bed'** column as a list of concatenated ClinicalUnit_BedLabel that are separated by comma e.g. Unit1_Bed1, Unit2_Bed2 etc. Only patients belonging to the selected institutions the logged in user is configured for will show in the results table. Both admitted and non-admitted patients will appear in the results table.

Clinical Insights Manager Viewer

Patient SearchExport Job List

Find Patient

Last Name:

First Name:

ID:

Gender:

Unit Label:

Bed Label:

Start DOB:

End DOB:

Institution:

MOH2020

MGH

CIMHospital04

AIMTest

MGH_Boston

Start Available Data:

End Available Data:

Search

Clear

Export

☐	Patient Name	Date Of Birth	Unit_Bed	Institution	Lifetime Id	Encounter Id	Alternate Id	Start Available Data	End Available Data	Action
☐	WARD, BERNARD	6/15/1981	hzUnit 1_hzB36	AIMTest	9345030			06/15/2020 06:56 EDT	06/15/2020 07:42 EDT	View
☐	THOMAS, ANDRE	6/15/1945	hzUnit 1_hzB51	AIMTest	3893220			06/15/2020 05:49 EDT	06/15/2020 07:42 EDT	View
☐	ANDERSON, GREG	6/15/2008	hzUnit 1_hzB38	AIMTest	9918056			06/15/2020 04:38 EDT	06/15/2020 07:42 EDT	View
☐	PETERSON, DAN	6/15/1997	hzUnit 1_hzB51	AIMTest	2329665			06/15/2020 03:32 EDT	06/15/2020 05:48 EDT	View
☐	JACKSON, MITCHELL	6/15/1997	hzUnit 1_hzB20	AIMTest	7916207			06/15/2020 03:08 EDT	06/15/2020 07:42 EDT	View
☐	LOPEZ, JUSTIN	6/15/1955	hzUnit 1_hzB18	AIMTest	8893165			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage
☐	WOOD, RODNEY	6/15/1970	hzUnit 1_hzB36	AIMTest	1961590			06/15/2020 03:02 EDT	06/15/2020 06:56 EDT	Stage
☐	EDWARDS, FRED	6/15/2004	hzUnit 1_hzB49	AIMTest	5883356			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage
☐	JAMES, PEDRO	6/15/1931	hzUnit 1_hzB31	AIMTest	1017183			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage
☐	WHITE, PERRY	6/14/1934	hzUnit 1_hzB3	AIMTest	2141158			06/14/2020 23:51 EDT	06/15/2020 07:42 EDT	Failed
☐	YOUNG, ALFRED	6/14/1925	hzUnit 1_hzB25	AIMTest	6764865			06/14/2020 23:41 EDT	06/15/2020 07:42 EDT	Stage

Clear Button

This button clears all data in the search fields and the results table.

Data Export

Once the patients are listed, the user can select one or more patients and export select data or all data using the Export Button.

- 1- When no patient checkboxes are checked, the button is disabled.
- 2- When one or more checkboxes are checked, the button is enabled.

When clicked, it opens a dialog to specify data export parameters for all selected patients. Currently the Export functionality is supported for all patients belonging to a single time zone. If the user selects patients belonging to different time zones and clicks export a dialog box will open with message, *“Selected patients have data that belong to different time zones. Please select patients having data in the same time zone.”*

The full export functionality is detailed in the [Patient Data Export](#) section in this guide.

Staging

Before users are able to view the patient’s data, the data has to be staged.

☐	Patient Name	Date Of Birth	Unit_Bed	Institution	Lifetime Id	Encounter Id	Alternate Id	Start Available Data	End Available Data	Action
☐	LOPEZ, JUSTIN	6/15/1955	hzUnit 1_hzB18	AIMTest	8893165			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage
☐	WOOD, RODNEY	6/15/1970	hzUnit 1_hzB36	AIMTest	1961590			06/15/2020 03:02 EDT	06/15/2020 06:56 EDT	Stage
☐	EDWARDS, FRED	6/15/2004	hzUnit 1_hzB49	AIMTest	5883356			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage
☐	JAMES, PEDRO	6/15/1931	hzUnit 1_hzB31	AIMTest	1017183			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	Stage

When the Stage action button is pressed, the patient’s data is scheduled for staging and the “Stage” button changes to “Staging” until the staging process is complete. Once the staging is complete, the action button will change to a green “View” button and the patient’s data now can be viewed.

The **Action** column shows the available action buttons for that patient. There are four possible statuses:

- 1- **Stage**
- 2- **Staging**
- 3- **View**
- 4- **Failed**

These buttons perform action as described below:

- 1- Clicking on **“Stage”** starts staging the patient data and button changes to **“Staging”**.
- 2- Clicking on **“Staging”** refreshes the patient search results.
- 3- Clicking on **“View”** navigates user to the patient view page.
- 4- Clicking on **“Failed”** navigates user to the **“Staging Job List”** page showing the error and recommended corrective action.

Note: The Action button shows **“Stage”** if no data of patient is staged yet. If some data of patient is staged, action button shows **“View”** irrespective of whether new data (delta data) for that patient is present that is not yet staged. For staging delta data, click on the patient and go to the Staging Job List page and then click Stage

Staging Job List

Clicking on a patient row or on a **“Failed”** staging button, opens the Staging Job list view. This view displays the following information for selected patient.

- 1- **First Name**
- 2- **Last Name**
- 3- **Gender**
- 4- **Date of Birth (DOB)**
- 5- **Institution**
- 6- **Status**
- 7- **Data Start Time**

8- Data End Time

9- Action

Clinical Insights Manager Viewer								
Patient Search Export Job List								
Staging Job List								
First Name	Last Name	Gender	DOB	Institution	Status	Data Start Time	Data End Time	Action
BERNARD	WARD	F	6/15/1981	AIMTest	Completed	06/15/2020 06:56 EDT	06/15/2020 07:42 EDT	View

For the **Status** column:

Clicking the status when status is 'Completed' or 'Failed' opens a list of extraction jobs previously completed for selected status.

'Completed' and 'Failed' statuses show following information:

- 1- **Data Start Time**
- 2- **Data End Time**
- 3- **Job Submit Time**
- 4- **Job Finish Time**
- 5- **Progress**
- 6- **Submitted By**

'Failed' status shows reason for failure in extra column 'Reason for Failure'.

Clinical Insights Manager Viewer								
Patient Search Export Job List								
Staging Job List								
First Name	Last Name	Gender	DOB	Institution	Status	Data Start Time	Data End Time	Action
		-		varun_timezone_2	Completed	09/15/2020 06:00 PDT	09/15/2020 06:00 PDT	View
		-		varun_timezone_2	Failed	09/15/2020 06:59 PDT	09/17/2020 20:53 PDT	
Data Start Time	Data End Time	Job Submit Time	Job Finish Time	Progress	Submitted By	Reason for failure		
9/15/2020 6:59 PDT	9/17/2020 13:53 PDT	10/6/2020 13:57 EDT	10/6/2020 13:58 EDT	0%	ponaji7501@maillei.net	Error occurred while staging data. Please try again.		
9/15/2020 13:59 PDT	9/17/2020 20:53 PDT	9/23/2020 12:05 EDT	9/23/2020 12:07 EDT	0%	varun.raval@philips.com	Error occurred while staging data. Please try again.		
9/15/2020 13:59 PDT	9/17/2020 20:53 PDT	9/23/2020 12:01 EDT		0%	varun.raval@philips.com	Error occurred while staging data. Please try again.		

Refresh

Clicking on the "refresh" icon retrieves the latest extraction job list for the current user. The refresh button appears when a job is submitted for extraction i.e. in progress for extraction or if the extraction job status has completed or failed.

Staged Data Retention

Each tenant has a predefined quota (2 TB by default) for storing data in Postgres. If staging more data for a tenant for a patient is causing data size for that tenant to be more than the quota, other patients' data for that tenant will be purged.

Purging of patients is based on Access Time policy. Access Time for a patient is defined as the latest of the times when that patient was either viewed or staged. Once the tenant’s staged data quota is reached, staged data having the oldest Access Time is purged until there is enough space for new patients to be staged.

If a patient’s data is purged, ‘i’ (info) icon is visible next to top right corner of ‘Stage’ button. Hovering on that icon shows “Data for this patient was purged” message. The data start time and data end times are in tenant’s time zone. The job submits and job finish times are in the user’s browser locale time zone.

Data Viewing

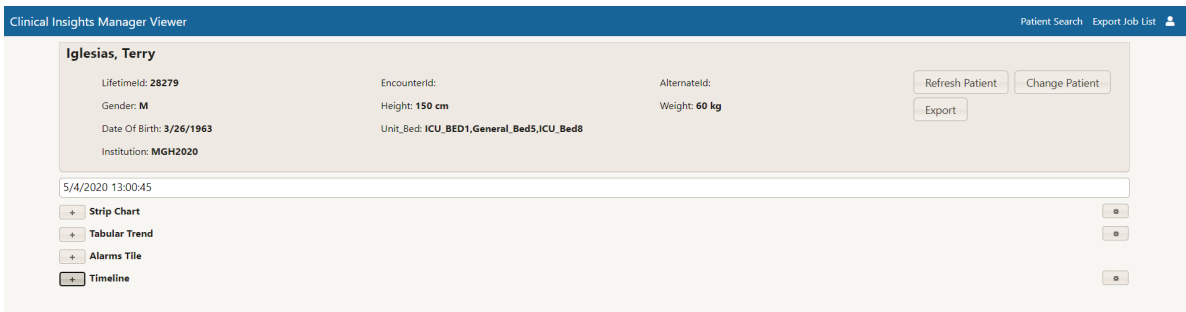
Pressing the “View” button, launches the CIM data viewer.



Patient Data Navigation

This data viewer is capable of the following:

- Patient-based navigation based on the patient search capability
- Time-based navigation and visualization of data. This requires data staging.
- Event Based navigation and visualization of data
- Patient data export into standard format files



The following patient data elements are shown:

- **Name (Last, First)**
- **Lifetime ID**
- **Encounter ID**
- **Alternate ID**
- **Unit_Bed**
- **Gender**
- **Height**
- **Weight**
- **Date of Birth**
- **Institution**

Note: All historical Clinical Units and Bed Labels are shown under ‘Unit_Bed’ column as a list of concatenated ClinicalUnit_BedLabel that are separated by comma e.g. Unit1_Bed1, Unit2_Bed2

Note: Date/Times on patient view page are represented in the tenant’s time zone

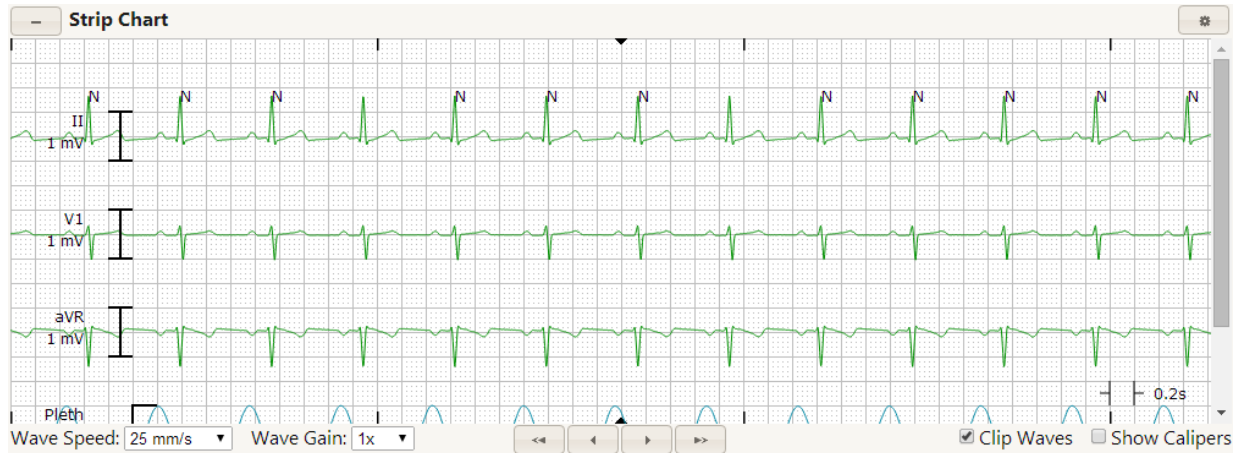
The following table lists the data viewer buttons and their corresponding behavior and functionality.

Button/UI	Behavior
Refresh Patient	Retrieves the latest staged physio data for the current patient.
Change Patient	Takes the user back to the Patient Selection page.
Export	Opens a dialog to specify data export parameters for the current patient being viewed.
Time Focus	The current time focus is shown.

Expand / Collapse	Clicking on the +/- button above each tile expands or collapses that tile from view. By default, all tiles are visible.
Settings	The settings button above those tiles that have settings opens a modal dialog with controls to change the settings for that tile.

Wave Strip Chart View

The following figure represents the wave strip chart view.



Wave Strip Settings

The following settings are available:

- Wave gain
 - x ½
 - x 1 (default)
 - x 2
 - x 4
- Wave speed
 - 6.25 mm/sec
 - 12.5 mm/sec
 - 25 mm/sec (default)
 - 50 mm/sec
- Visible Waves
 - User can select which waves are visible in the tile
 - Initially, 4 waves are visible
 - Only waves that contains wave data at current time focus are available for selection

Note: The waves selected by the user for viewing will disappear if viewing a time duration which contains no data, and the checkbox for the disappearing wave in the setting will vanish as well. When scrolling to a different time which contains previously disappeared wave data, that waves will be back available for selection in the setting.

Clip Waves checkbox:

When this is checked, waves are clipped so they do not overlap with other waves.

Show Calipers checkbox:

When this is checked, an interactive caliper measurement tool is shown over the wave. Dragging this tool with the mouse will allow the user to measure time spans.

Wave Strip Time Navigation

The following navigation controls are available:

- Page Left – moves one page to the left.
- Scroll Left – moves one second to the left.
- Scroll Right – moves one second to the right.
- Page Right – moves one page the right.

Note: a “page” is whatever fits on the screen, so if you are viewing 10 seconds worth of data, the page buttons will navigate by 10 seconds

Tabular Trend View

The following diagram represents the numerical tabular trend data.

Tabular Trend									
	14:50	14:55	15:00	15:05	15:10	15:15	15:20	15:25	15:30
HR	-	-	-	120	99	80	80	80	80
PVC	-	-	-	22	0	0	0	0	0
ST-I	-	-	-	2.4	1.9	0.0	0.0	0.0	0.0
ST-II	-	-	-	3.5	2.7	0.1	0.2	0.1	0.1
ST-III	-	-	-	0.9	0.6	0.0	0.1	0.0	0.0
ST-aVR	-	-	-	1.9	1.6	0.2	-0.1	0.2	-0.1
ST-aVL	-	-	-	3.9	3.0	0.2	0.0	0.2	0.0
ST-aVF	-	-	-	4.6	3.5	0.2	0.1	0.2	0.1
ST-V1	-	-	-	4.2	3.2	0.2	0.0	0.2	0.0
ST-V2	-	-	-	3.0	2.3	0.1	0.2	0.1	0.2
ST-V3	-	-	-	1.0	0.8	0.1	0.3	0.1	0.2
ST-V4	-	-	-	-3.0	-2.3	-0.1	0.2	-0.1	0.2
ST-V5	-	-	-	-	-	-	-	-	-

Tabular Trend Settings

The following settings are available:

- Duration
 - 1 hour (default)
 - 4 hours
 - 8 hours
 - 12 hours
- Column Duration
 - 1 minute
 - 5 minutes
 - 15 minutes (default)
 - 1 hour

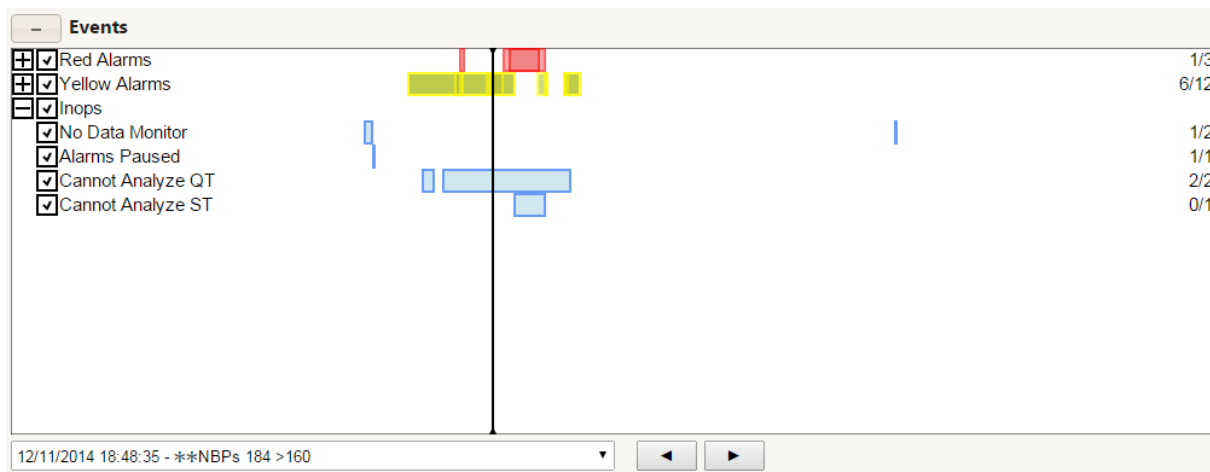
Note: Date/Times on patient view page are represented in the tenant's time zone

Tabular Time Navigation

Clicking anywhere in the top header or the data area will change the time focus to the time shown in the header for that column.

Alarm Events View

The following diagram represents the alarm and event data view.



Alarm Events groups

Events are grouped by their severity:

- 1- Red Alarms
- 2- Yellow Alarms
- 3- Inops

Events within the same group are ordered by the time they occurred.

Event groups can be expanded or collapsed by clicking on the +/- box next to the group row.

Events are displayed based on the Announce and End times of the event. Events which are not ended (for any reason) are displayed as tick marks at the Announce Time.

When the time focus is on an event, the dropdown will list the time and text of the event.

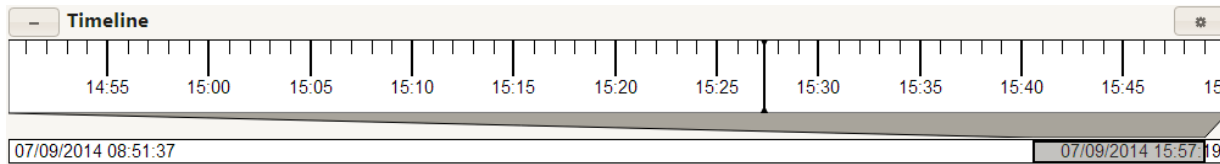
If more than one event occurs at the current time focus, the list is available in the dropdown sorted by the announce time of the event with the most recent event at the top.

Alarm Event Navigation

The left and right arrow buttons allow the user to navigate to the next or previous time when an event occurred. The user cannot use these buttons to navigate to events beyond those currently displayed in the event tile.

Timeline Tile

The diagram below shows an example of how the timeline could appear visually. It consists of a main view window with date/time information on it as well as a marker to indicate the specific time which is focused and a slider which shows the extents of the timeline and contains an indicator meant to display the area of focus on the viewer window. Both areas can be constructed to give an idea as to the location of data, events, etc. with graphical cues as indicated in the figure below. They are also both intended to support user interaction via clicking and dragging. The range of the timeline is the range of the extracted data for that patient.



Timeline Settings

The following settings are available:

- View Duration
 - 1 hour (default)
 - 4 hours
 - 8 hours
 - 12 hours

Note: Date/Times on patient view page are represented in the tenant's time zone

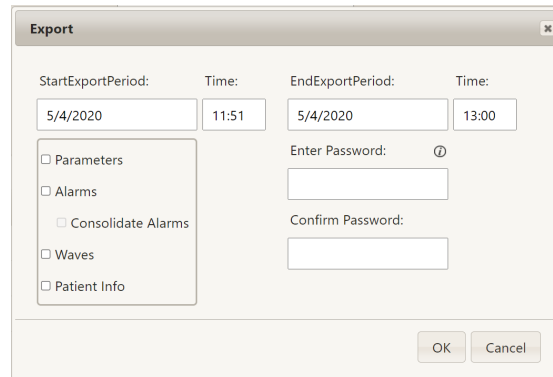
Timeline Navigation

Clicking anywhere in the top part of the timeline will change the time focus to that time. Dragging the thumb in the bottom part of the timeline will change the window of time shown.

Patient Data Export

The user can specify the following options when exporting patient data to files:

- 1- Start of Export Period and Time
- 2- End of Export Period and Time
- 3- Parameters
- 4- Alarms
- 5- Consolidate Alarms
- 6- Waves
- 7- Patient Info



Export Settings

The user can specify the following options when exporting patient data to files:

- Start of Export Period and Time
- End of Export Period and Time
- Parameters
- Alarms
- Consolidate Alarms
- Waves
- Patient Info

1. When only one patient is selected, the start and end export period are auto-filled to the patient's available data dates. The checkbox options are persisted for a particular session.
2. If one of the date fields are left blank or if none of the checkboxes are checked, the export will only include the patient list file.
3. If the time fields are left blank, they will default to midnight.
4. **Consolidate Events** can only be checked if Events is checked. If checked, all patients' events are added to one file.
5. The start export time and end export time are in tenant's time zone. Currently CIM does not support exporting patient data for patient's belonging to different time zone. Selecting patients from different time zone throws a dialog explaining that selecting patients belonging to different time zones is not allowed.

Export Password Criteria

- The password must be of at least 8 characters.

- The password must be of at most 64 characters.

Note: Password is required from user to encrypt the exported zip file. User will use the same password to decrypt the exported zip file.

Clicking on OK button will validate the password criteria and check whether password in both password fields match. If passwords do not fulfil the criteria or two fields do not match, an error message is displayed in red letters for few seconds inside the export dialog box.

Note: Upon exporting, the Patient list file contains all the admit records for a given patient and is not bound by the Export start and end time. If a given patient was admitted to different beds and, as a result, had multiple records, the patient list file will indicate all these records. All the other files which are generated as a result of selecting any of the additional parameters are bound by the start and end export time.

A maximum of 18 days across all patients in a single export job. If total number of days in one export job are more than 18, clicking the OK button will show an error dialog box with message “You have selected total of x days across all selected patients for export. Maximum supported days are 18. Please shorten export duration or reduce the number of patients and try again.” Upon closing the error dialog box, the user will be able to edit the export dialog options.

Clinical Insights Manager Viewer					Patient Search	Export Job List
Export Job List						
Job Id	Job Submit Time	Progress	Status	Action		
d4b0b360-cbbc-4dea-9024-a70426d25d13	4/20/2021 14:22 EDT	100%	UPLOADED	Download		
000d5416-abcc-436c-9686-3619306c0492	4/20/2021 10:56 EDT	100%	UPLOADED	Download		
ae1efdf9-36bc-45b2-a916-223a2bfbf2c2	3/22/2021 15:40 EDT	100%	UPLOADED	Download		

Export Job List

Displays the following information for all results.

The following data elements are shown:

- **Job Id**
- **Job submit time**
- **Progress**
- **Status**
- **Action**

Clinical Insights Manager Viewer					Patient Search	Export Job List	
Export Job List 							
Job Id	Job Submit Time			Progress	Status	Action	
fff114ba-a650-43f8-bb33-5181d29a07a1	10/16/2020 10:39 EDT			100%	UPLOADED	Download	
First Name	Last Name	Institution	Date of Birth	Data Start Time	Data End Time	Exported Attributes	
		varun_timezone_2		9/15/2020 8:13 PDT	9/15/2020 10:23 PDT	Parameters	
bff2f00b-9767-4d12-b9c5-92918cf9105d	10/14/2020 16:45 EDT			100%	UPLOADED	Download	
ff31ebf8-e4c0-4e59-a845-653fae5e8774	9/22/2020 10:35 EDT			0%	EXPORTERROR		

For **Job Id** column: Clicking the job id opens a list of patients selected for that export job with following information:

- **First Name**
- **Last Name**
- **Institution**
- **Date of Birth**
- **Data Start Time**
- **Data End Time**
- **Exported Attributes**

For **Action** column: The action has a download button if the export was successful to download the file to local computer.

Start DOB:

End DOB:

Institution:

Start Available Data:

End Available Data:

Search

Clear

Export

☐	Patient Name	Date Of Birth	Unit_Bed	Institution	Lifetime Id	Encounter Id	Alternate Id	Start Available Data	End Available Data	Action
☐			My_Unit_BED4					09/15/2020 17:26 EDT	09/17/2020 23:53 EDT	Stage
☐			My_Unit_BED3					09/15/2020 13:59 PDT	09/17/2020 20:53 PDT	View
☐			My_Unit_BED1					09/15/2020 12:19 PDT	09/17/2020 20:53 PDT	Failed
☐			My_Unit_BED2					09/15/2020 12:19 PDT	09/17/2020 20:53 PDT	Failed
☐			My_Unit_BED1	varun_timezone_2				09/15/2020 08:13 PDT	09/15/2020 10:23 PDT	View
☒			My_Unit_BED2	varun_timezone_2				09/15/2020 08:13 PDT	09/15/2020 10:23 PDT	Failed
☒	Maddox, Mary	1/1/1970	My_Unit_BED5	MGH2020	25456			05/04/2020 11:51 EDT	05/04/2020 13:00 EDT	View
☐	Iglesias, Terry	3/26/1963	My_Unit_BED3	MGH2020	28279			05/04/2020 11:13 EDT	05/04/2020 13:00 EDT	View

Export Error

Selected patients belong to multiple institutions. Please select patients belonging to same institution for export.

OK

Export Files Structure and Formats

Compressed Directory

When a user exports patient data, a ZIP file is created and placed under the “Export Job List” menu.

One file is created per export, and the name of the zip file will have format “CIM_Export_dd-MMM-yyyy_hh-mm-ss” where “dd-MMM-yyyy_hh-mm-ss” represent the submit time of the export in timezone of the user who downloaded the file. For example, an export job submitted at time 24 Feb 2021, 01:00 PM will create a zip file named CIM_Export_24-Feb-2021_13-00-00.
All exported data is stored in this zip file.

Alerts Directory

When the Consolidate Events option is checked, the Alerts directory is created in the ZIP file containing a CSV file with alerts for all selected patients.

Patient List Directory

When an export is requested, the PatientList directory is created in the ZIP file containing a CSV file with patient information for all the selected patients. The Patient List file name is ‘ExportPatientList_’ followed by the date in ‘MM-dd-yyyy_HH-mm-ss’ format. The patient list file lists all of the patient history irrespective of the export duration mentioned using the “ExportStartTime” and “ExportEndTime”. The CSV contains for each patient:

- PatientId – the unique identifier for the patient
- ClinicalUnit – the unit the patient was in from time shown in StartTime column to the time patient was transferred or discharged.
- BedLabel – the bed assigned to the patient during for the time period starting from the time mentioned in the StartTime column till the time patient was transferred or discharged.
- LifetimeId – LifetimeId of the patient, only exported if Patient Info is selected, otherwise left empty.
- EncounterId – EncounterId of the patient, , only exported if Patient Info is selected, otherwise left empty.
- AlternateId – AlternateId of the patient, , only exported if Patient Info is selected, otherwise left empty.
- Name – patient name, only exported if Patient Info is selected, otherwise left empty.
- AdmitState – The patient admission state for the time period starting from the time mentioned in the StartTime column till the time patient was transferred or discharged.
- StartTime – time the patient’s physio data in the database starts in ‘MM/dd/yyyy HH:mm:ss.fff zzz’ format
- DischargeTime – Time of the first discharge for the patient in ‘MM/dd/yyyy HH:mm:ss.fff zzz’ format. Empty if the patient was never discharged.
- ExportStartTime – time of the export start in ‘MM/dd/yyyy HH:mm:ss.fff zzz’ format
- ExportEndTime – time of the export end in ‘MM/dd/yyyy HH:mm:ss.fff zzz’ format

Patient Directories

For every patient selected, a directory is created in the ZIP file containing all patient data, separated by calendar day periods. The patient directory name is [PID]-followed by the patient ID.

Date by Stay Directories

For every calendar day period, a directory is created in the patient directory containing all the data for that period split into patient stays. The directory name is the start date in ‘MM-dd-yyyy’ format of the current period and the patient stay sequence.

Name	Date modified	Type
 04-30-2020_Stay0	04/21/2021 3:01 ...	File folder
 05-01-2020_Stay0	04/21/2021 3:01 ...	File folder

Alerts File

When the Events option is checked, the alerts.csv file is created in the patient directory, regardless of the Consolidate Events option.

The file contains information for all alerts occurring within the specified timeframe and patient stay, specifically:

- AnnounceDate – The date the alarm was announced shown in 'MM/dd/yyyy' format.
- AnnounceTime – the time the alarm was announced displayed in 'HH:mm:ss.fff zzz' format.
- Sequence – A sequential number that correlates to when an alert occurs at the monitoring central station. This number helps determine the order in which alerts for a given patient are announced.
- OnsetDate – the date the alarm condition begins shown in 'MM/dd/yyyy' format
- OnsetTime – the time the alarm condition begins in 'HH:mm:ss.fff zzz' format
- Label – the alarm text at the time of announcing
- Source – the source id of the alarm, such as the numeric representation of heart rate.
- Code – the generic type of alarm such as the numeric representation of high rate limit.
- Severity – the numeric representation of the alarm severity such as red or yellow
- Kind – the numeric representation of the alarm category such as patient or technical
- SubtypeId – Additional Id for the alarm
- EndDate – The date the alarm ends shown in 'MM/dd/yyyy'. 01/01/0001 if the alarm has not ended
- EndTime – the time of the alarm ends in 'HH:mm:ss.fff zzz' format. 00:00:00.000 +00:00 if the alarm has not ended
- Manufacturer – Company that developed the device that sourced the alarm.
- SerialNumber – Device, that sourced the alarm, Serial number
- SystemId - Unique identifier for the device, that sourced the alarm, if no serial number is available from the device.
- ModelId – Device, that sourced the alarm, model identifier.

Numerics File

When the Parameters option is checked, the numerics.csv file is created in the patient directory.

- The file contains Periodic and Aperiodic numerical information occurring within the specified timeframe and patient stay.
- EWS are considered enumerations and are not included in this file.

The file format is:

- Date – the date the numeric(s) was measured shown in 'MM/dd/yyyy' format
- Time – the time the numeric(s) was measured shown in 'HH:mm:ss.fff zzz' format.
- Diff – the difference in time from the given row to the previous row, i.e. how long it's been since the last set of numerics were measured shown in 'HH:mm:ss.fff' format.
- Sequence - A sequential number that correlates to when a numeric occurs at the monitoring central station. This number helps determine the order in which numeric values for a given patient are generated.
- List of all numeric labels that were measured for the patient during the export time and their values for the given times

Wave Header File

When the Waves option is checked, a header file (.hea) is created in the patient directory for every wave signal file exported.

- The file name includes the wave label and the sample period.
- The file contains the name of the associated signal file and the wave's attributes.
- Base Time – The earliest physio data for the current timeframe and patient stay, shown in the format 'MM/dd/yyyy HH:mm:ss.fff zzz'
- Wave Label
- Record Name – Name of the associated wave file, without the extension
- Number of Signals- always contain 1 signal
- Sample Frequency – Samples per second
- Number of Samples – number of samples in the wave file
- File Name – Name of the associated wave file
- Format – the format of the file. Should always be 16 bit
- ADC Gain – The gain of the wave, otherwise known as the calibration, scaled upper minus lower. This can be zero if there is no calibration. See 'Unit Label' for units of measurement.
- ADC Resolution – the max number of bits used by any wave sample in the wave.
- First Sample Value – The value of the first wave sample

The file contains a list of all attributes:

- Sample Index – the index that the row of attributes starts to apply
- Scale Lower - For ECG and pressures, the minimum value that was displayed at the PIC iX based on the display gain. For all other waves, the minimum possible sample value.
- Scale Upper - For ECG and pressures, the maximum value that was displayed by the PIC iX based on the display gain. For all other waves, the maximum possible sample value.
- Calibration Scaled Lower - The lower sample value of the calibration.
- Calibration Scaled Upper – The upper sample value of the calibration.
- Calibration Abs Lower – The real value of the lower calibration in the given UnitCode (such as mV). For example, for ECG equals 0 mV.
- Calibration Abs Upper – The real value of the upper calibration in the given UnitCode (such as mV). For example, for ECG equals 1 mV.
- Calibration Type – Defines the type of calibration for the wave (ie Stair, Bar, etc)
- Channel – The channel of the ECG wave. 0 = Primary; 1 = Secondary
- Is Derived – Indicate if the wave is derived.
- Low Edge Frequency - ECG high pass cutoff frequency in hz.
- High Edge Frequency - ECG low pass cutoff frequency in hz.
- Unit Label - The unit of the calibration, such as mV.
- ECG Lead Placement – Placement of the ECG leads, such as standard, EASI or Hexad
- Source Device ModelId – The sourcing device model identifier.
- Source Device Serial Number – The sourcing device serial number.

Wave Signal File

When the Waves option is checked, a signal file (.dat) is created in the patient directory for every wave exported. Waves with different source devices or sample periods are considered different waves.

- The file name includes the wave label and the sample period.
- The file contains wave samples which are stored as binary data.

Wave Invalid Samples File

When the Waves option is checked, an invalid_samples.csv file is created in the patient directory for every wave signal file exported.

- The file name includes the file type invalid_samples, the wave label and the sample period.
- The file contains the indices of invalid wave samples in the signal file in a start/end format. For example, if the start is 5 and end is 30 for a row it means that wave samples 5-30 are all invalid.

Note: If no invalid samples available a blank file will be created.

Wave Specification Information File

When the Waves option is checked, an information (.info) file is created in the patient directory.

- The file name is Info.info
- The file contains:
 - The Patient Id
 - The start time of the wave files shown in 'MM/dd/yyyy HH:mm:ss.fff zzz' format
 - A list of:
 - The Wave File name
 - Samples per second
 - Scale
 - Scale units of measure
 - Wave label
 - Gain
 - Clock file name – next to the wave that's the primary ECG at that time of the export
 - Annotation File Name – next to all non-primary ecg waves

Clock File

When the Waves option is checked, the clock.csv file is created in the patient directory.

The file contains a mapping of the wall clock datetime (second column) to the milliseconds elapsed since the beginning of the first wave of the current timeframe and patient stay (first column). Datetime is shown in 'MM/dd/yyyy HH:mm:ss.fff zzz' format.

Enumeration Files

When the Waves option is checked, one file for every enumeration exported for the patient is created and included in the patient directory.

- The file name includes the enumeration label and the physio ID.
- The file contains:
 - Label – the label of the enumeration
 - Time Offset – how many milliseconds since the beginning of the current timeframe and patient stay the enumeration occurred.
 - Value - the enumeration value at that time

Paced Pulses Files

When the Waves option is checked, a paced_pulses.csv file is created in the patient directory for every ECG wave exported. If no paced pulses are present, the file is empty.

- The file name includes the file type paced_pulses, the wave label and the sample period.
- The file contains:
 - Paced Pulse Samples – the sample indices of when a paced pulse occurs in the signal file. For example, if a paced pulse occurs at sample 5 and 10, the file lists these sample indices.

Sharing Exported Data

There are several cases where some of the data elements from the exported files need to be anonymized before the data can be shared with a non-covered entity. There are two such data elements in the [ExportPatientList].csv:

- 1- 'Clinical Unit'
- 2- 'Bed Label'

s > CIM_Export_a1ee2cfc-0407-40a8-956e-162bb875747e > PatientList			
Name	Date modified	Type	Size
 .ExportPatientList_03-25-2021_21-30-00.csv.crc	5/9/2021 5:49 AM	CRC File	1 KB
 ExportPatientList_03-25-2021_21-30-00.csv	5/9/2021 5:49 AM	Microsoft Excel C...	1 KB

Change the clinical unit and bed label in this file to anonymized labels.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	PatientId	ClinicalUnit	bedLabel	LifetimeId	AlternateId	EncounterId	Name	AdmitState	StartTime	DischargeTime	ExportStartTime	ExportEndTime	TenantName	InstitutionName
2	a0edaf03-6b58-4f80-b1ba-9cd343a21aec	My Unit	beds				MoreWavesPerformance, ngn	1	03/26/2021 02:36:34.100 +0530		03/26/2021 03:00:00.000 +0530	03/27/2021 03:00:59.999 +0530	varun_test	bedsims

During daylight savings, the time is moved forward on Sunday by 1 hour from 2:00 am to 3:00 AM. When daylight savings end, the time clock is moved backwards from 2:00 am back to 1:00 AM.

Clinical Insights Manager Patient Search Export Job List

Pence, Mickey

Livedward Encountered Alteredward
 Gender M Height 185 cm Weight 85 kg
 Date Of Birth: 1/20/1970 Unit: Bed URD / BED10
 Institution:
 Medical_Finland_HL_Test_01252020_BeforeDay
 Light

3/8/2020 1:59:58

Strip Chart

ECG Lead: 120 bpm
P Lead: 120 bpm
R Lead: 120 bpm

Speed: 25 mm/s Strip Speed: 25 mm/s

Strip Waves Clippers

Time	HR	PR	SpO2	Temp
1:59:50	120	98	98	36.6
1:59:51	120	98	98	36.6
1:59:52	120	98	98	36.6
1:59:53	120	98	98	36.6
1:59:54	120	98	98	36.6
1:59:55	120	98	98	36.6
1:59:56	120	98	98	36.6
1:59:57	120	98	98	36.6
1:59:58	120	98	98	36.6

11/1/2020 15:00

Strip Chart

13/1/0000 1:59:00

Speed 25 mm/s Size x1

Strip Speed

☒ Clip Waves ☐ Callers

Tabular Trend

	1:59	1:04	1:09	1:14	1:19	1:24	1:29	1:34	1:39
HR	120	31	-	-	-	-	120	120	120
btmHR	120.12	-	80.05	120.12	120.12	120.00	120.12	120.00	120.12
SpO ₂	98	-	86	86	98	98	98	98	98
Perf	3.6	-	3.9	3.9	3.6	3.6	3.6	3.6	3.6
RR	30	-	76	40	30	30	30	30	30

Alarm Insights Manager (AIM)

AIM Dashboard

AIM dashboard is a web-based interactive application that provides visualization of alarms using a multitude of alarm queries, view by and filter by controls. The following document explains the navigational, filtering concepts, and the computational methods behind each alarm query.

AIM has three main concepts:

- 1- Alarm Queries
- 2- Alarm Aggregation
- 3- Data Filtering

Alarm Queries

AIM hosts a list of queries that represent various alarm operational metrics and provide insights into root cause of alarm fatigue and standards of care. To visualize an alarm query, the user simply clicks on the query text, the result is displayed as a chart. By default, alarm query metrics are aggregated on a per month basis. There are other options provided for alarm aggregation.

Alarm Aggregation

Alarms can be aggregated using one of the following aggregation groups, represented on the top tool bar.

- 1- Month
- 2- Week
- 3- Day
- 4- Hour
- 5- Unit
- 6- Bed
- 7- Patient
- 8- Alarm
- 9- Severity

The following figure shows the AIM query, aggregation, and filter concepts.



Data Filters

There are 2 types of data filters:

- 1- **Explicit**
- 2- **Contextual**

Explicit filters provide the ability to select the clinical units under study, the alarm severities and date range of interest. The following diagram shows the filtering controls. By default, within an institution, all units, all severities and the entire data range is selected.

Filters As of Mar 14, 2021, 1:54:17

Institutions
EnglishB02

Units Select All Unselect All

- ☒ ACU
- ☒ CCU
- ☒ ICU
- ☒ NICU

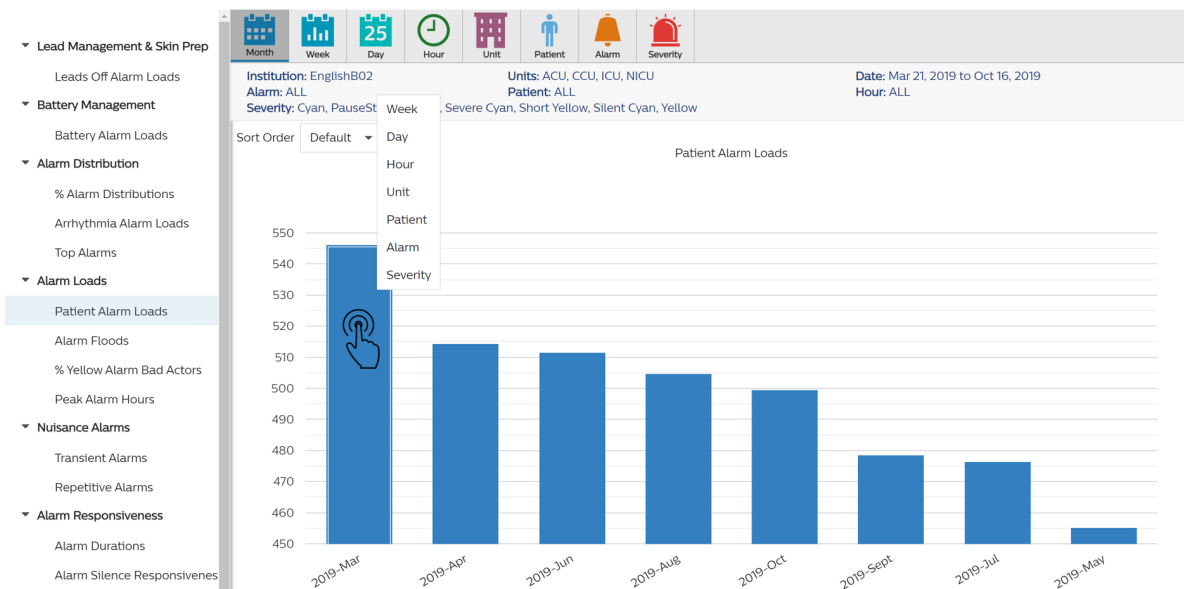
Severity Select All Unselect All

- ☒ Cyan
- ☒ PauseStandby
- ☒ Red
- ☒ Severe Cyan

Time Range Default Preset

21-Mar-2019 - 16-Oct-2019

Contextual filters provide the ability to filter on a specific context: Month, Week, Day, Hour, Unit, Patient, Alarm or Severity by mouse clicking on the data column that represents that context. The following figure shows filtering patient alarm load data for the month of March by mouse clicking on the column representing March. A menu is displayed to provide instant aggregation selection on the resultant filtered data (Week, Day, Unit, Patient, etc.).



Note: More details on Contextual Filtering is covered in [Contextual Filters](#) later in this document.

Definitions

Alarm Load

Alarm load, also known as alarm burden, express the normalized alarm count per **monitored** patient day (**ALMPD**). Monitored patient day is defined as the total number of aggregate hours a patient is monitored divided by 24 (hours per day).

For instance, if a patient John Doe was monitored for an aggregate duration of 42 hours over 2 days, then the monitored patient days for John is $42/24 = 1.75$ monitored patient days.

Let's assume that during the 42-hour period, a total of 250 alarms occurred for this patient. The Patient alarm load would be equal to $250/1.75 = 142$ alarms per patient day.

A crude but acceptable first release method for computing alarm load is to use alarm load per patient day (**ALPPD**). This assumes that patients who had at least a single alarm in a day were monitored for the full day (24 hours). In the above example for John Doe, the monitored days would be 2 days. The alarm load for that patient would be $250/2 = 125$ alarms per patient day.

Note: All "Load" Queries are computed as load per patient day.

Counting Alarms

The following examples illustrate in a very simplified way how alarms are represented in the AIM database. The following example is for a "VTach" alarm that was announced at 12:08:54 and ended 5 seconds later at 12:08:59.

The Id column represents a unique instance of an alarm.

Time Stamp	Id	Label	Is Ended	Is Silenced
12:08:54 AM	D7059F9D-F792-4099-989D-853BDDCFF3E8	*** VTach	0	0
12:08:59 AM	D7059F9D-F792-4099-989D-853BDDCFF3E8	*** VTach	1	0

The following example is for a **“Cannot Analyze ST”** alarm that was announced at 11:01:02 and ended 10 seconds later at 11:01:12.

Time Stamp	Id	Label	Is Ended	Is Silenced
11:01:02 PM	CBB328CD-DCD8-48EE-8FD9-EF426FFF0CEA	Cannot Analyze ST	0	0
11:01:12 PM	CBB328CD-DCD8-48EE-8FD9-EF426FFF0CEA	Cannot Analyze ST	1	0

The following example is for a **“***ARTs 185>180”** alarm that was announced at 12:21:25 and was silenced 8 minutes and 32 seconds later at 12:29:57. This alarm condition was still ongoing since it has not ended.

Time Stamp	Id	Label	Is Ended	Is Silenced
12:21:25 AM	0B887C91-3FAA-403F-A06B-8072174BEADF	***ARTs 185 >180	0	0
12:29:57 AM	0B887C91-3FAA-403F-A06B-8072174BEADF	***ARTs 185 >180	0	1

The following is a single low SpO₂ alarm that occurred at 12:58:24 and underwent a measured value change (from SpO₂ = 88 to SpO₂ = 78) 5 seconds later. It then ended nearly a minute afterwards.

Time Stamp	Id	Label	Is Ended	Is Silenced
12:58:24 AM	E14C6F53-ABA3-471B-ACA3-DC93AF8E880D	**SpO ₂ 80 <88	0	0
12:58:29 AM	E14C6F53-ABA3-471B-ACA3-DC93AF8E880D	**SpO ₂ 78 <88	0	0
12:59:30 AM	E14C6F53-ABA3-471B-ACA3-DC93AF8E880D	**SpO ₂ 78 <88	1	0
Count = 1				

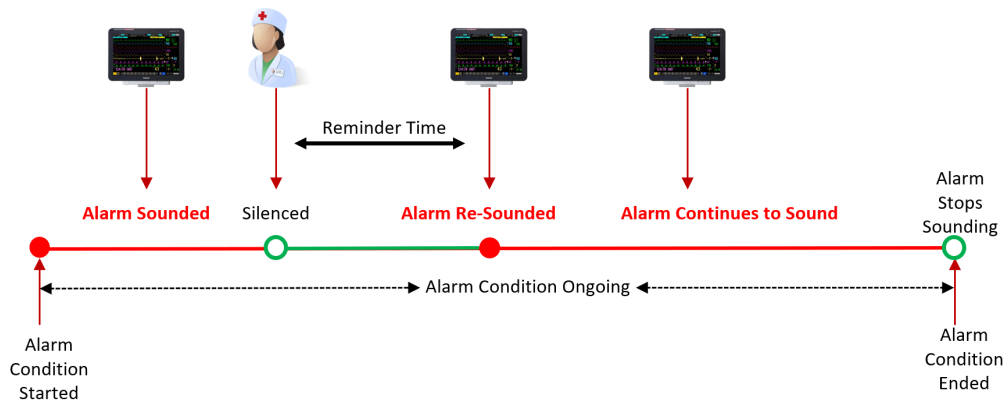
When counting alarms, the number of alarms is represented by the first occurrence of the alarm identified by its unique Id. Each of the above examples is counted as a single alarm.

Similarly, the following example shows multiple rows that indicate a change in the alarm condition. In this case, this is also counted as one alarm even though it underwent multiple measured ARTs value changes and was silenced multiple times while the condition was still ongoing.

Time Stamp	Id	Label	Is Ended	Is Silenced
4:23:30 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 191 >180	0	0
4:23:35 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 194 >180	0	0
4:23:40 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 197 >180	0	0
4:23:45 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 198 >180	0	1
4:23:50 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 204 >180	0	1
4:23:56 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 210 >180	0	1
4:24:01 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 211 >180	0	1
4:24:11 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 219 >180	0	1
4:24:16 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 221 >180	0	1
4:24:26 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 222 >180	0	1
4:24:31 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 227 >180	0	1
4:24:37 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 230 >180	0	1
4:25:02 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 231 >180	0	1
4:28:01 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 232 >180	0	1
4:42:57 AM	C945A8A2-4CB2-4C47-936D-00027042A505	**ARTs 232 >180	1	1
Count = 1				

Reminder Alarms

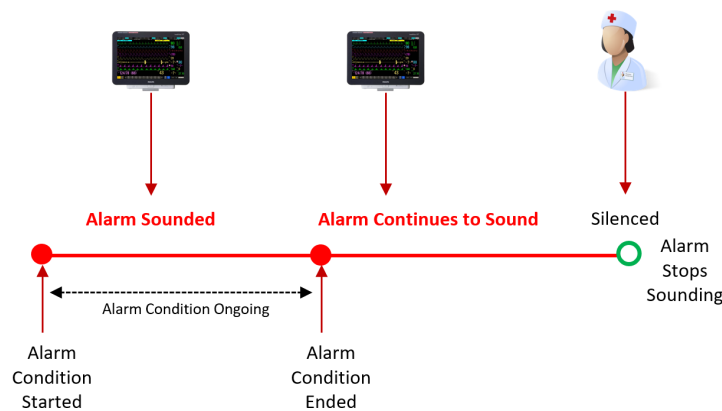
If the patient monitor's reminder alarm setting is turned ON, and if an alarm is silenced, the patient's monitor will re-alarm after the reminder time period has elapsed. The "reminder" alarm continues to sound, as long as the alarm condition is ongoing until it is either silenced again or the alarm condition ends.



This is counted as 1 alarm even if the alarm is re-sounded, as a reminder, as a result of the alarm condition being still active and not ended.

Latching Alarms

If a patient monitor's latching configuration is turned on (whether visual and audible or visual only), and an alarm occurs and then the alarming condition ends, the alarm will continue to sound or display until it is silenced.



Latching alarms counted as 1 alarm in spite of the alarm continuing to sound (or display) after the condition ends.

AIM Navigation

View By

Alarm queries can be aggregated and viewed by Month, Week, Day, Hour, Unit, Bed, Patient, Alarm or Alarm Severity.

The number of data points that can be displays is controlled by the number of rows under filters. The maximum number of rows is set at 30. This means, the user can view by up to 30 months, 30 weeks, 30 days, 30 units, 30 Beds, 30 patients, or 30 alarms at a time.

Rows

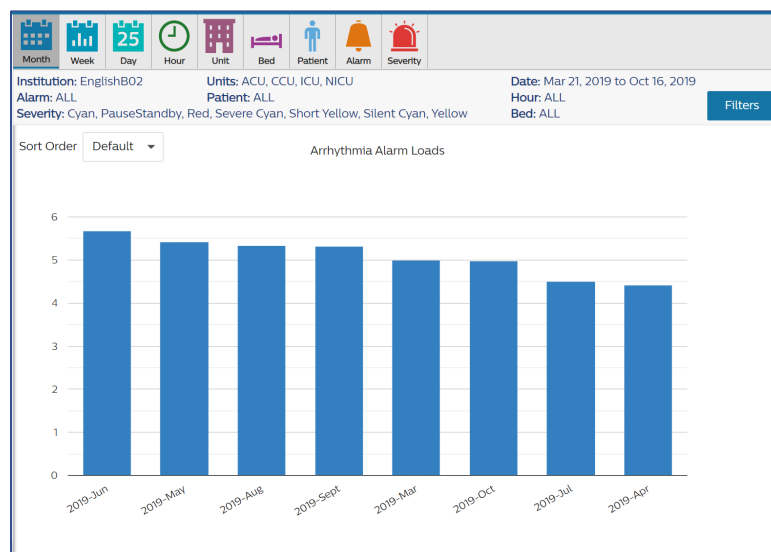
30

All “Load” query results yield the top number of rows.

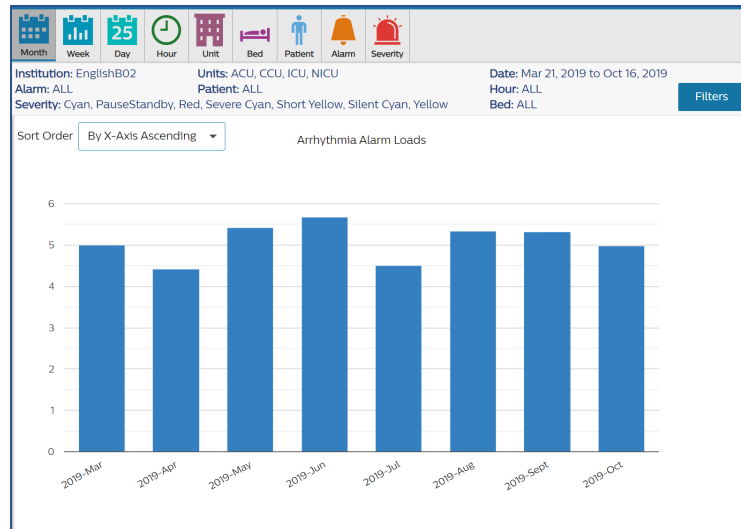
Sort By

There are 3 ways for sorting the data.

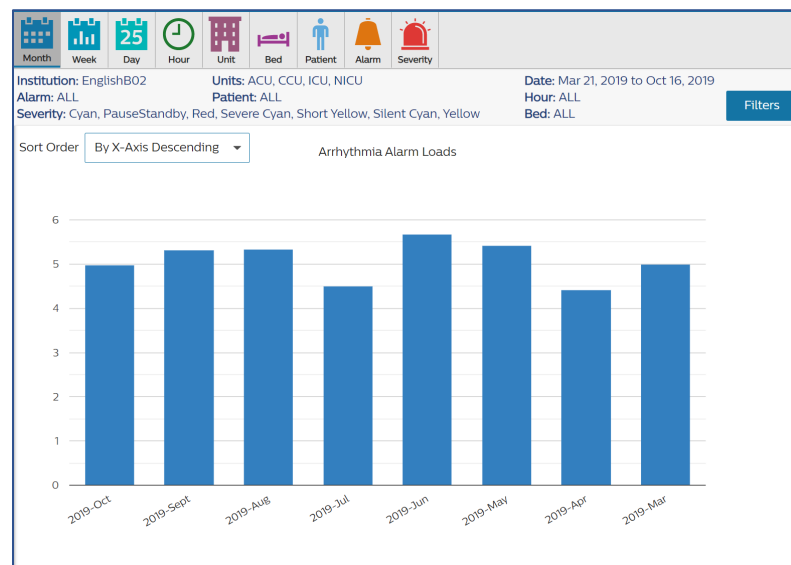
1. Default: By default, all load data is sorted in descending order based on the y-axis value. The highest alarm loads will show first followed by the lower loads.



2. Time-Axis Ascending: the user can sort on the time axis by ascending order. This only applies to time-based x-axis such as Month, Week, Day, and hour.



3. Time-Axis Descending: the user can sort on the time axis by ascending order. This only applies to time-based x-axis such as Month, Week, Day, and hour.



Explicit Filters

There are 4 explicit filters:

- 1- Institution
- 2- Units
- 3- Alarm Severities
- 4- Date Range

Once an institution is selected, the list of clinical units that participated in alarm insights is displayed and checked. Also, the list of existing severities within the dataset is listed and checked. Similarly, the data date range is displayed and selected.

Filters  As of May 17, 2021, 4:52:28 PM

Institutions

EnglishB02

Units [Select All](#) [Unselect All](#)

- ☒ ACU
- ☒ CCU
- ☒ ICU
- ☒ NICU

Severity [Select All](#) [Unselect All](#)

- ☒ Cyan
- ☒ PauseStandby
- ☒ Red
- ☒ Severe Cyan

Time Range [Default](#) [Preset](#)

21-Mar-2019 - 16-Oct-2019 

Filters  As of May 17, 2021, 4:52:28 PM

Institutions

FrenchC03

Units [Select All](#) [Unselect All](#)

- ☒ ACU
- ☒ ICU
- ☒ NICU
- ☒ PICU

Severity [Select All](#) [Unselect All](#)

- ☒ Cyan
- ☒ PauseStandby
- ☒ Red
- ☒ Short Yellow

Time Range [Default](#) [Preset](#)

01-Mar-2019 - 13-Apr-2019 

Pressing the Refresh  icon refreshes the filter from the up to date data set.

The user can select one or more units, alarm severities and a date range. The selection acts as a filter and filters out any non-selected units, alarm severities within the selected date range.

The user can select a date range by clicking on the calendar icon and selecting a start and end day.

< October 2019 >

Su	Mo	Tu	We	Th	Fr	Sa
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

21-Mar-2019 - 16-Oct-2019 

When a date is selected, it implicitly sets the time filter to be 00:00:00 for that day.

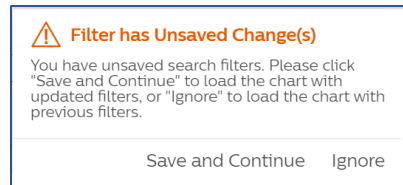
Also, a pre-defined date range is provided under “Preset” for quick date range selection.

Preset

- Last Day
- Last Month
- Last 6 Months
- Last Year

To Reset the date range to the full range of data, the “Default” link can be used and the entire data range will be selected.

If the filter changes were not applied and the user attempts to navigate to a different query or to a different view by option, a warning dialog appears as follows:



Pressing "Save and Continue" applies and saves the filters and executes the user's action.
Pressing "Ignore" reverts the filter changes to the last saved filters and executes the user's action.

Note: You must press "Apply" for any filter changes to take effect

Active Filter Status Panel

A filter status panel is located below the "View By" Tool bar. It displays the list of all active filters
By default, no filters are active. This means that all units, all alarm severities and the entire data range is included in any queries.

Institution: EnglishB02	Units: ACU, CCU, ICU, NICU	Date: Mar 21, 2019 to Oct 16, 2019	Filters
Alarm: ALL	Patient: ALL	Hour: ALL	
Severity: Cyan, PauseStandby, Red, Severe Cyan, Short Yellow, Silent Cyan, Yellow		Bed: ALL	

When filters are applied, the active filters are displayed in the filter status panel. For example, filtering on one unit (CCU) and on Red alarms only yields the following:

Institution: EnglishB02	Units: CCU	Date: Mar 21, 2019 to Oct 16, 2019	Filters
Alarm: ALL	Patient: ALL	Hour: ALL	
Severity: Red		Bed: ALL	

Filters As of May 17, 2021, 4:52:28 PM

Institutions

EnglishB02

Units Select All Unselect All

☐

ACU

☒

CCU

☐

ICU

☐

NICU

Severity Select All Unselect All

☐

Cyan

☐

PauseStandby

☒

Red

☐

Severe Cyan

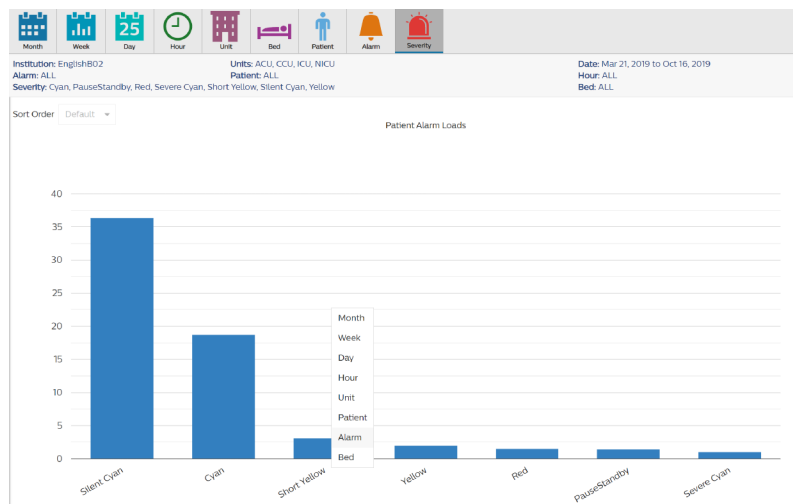
Time Range Default Preset

21-Mar-2019 - 16-Oct-2019

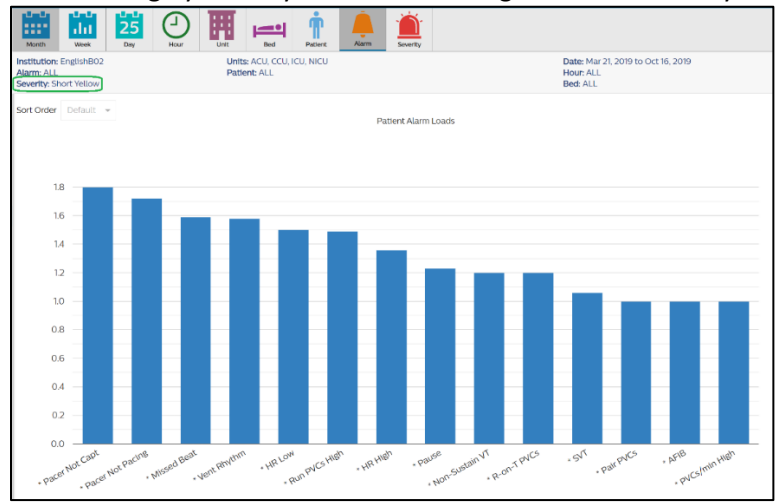
Contextual Filters

Contextual filters provide an intuitive and interactive way to filter on data that the user sees in the chart. The user can click on any data column representing month, week, day, hour, unit, bed, patient, alarm, or severity and filter on that data column. The following are several examples that illustrate the concept of contextual filtering.

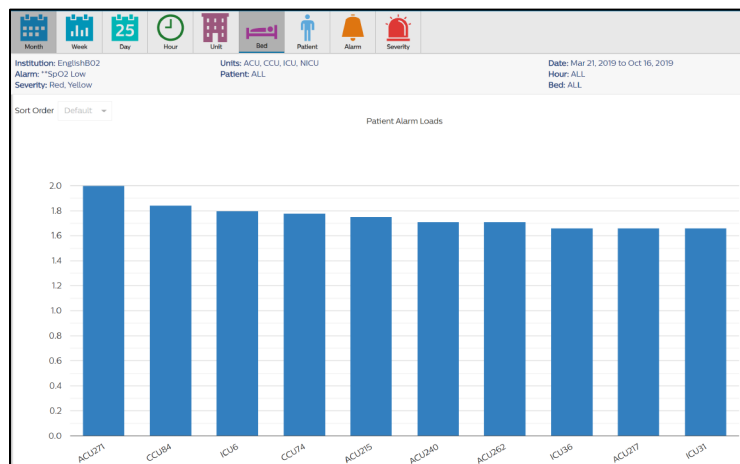
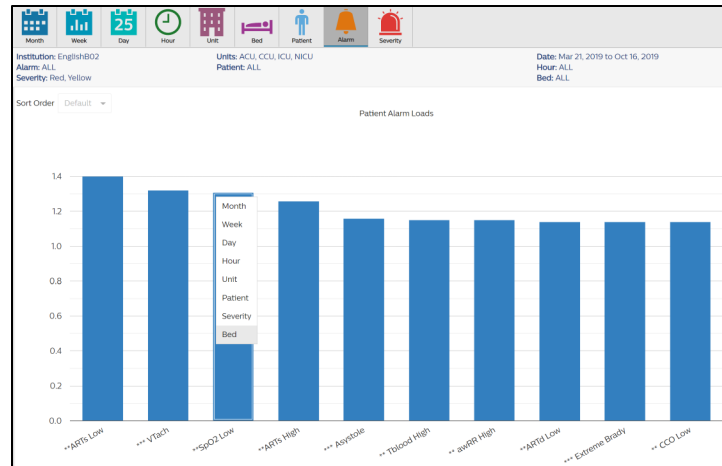
If the user is viewing alarm data by severity and wanted to filter on a specific severity and view the details of the alarms under that severity (By month, week, day, hour, unit, bed or patient), the user can left-mouse click on the bar of interest. This sets the filter to that bar which is Severity = Short Yellow in this case. Also, a menu pops up to allow the user to visualize the results of the filtered data.



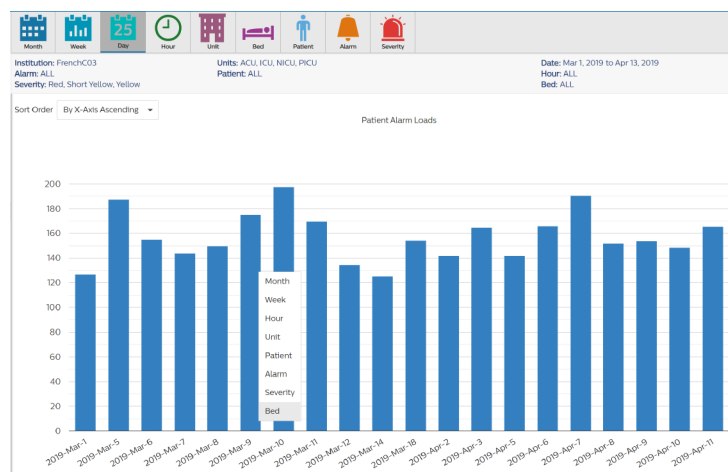
Filtering on Short Yellow and viewing by Alarm yields the following. Note the Severity filter in the status panel.



Similarly, filtering on SpO2 Low by clicking on that column and viewing by Bed yields the following:



The following is another example that illustrates contextual filtering. In this example, the user is viewing alarm loads by day and decides to drill down into a specific day (for example: March 10 2019)



Note that the filter panel shows Date = March 10.

Next, if the user wants to select the highest alarming bed and drilldown into what alarms are happening for that bed, the user clicks on the bed and views by alarm.

However, the result shows the distribution of ****FR-ae_BAS** by bed for only **Bed_282** since the Bed filter was set from before to that bed.

Note: Contextual filters are sticky and hence the result of multiple filters set is naturally additive. To Reset any contextual filter (Bed, Patient, Alarm), click on the related “View By”. In this example: To reset the filter on Bed_282, click on the “View By” Bed button. This will reset the alarm filter to ALL Beds and the result is the distribution of ****FR-ae_BAS** across **all beds**.

Lead Management and Skin Preparation

Leads-Related Alarm Loads

There is a relationship between electrode-skin contact and electrical impedance measurement on signal quality. Much of the resistance with artifact is caused by dead skin cells; improper skin preparation before electrode placement, dried electrode gel and infrequent replacement of electrodes.

This can increase artifact by elevating skin impedance and consequently increasing lead-related alarms. The Leads off query provides a measure of proper skin preparation and electrode placement and replacement. It is calculated as **lead-related alarm load per patient day**. This query also includes non-lead related sensor alarms such as Pleth/SpO2 and Blood pressure Cuff sensors. For a list of Lead-related alarms, see Appendix.

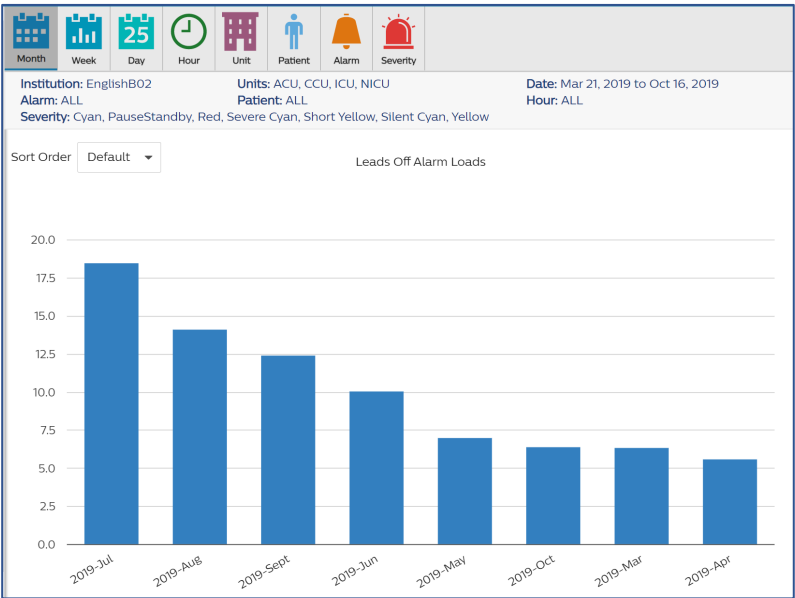
This query includes the following types of leads and measurements:

- ECG
- Resp
- Pressure
- Pleth
- EEG
- NMT

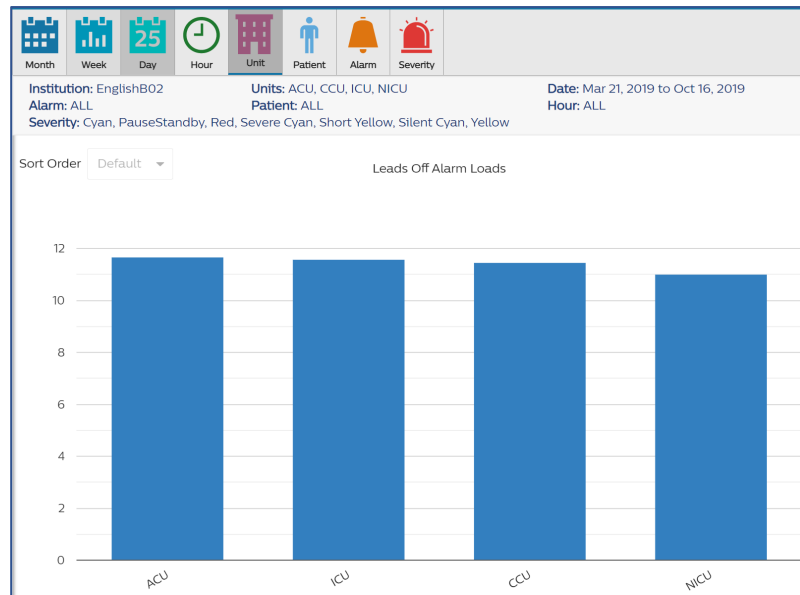
For each of the leads above, the following types of lead-related alarms are included:

- <Lead type> Leads Off
- <Measurement> Erratic
- <lead/Electrode> Noisy Signal.

Viewing by Date: Historical Benchmarking

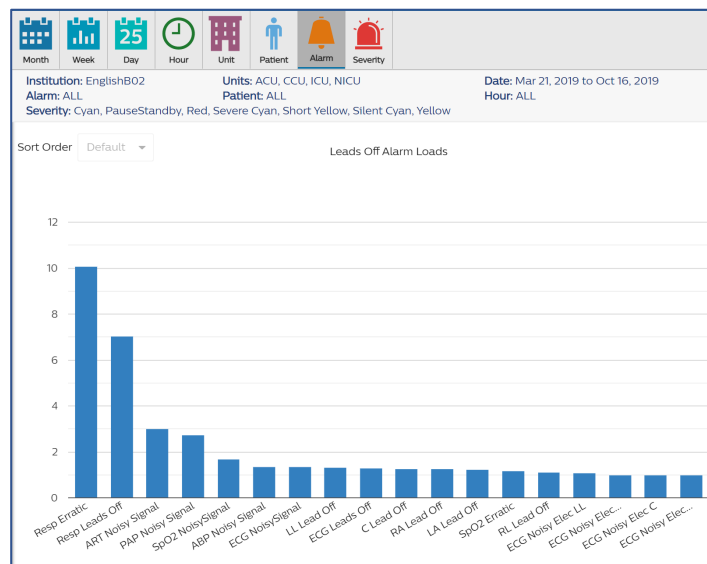


Viewing by Unit: Comparison across units



Viewing by Alarm:

Shows resp lead related top alarms.

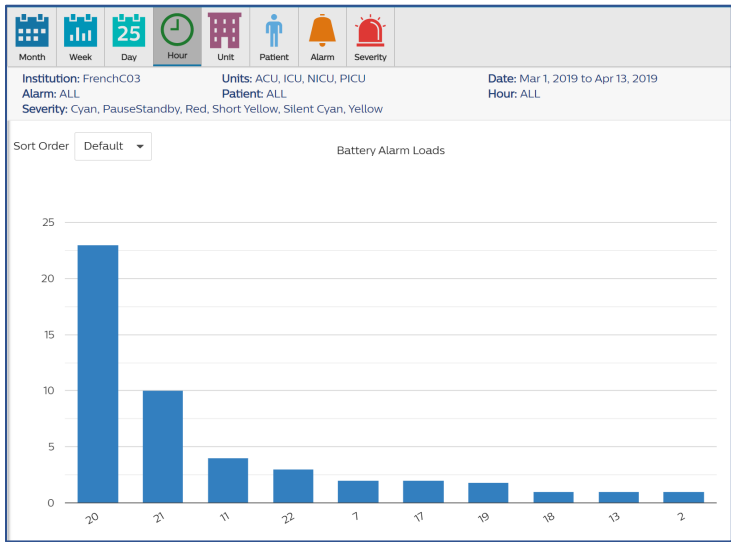


Battery Management

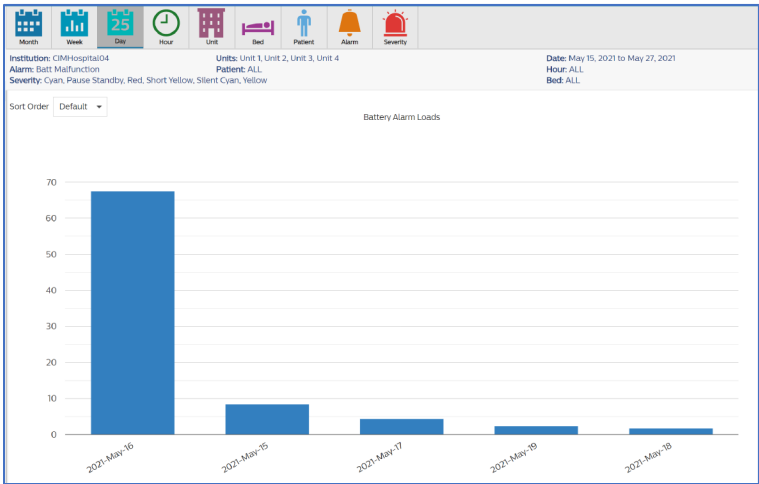
Battery Alarm Loads

Telemetry patient monitoring devices operates with either disposable or rechargeable batteries. When the battery level reaches 10%, the telemetry devices generate battery-related alarms. The telemetry devices also stop transmitting data across the network to the central station for surveillance and storage when they reach low battery levels. The “battery Alarm Load” metric calculates the **battery-related alarm load per patient day**.

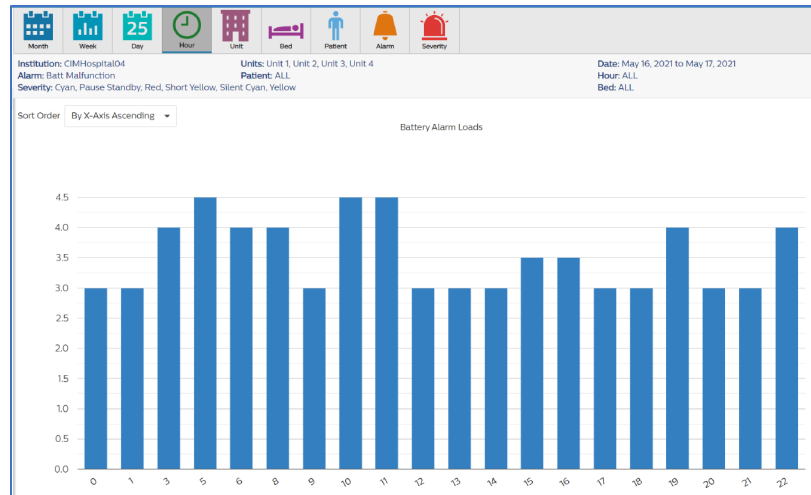
The following hourly chart for a telemetry unit, shows that the majority of battery alarms occur on the 20th hour of the day. It shows about 23 alarms during the 20th hour of the day.



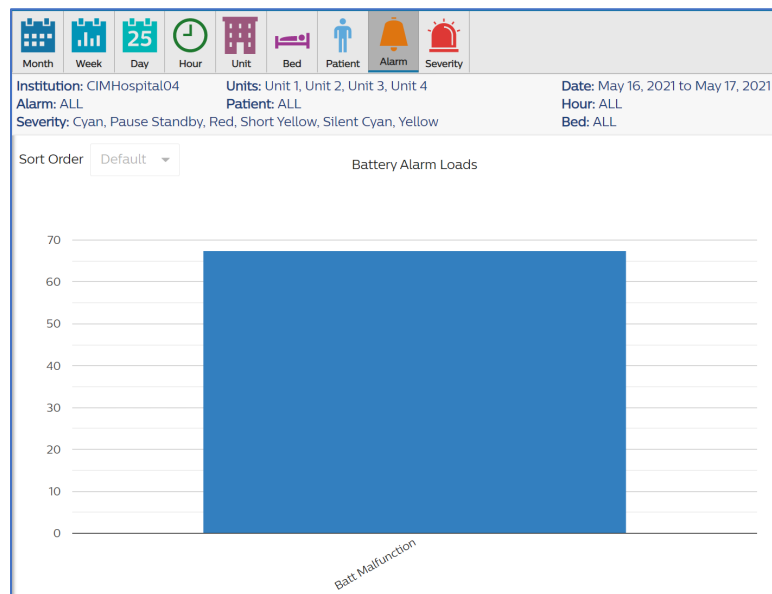
The following chart shows battery-related alarms per day. Notice that about 67 alarms per patient day occurred on May 16.



Drilling further into the hour distribution of these alarms during that day shows a relatively even distribution of alarms across all hours of the day.



Viewing these alarms by alarm shows that it is a single alarm indicating a battery malfunction and it is un-related to proper and timely battery replacement.

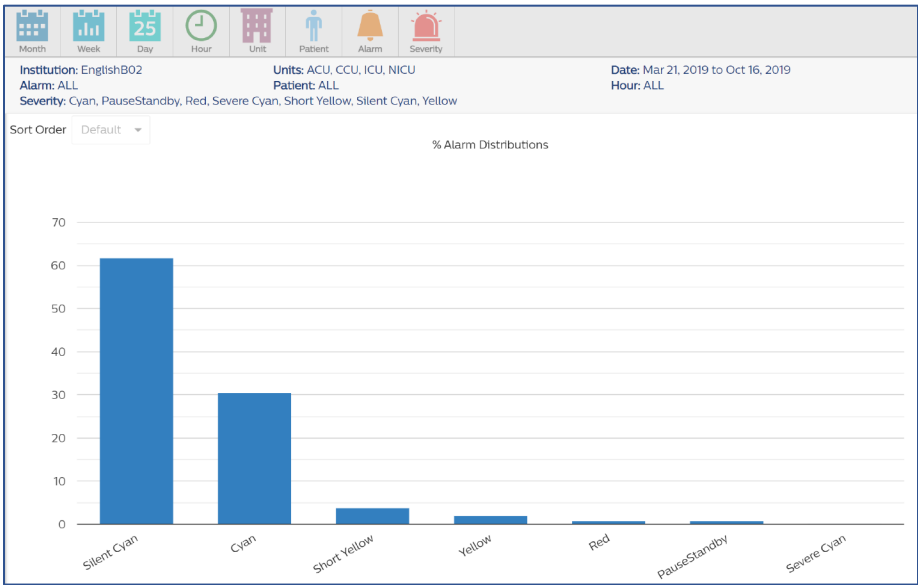


Proper battery management and periodic battery replacement reduces alarms generated from the telemetry patient monitor and eliminates gaps in the patient's data record caused by a pause in data transmission from these devices. Typically, a nurse-aide or technician are responsible for changing batteries periodically and making sure devices have fully operational batteries. This metric could be used to assess not only the battery alarm load on a caregiver but also to assess the effectiveness of a tech managing these telemetry devices.

Alarm Distribution

% Alarm Distribution

The % alarm distribution provides insights into the relative distribution of alarms based on their severity. It is represented as a percentage. % alarm distribution represents **% alarm count distribution by alarm severity**. Hence, when viewing this query, the “View By” tool bar is disabled.



% Top Alarms

% Top Alarms: % Alarm count distribution by alarm viewed by alarm and % value sorted in descending order.

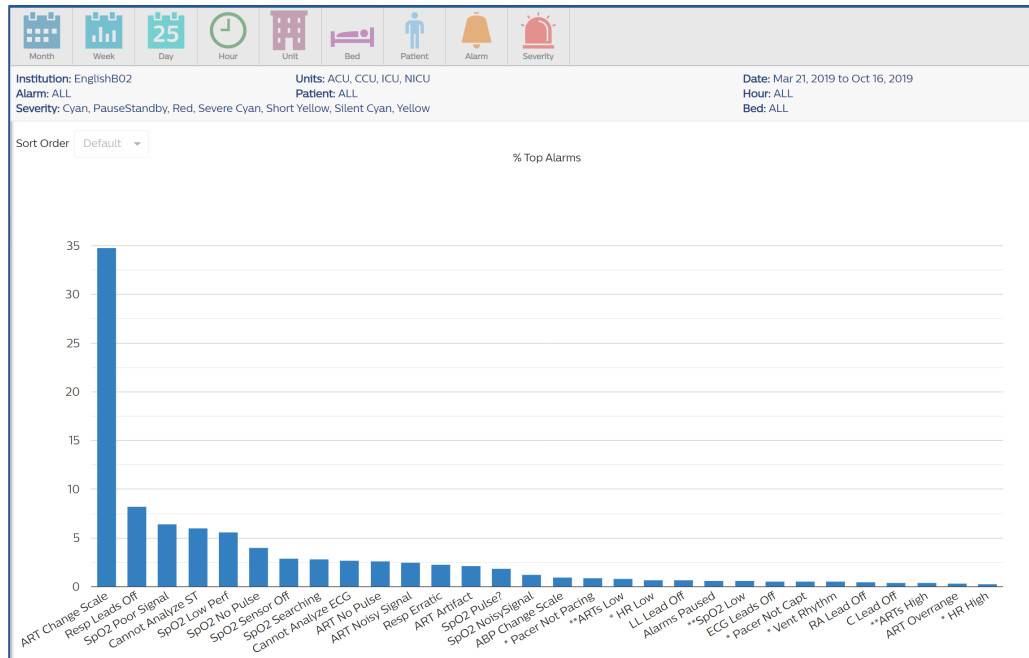
The following is an example of calculating the top alarms.

Alarm	Count	% Count
Leads Off	120	41.5%
SpO2 Low	51	17.6%
HR Low	58	20.1%
PVC	60	20.8%

Computing top alarms using patient loads is equivalent ALPPD view by alarm. As mentioned earlier in the “Viewing by Alarm” section, this would yield the same view as Patient Alarm load viewed by Alarm. The following table illustrates the computation of top alarms using ALPPD.

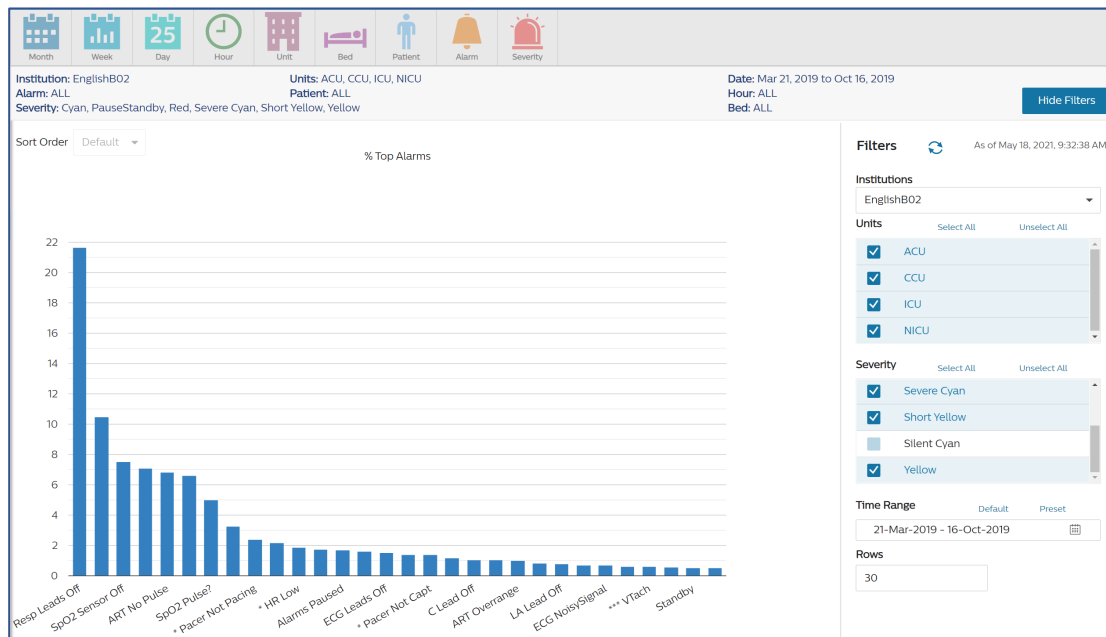
Alarm/Patient	A	B	C	ALPPD
Leads Off	90	20	10	40.0
SpO2 Low	7	4	40	17.0
HR Low	10	45	3	19.3
PVC	0	60	0	20.0

The Top alarms query provides insights to the highest occurring alarm within the specified unit(s), date range, and alarm severities.



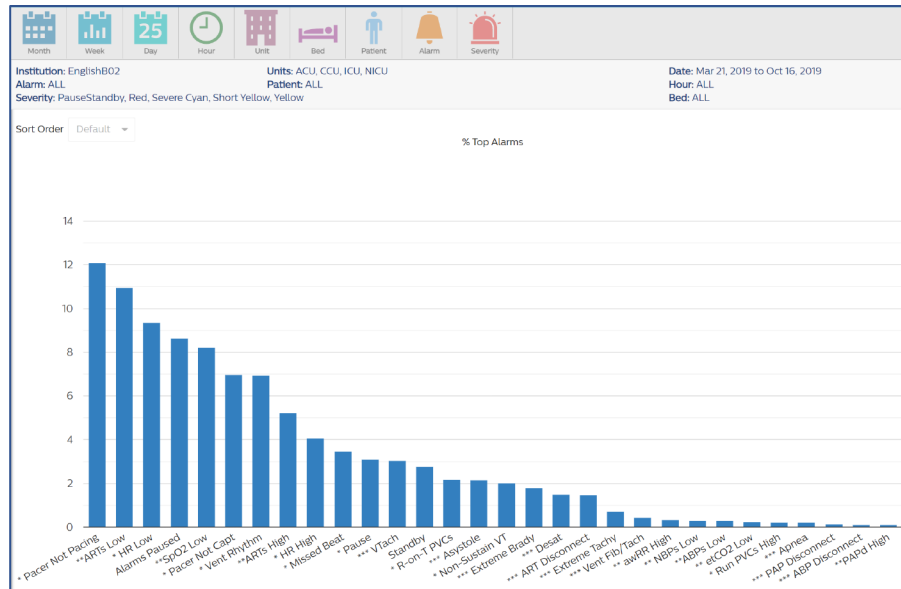
Top Non-Silent Cyan Alarms

The ART Change scale is the top alarm across the entire dataset. Eliminating this outlier (Silent Cyan) and focusing on each group of alarm severities yields a more concise view.



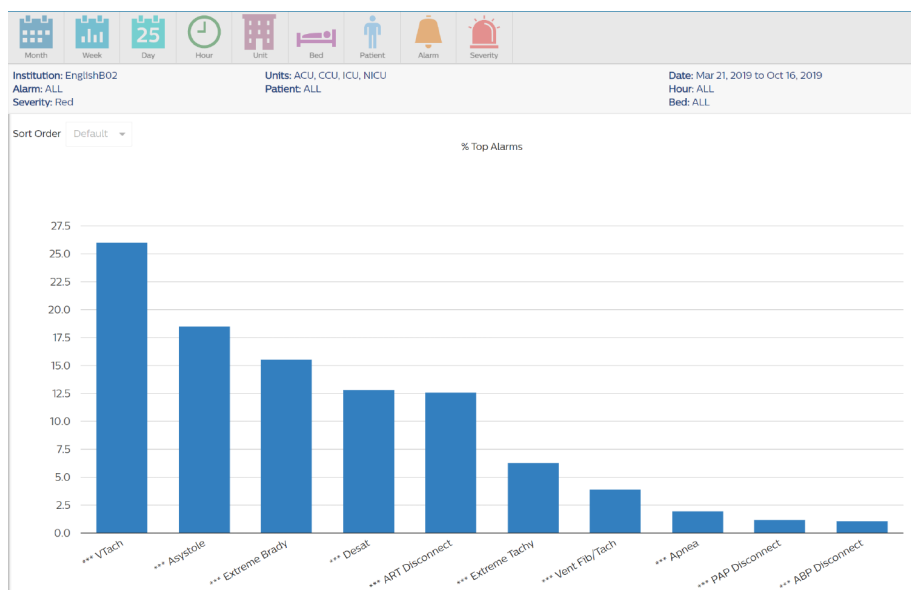
Top Non-Cyan Alarms

Resp Leads Off is next top alarm (Cyan Inop) across the entire dataset. Similarly, eliminating this outlier (Filtering out Cyan alarms) yields a more insightful view on top clinical alarms.



Top Red Alarms

Examining top Red alarms yields the following distribution with the top 3 red alarms being VTach, Asystole and Extreme brady.



Examining top alarm across units requires explicit filtering one unit at a time.

% Yellow Alarm Bad Actor

Alarm fatigue is typically due to non-actionable alarms. Typically, yellow or short yellow alarms are usually not actionable. Some cyan in-ops can also be non-actionable. For the sake of this release, we only focus on yellow and short yellow alarms. When these non-actionable alarms constitute the majority of alarms (70% or higher), they are referred to as bad actor alarms. **% Yellow Bad Alarm Actors: % of Yellow relative to Red + Yellow + Severe Cyan alarms.**

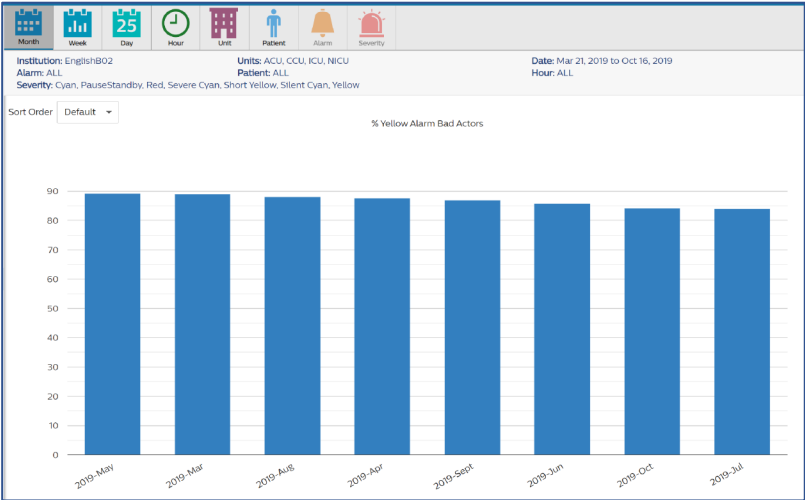
In the example below, the % bad alarm actors result is computed by dividing the total yellow over the total count of alarms (excluding Pause/Standby and in some cases excluding silent cyan).

Alarm	Count	Severity
	0	Severe Cyan
ART Disconnect	11	Red
V Tach	3	Red
Brady	12	Red
Apnea	23	Red
Low HR	7	Yellow
High HR	9	Yellow
ART S	62	Yellow
SpO2 Low	76	Yellow
ART M	26	Yellow
Total	229	
%bad alarm actors	180/229 = 78.6%	

This query provides views by: Month, Week, Day, Hour of day, Unit, and Patient.

Viewing by Month

Provides a monthly view of yellow bad actor alarms. Provides a historical benchmarking for continuous improvements of this KPI.

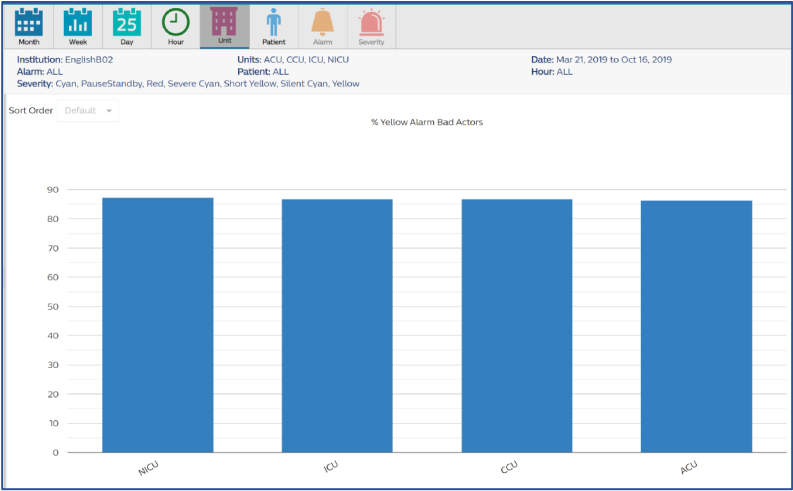


Viewing by Alarm

This query does not provide a direct drilldown for viewing by alarm. However, to view the yellow alarms offenders that are contributing to these bad alarm actors, view the % Top alarms with a filter on Yellow severity.

Viewing by Unit

Provides a Yellow Bad alarm actor benchmarking across various clinical units



Alarms Loads

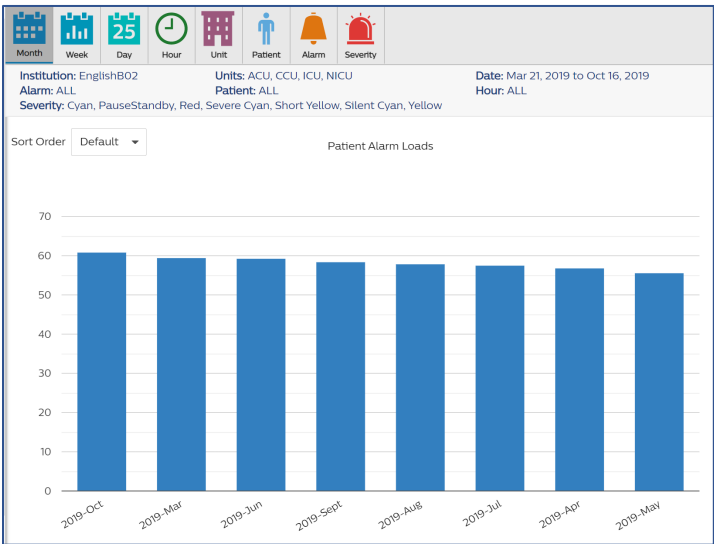
Patient Alarm Load

This metric represents total alarm load per patient day.

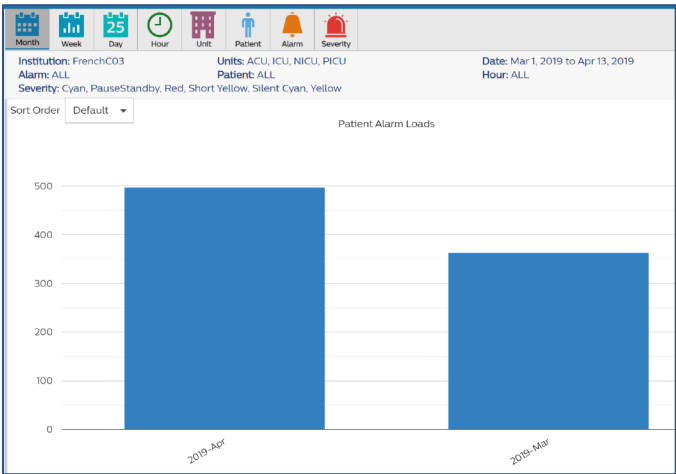
Viewing by Date: Historical Benchmarking

This view provides a historical benchmark of the average alarm load per patient day. It provides a 50,000-foot view of the institution’s alarm load.

In a critically homogeneous set of clinical units, the ALPPD metric provides a better insight for the relative historical variance across various month. This provides insights into continuous improvement and historical benchmarking. This view, however, cannot be used for alarm root cause analysis.

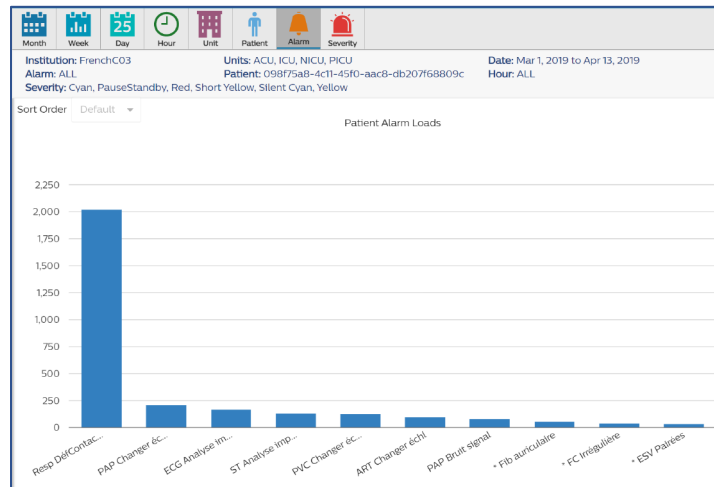


The load per patient day in this hospital seems relatively low for an ICU. Examining a different hospital yields a much higher load per patient day at almost 4 times more than the previous hospital.

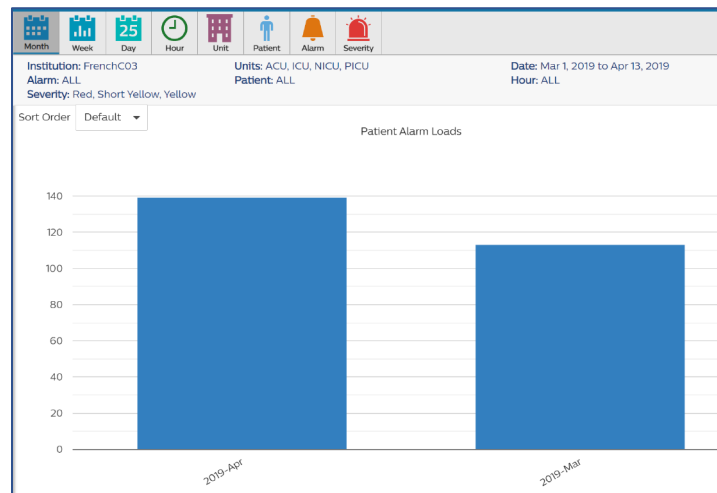


View by Alarm:

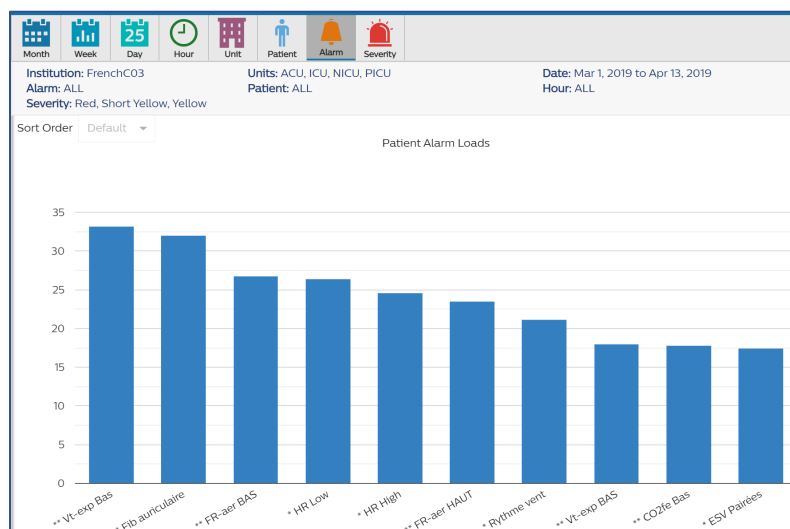
This shows that the majority of alarms contributing to very high alarm load are the cyan alarms.



Filtering out Cyan alarms (Silent and Cyan), leaving severe Cyan in, yields the following view of patient alarm load per day.



View by Alarm after filtering cyan alarms out:



Sorting by Date/Time

By default, query results are sorted in descending order. Alarm responsiveness queries are sorted in ascending order.

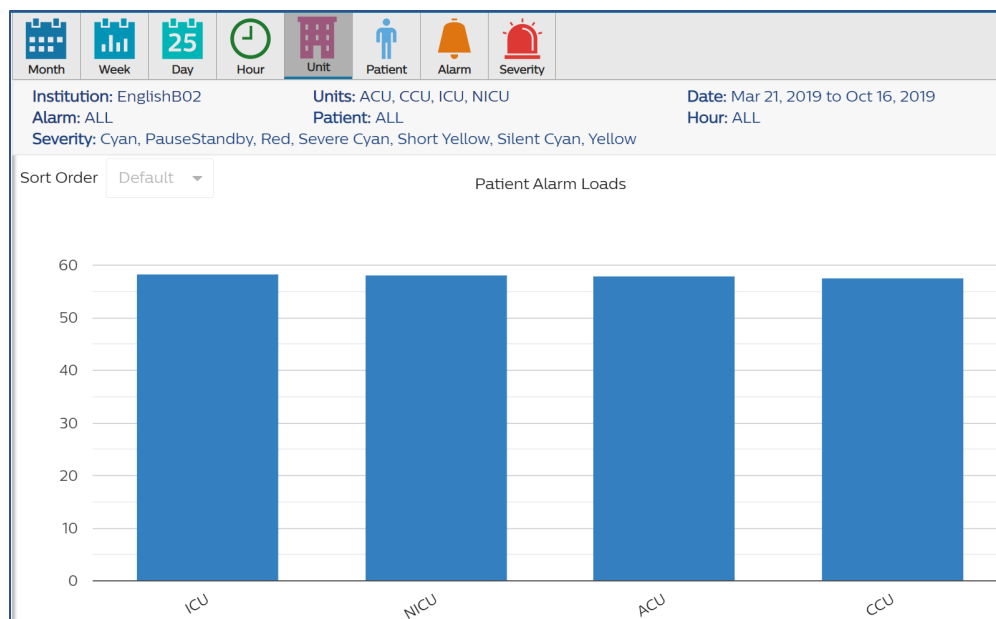


Viewing by Patient

This provides a clear insight into whether or not the ALPPD metric is distributed evenly across patients or whether there is one particular patient or patients that are skewing the ALPPD metric. Coupled with filtering on the specific group of alarms (leads off, Battery, Arrhythmia), provides a more specific insight into the outlier patients, days and alarms. By eliminating those outliers, a more representative view of the alarm load emerges.

Viewing by Unit: Benchmarking Across Units

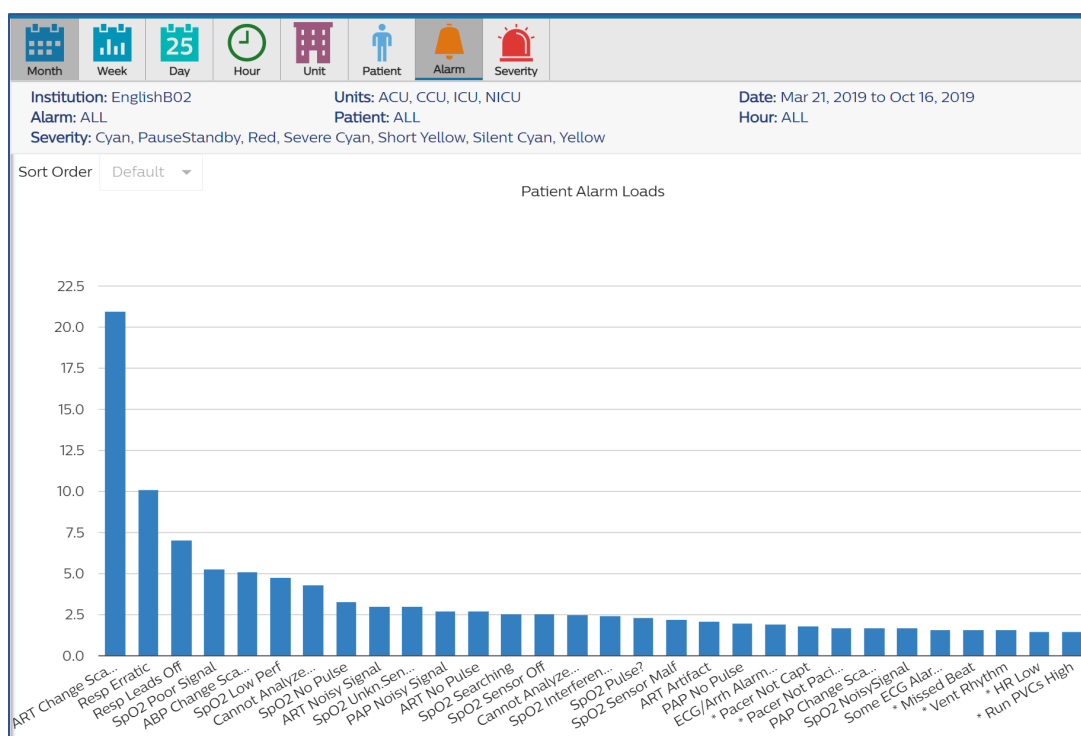
In a critically homogeneous set of units, where a comparable number of physiological measurements is used across those units this provides alarm load benchmarking across units.



In a critically heterogeneous set of clinical units, filtering on a single unit at a time, eliminates artifacts that are caused by the unit heterogeneity and yields a better view of the ALPPD metric. Filtering further on the specific group of alarms that have a common root cause such as Leads, battery, or Arrhythmia alarms yields a more concise view of the root cause and allows for actionable recommendations and improvements.

Viewing by Alarm

ALPPD, viewed by alarm and sorted in descending order, provides a view of top ALPPD. This metric indicates the highest alarm load per patient for the overall alarms. Filtering on specific alarm groups (leads off, Battery, Arrhythmia), provides more specific insights on top alarms by alarm category. This metric correlates with “Top Alarms”, except that “Top Alarms” is either a total count or a percentage rather than a load per patient day.

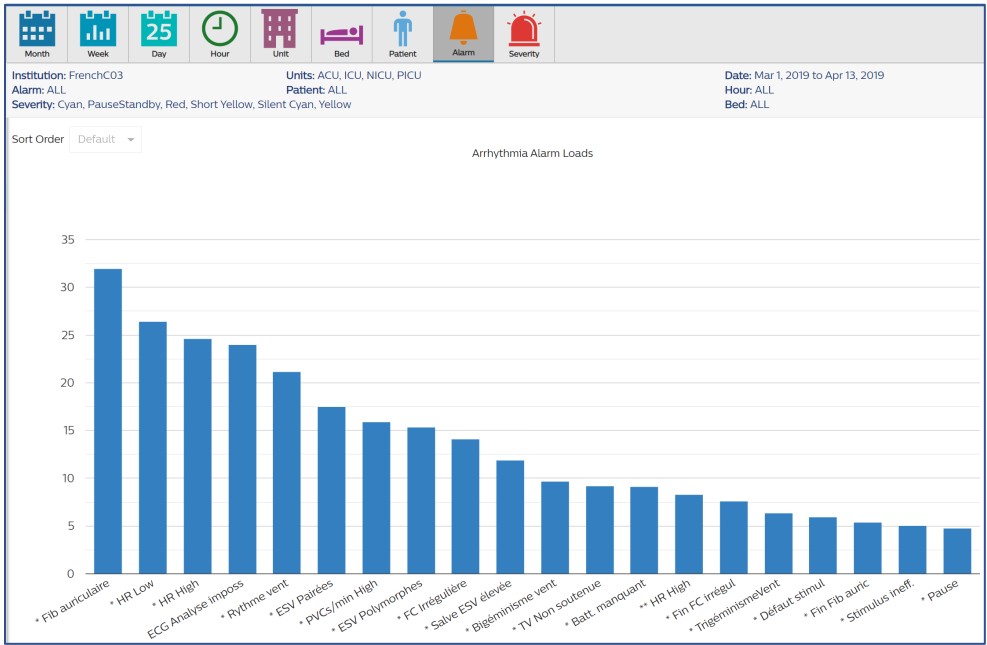


Arrhythmia Alarms

This query represents **arrhythmia-related alarm load per patient day**. For a list of arrhythmia-related alarms, see appendix.

View by Alarm

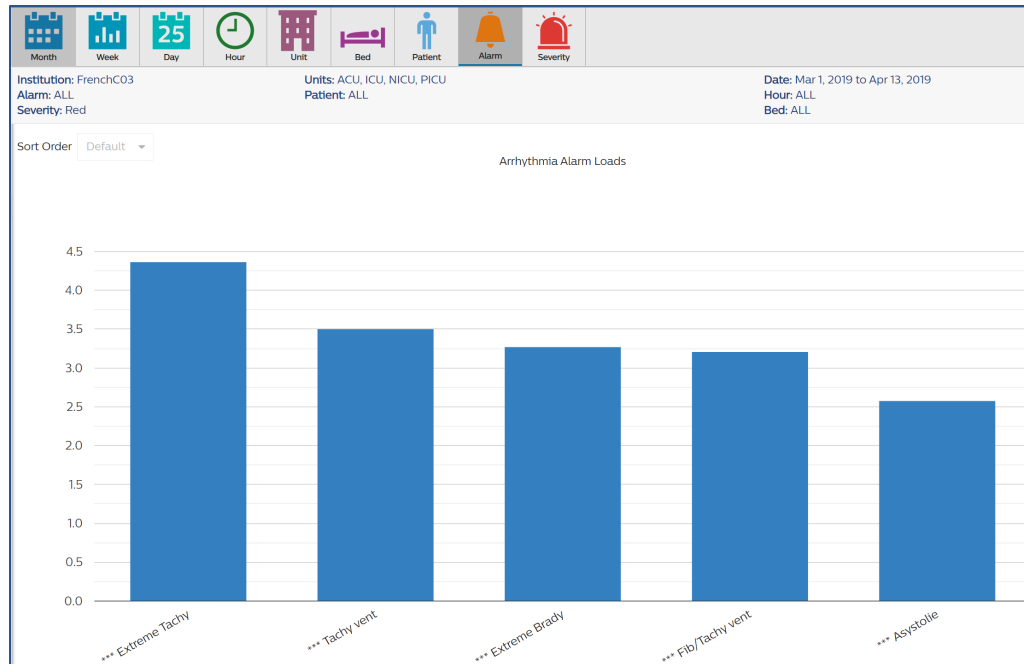
Viewing by alarm shows these alarm loads per patient day.



To focus only on life threatening arrhythmias, namely asystole, extreme bradycardia, extreme tachycardia, ventricular tachycardia, and ventricular flutter/fibrillation, we filter on Red arrhythmia alarms.

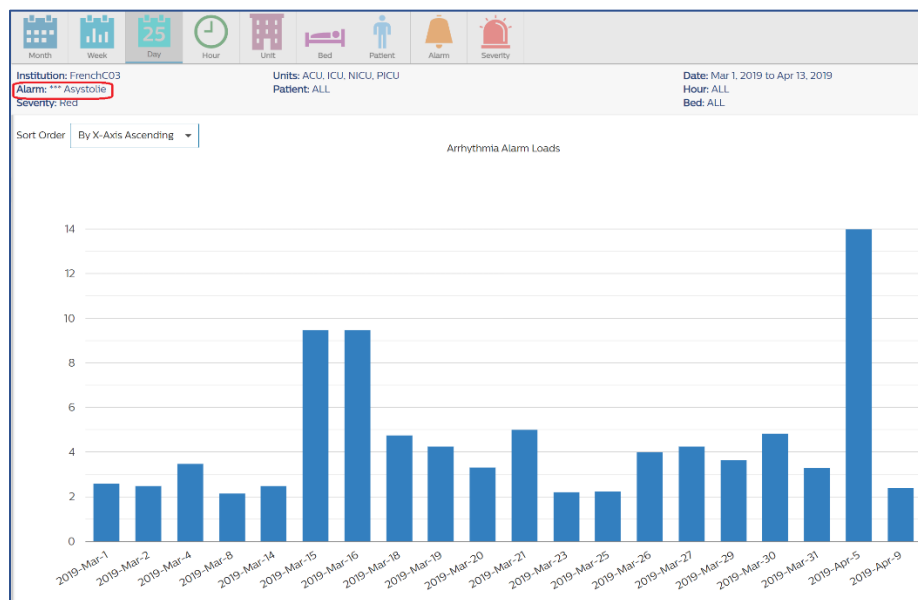
Arrhythmia Alarm	Definition
Asystole	No QRS for at least 4 seconds
Extreme Tachycardia	Heart rate higher than 140 bpm for 17 consecutive beats
Extreme Bradycardia	Heart rate lower than 40 bpm for 5 consecutive beats
Ventricular Tachycardia	5 or more ventricular beats with heart rate higher than 100 bpm
Ventricular Flutter/ Fibrillation	Fibrillatory, flutter, or oscillatory waveform for at least 4 seconds

Filtering on Red alarms only yields the following chart with a relatively high load for all these arrhythmia events.



Further drilldown on each of these arrhythmia events provides insights on whether these are localized and isolated events for a specific patient or set of patients or whether there are systemic problems underlying these events.

Context filtering on the “Asystole” alarm and viewing by day yields a systemic problem across almost all days.



Context filtering on April 5th with the highest alarm load day of 14 Asystole alarms per patient and viewing by bed shows that all 14 alarms were for a single bed (Bed_293). Viewing by patient also shows that all these alarms occurred for a single patient on that day.



Accurate alarming of cardiac arrhythmias is essential to patient monitoring. Failure to detect arrhythmias can lead to severe adverse events, while false alarms can be a source of disruption in busy clinical settings.

In order to improve alarming on asystole under certain conditions, you can set Asystole Detect. in Configuration Mode to Enhanced. In enhanced mode an asystole alarm will be suppressed for up to five seconds if a valid beat-to-beat Pulse is detected from a Pressure.

Also, there are several settings for enhancing arrhythmia alarm detection as shown in the table below. Refer to your Philips IntelliVue clinical guide or consult with a Philips clinical specialist.

Setting	Parameter
Measurement mode	Multi (lead 1 and lead 2)
QRS threshold (mV)	0.15
Asystole Delay (sec)	4
Extreme Tachy (BMP)	150
Extreme Brady (BMP)	40
V-Tach Rate BMP	100
V-Tach length (PVC's)	6

Alarm Flood

Alarm floods are defined by the American National Standards Institute (ANSI/ISA 18.2) as more than 10 annunciated alarms per operator in a 10-minute period. During an alarm flood, attention demands surpass resources, and sensory overload results in failure to prioritize and effectively manage alarms, causing real or significant events to be missed. Alarm loads of this magnitude exceed the cognitive processing capacity of an individual, and as such, are classified as extremely hazardous in critical care.

In an acute care setting, Alarm Flood is defined as **10 or more alarms within a 10 minute period** per caregiver which is a load that is more than a single caregiver can respond to or deliver proper care during alarm floods. However, due to lack of caregiver information in the first release of AIM, we have defined **Alarm Flood** as 10 or more alarms for the same patient in a 10-minute period normalized by total patient count. i.e. **10 or more alarms within a 10 minute period per patient day**.

This assumes a 1/1 nurse to patient ratio. It is estimated that 7 alarm floods can consume 2.25 hours of a nurse's shift which is equivalent to 18% in a 12-hour shift.

Then following examples illustrate the method for alarm flood computation.

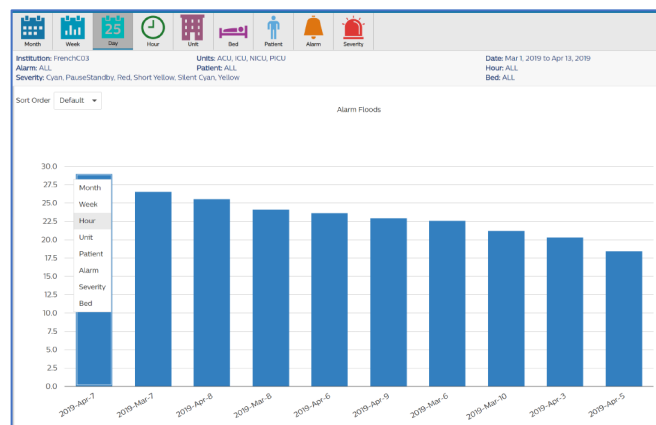
	Time	Patient 1	Patient 2	Patient 3	Patient 4
	9:00:00	HR Low	SpO2 Low		Resp Leads Off
	9:00:10	SpO2 Low	ECG Leads Off		
	9:01:00	ECG Leads Off	HR High		Resp Low
	9:01:20	HR Low	Tachy	HR Low	
	9:02:00	HR Low	Extreme Tachy		
	9:03:00	SpO2 Low	Apnea		
	9:04:00	ECG Leads Off	SpO2 Low		
	9:04:00	Apnea	HR High		
	9:05:00	Run PVC	Tachy		
	9:05:30	Apnea	ECG Leads Off	Ectopic Beat	
	9:06:00	Pleth Non-Pulsatile	Battery Low	Battery low	Resp Low
Alarm Flood		1	1	0	0
	10:00:05	HR Low	SpO2 Low		
	10:00:20	SpO2 Low	ECG Leads Off	HR Low	
	10:01:00	ECG Leads Off	HR High		Battery Low
	10:01:20	HR Low	Tachy		
	10:02:00	HR Low	Extreme Tachy		
	10:03:00	SpO2 Low	Apnea		
	10:04:00	ECG Leads Off	SpO2 Low	SpO2 Low	
	10:04:00	Apnea	HR High		
	10:05:00	Run PVC	Tachy		
	10:05:30	Apnea	ECG Leads Off		
	10:07:30	Pleth Non-Pulsatile	Battery Low		
Alarm Flood		1	1	0	0

The total alarm flood load per patient day is $2/4 = 0.5$ floods per patient day.

Viewing Alarm Flood by Alarm

Given that alarm floods are events that occur within a 10-minute window, it is best to view these floods by narrowing down the time window the smallest support time window. This can be done by viewing by day first and then picking a day of interest and viewing by hour.

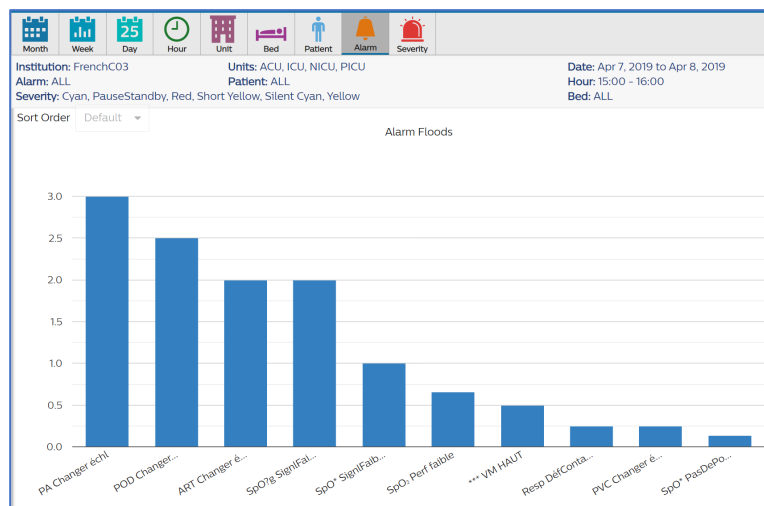
Viewing alarm floods by day yields the following chart:



Selecting a day (Apr-7-2019) and viewing by hour yields the following hourly chart.

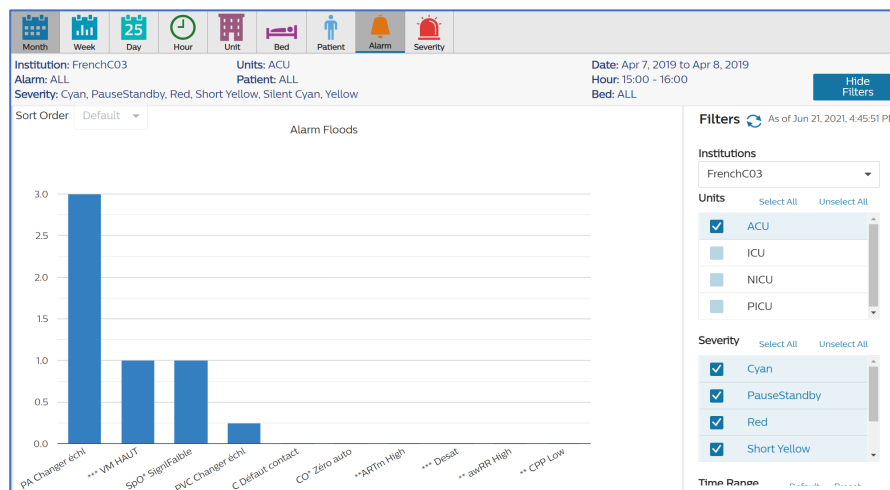


Selecting an hour of interest and viewing by Alarm yields the following chart



This chart shows that there are several alarm floods within that hour.

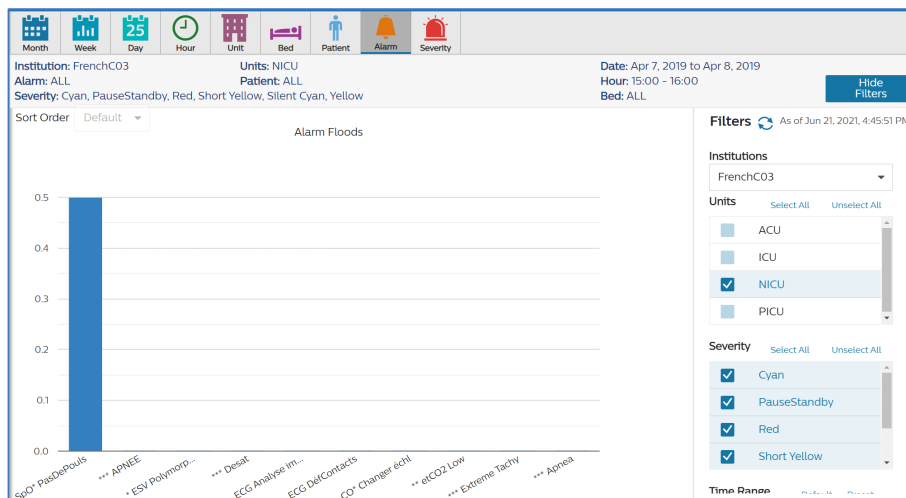
To drill down to a particular unit and eventually to a patient-based floods, filter on one unit at a time and examine the floods for each.



This unit shows floods due to gas analyzer, SpO2 weak Signal, ARTm high, Desat and few others.

Selecting another unit yields the following flood chart.

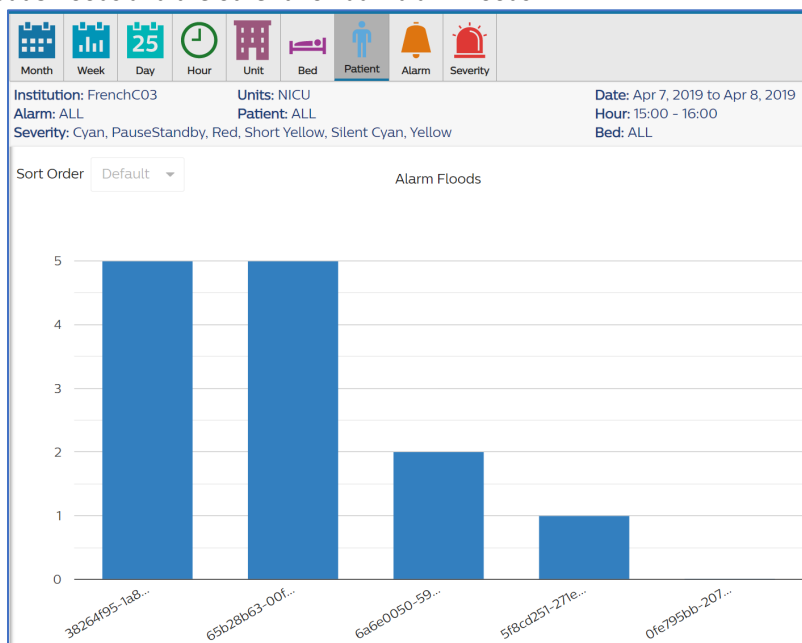
Note that the alarm flood in NICU, unlike ACU, is caused by SpO2, Apnea, and Desat-related alarms among other alarms.



Viewing Alarm Flood by Patient:

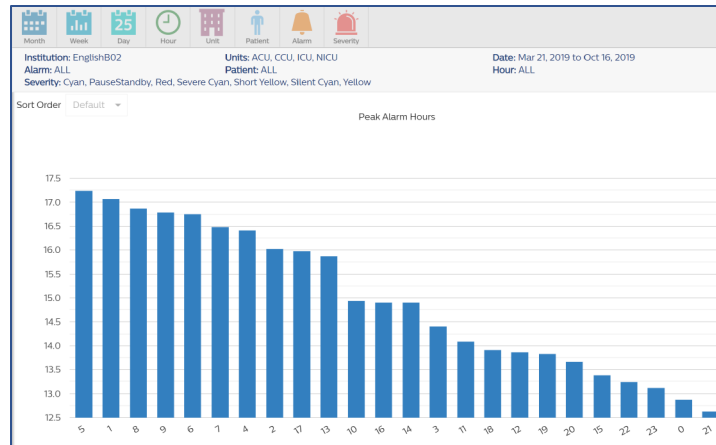
To understand the distribution of these alarm floods by patient, after filtering by day, by hour and by unit, viewing by patient yields the following chart.

This chart shows that there are 4 patients in NICU that experienced alarm floods during that hour on that day. Two of these patients had about 5 floods and the other two had 2 alarm floods.

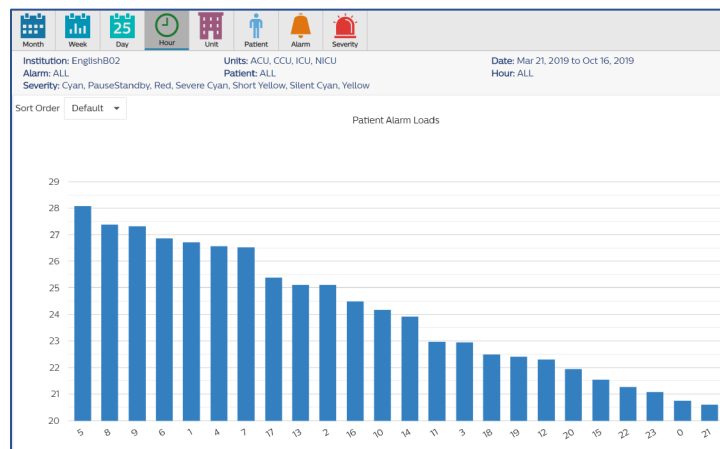


Peak Alarms Hours

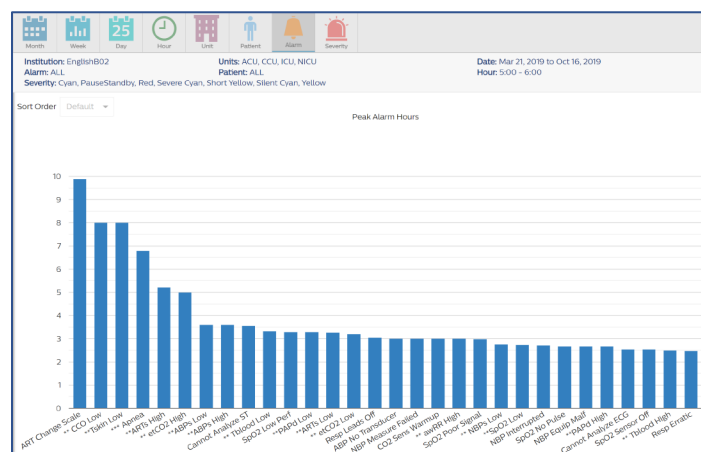
Peak alarm hours provide a view of **alarm load per patient day aggregated by hour of day**. This is equivalent to Patient Alarm Load query viewed by hour.



This view can also be viewed using the Patient Alarm load, view by hour.

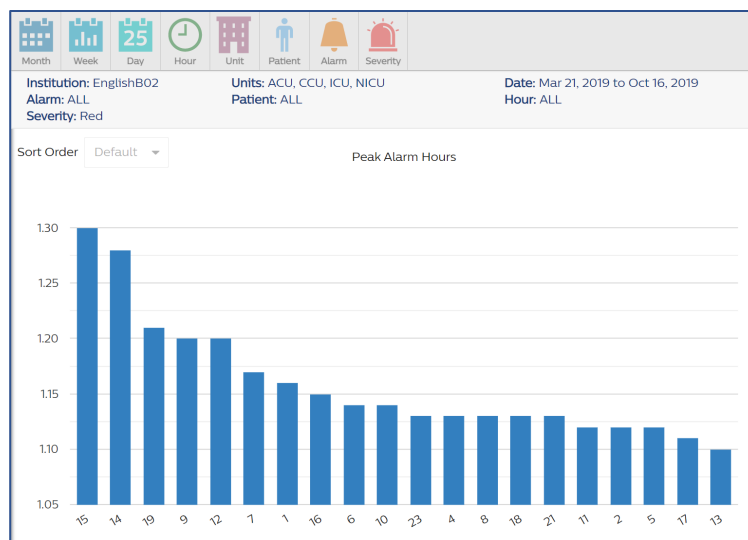


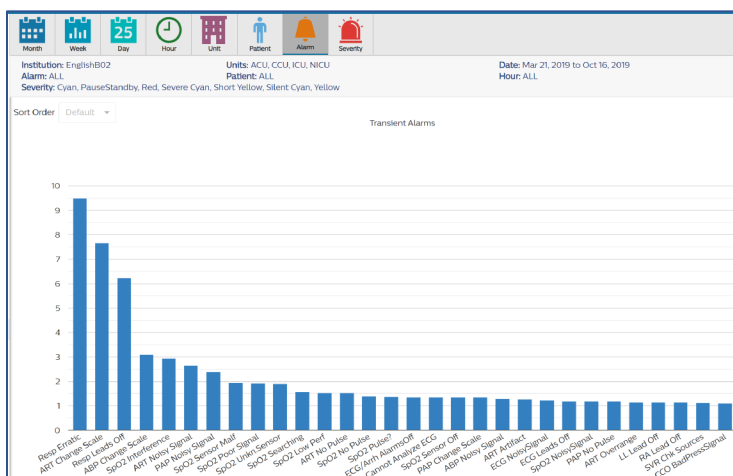
View by Alarm:



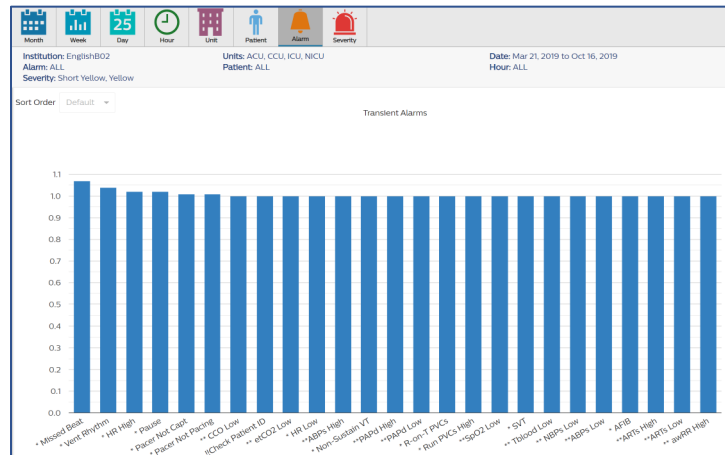
Filter by Red alarms Only:

This allows a view of peak alarm hours for Red alarms.

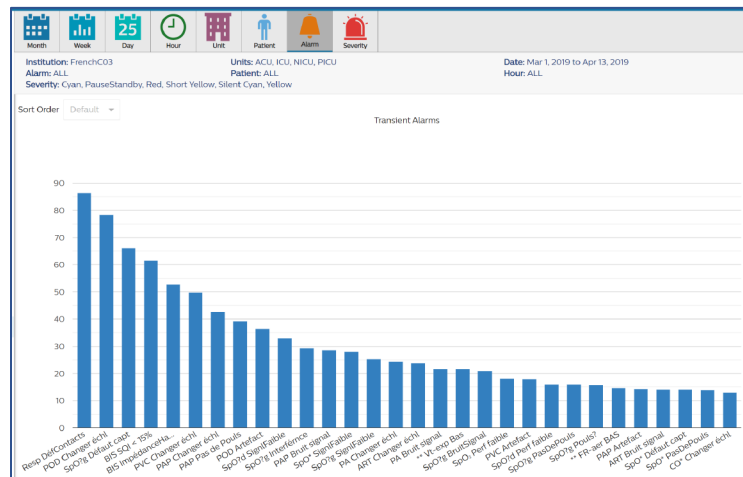




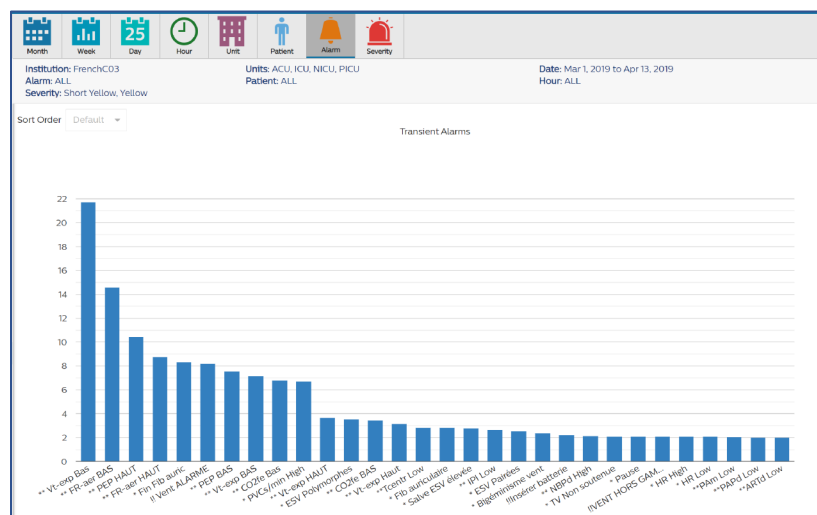
Filtering on yellow only, yields a small transient alarm load per patient day at an average of 1 per patient day.



Examining transient alarms in the context of a different hospital yields a much different transient alarm per patient day at a range of 85 – 20 for all alarms.



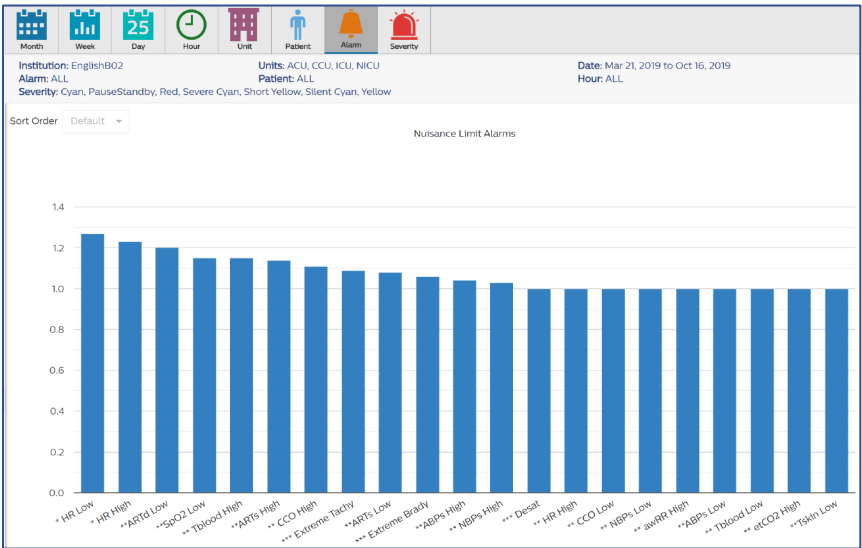
For yellow alarms, the transient alarm load per patient day is at a range of 21 – 3 transient alarms per patient day.



Nuisance Limit Alarms

Nuisance limit alarms are alarms that violate lower or upper limits by 3.5% or less. For example, if SpO₂ lower limit is set at 90% and its value drops to 88 which is a 2% drop below lower limit, this is considered safe in most cases and thus, this alarm is non-actionable and is considered a nuisance. Similarly, if HR upper limit is set at 85 and its value increases to 88, a 3.5% increase, this is considered safe in most cases and this, this alarm is non-actionable and is considered a nuisance.

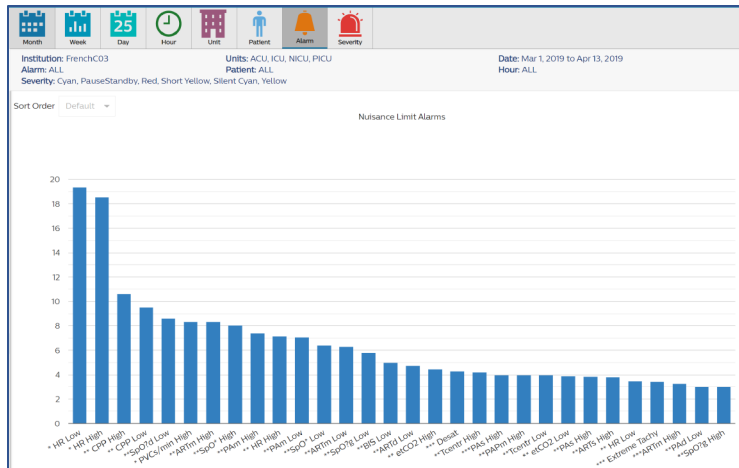
Viewing nuisance limit alarms by month yields a relatively small load per patient day at an average of about 1.5 per patient day.



Viewing nuisance limit alarms by alarm shows HR low and high limit alarms being the top factors but at a relatively small (1.5) alarm load per patient day.



Examining nuisance limit alarms in the context of a different hospital yields a much different transient alarm per patient day at a range of 20- 4 for all alarms with the top offenders being HR low and High limit alarms.



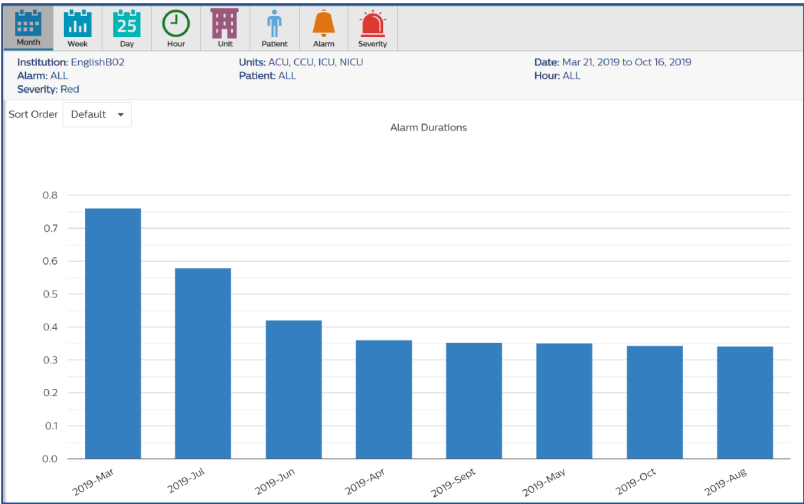
Alarm Responsiveness

Alarm Duration

The alarm duration metric is a representation the **average alarm duration** until the alarm condition ends. It provides insights into the time length of the corrective actions taken to address alarms. Long alarm durations indicate stale alarms that are meaningless or totally ignored. These alarms waste time and reduce confidence in the value of the alarm system. These alarms should most likely be turned off.

For Red Alarm durations, the average Red alarm duration is 45 seconds.

Red Alarm Duration:

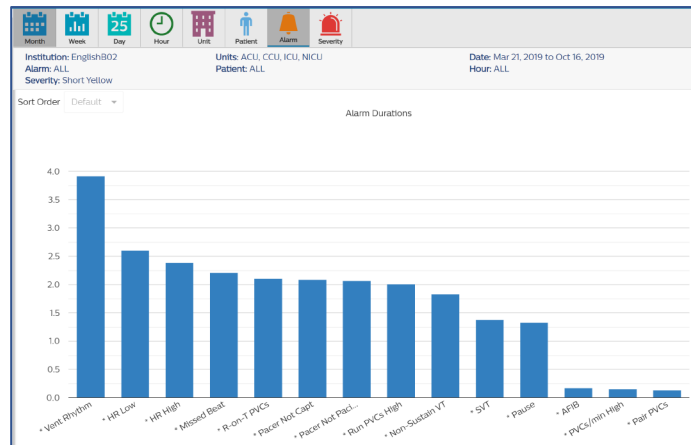


Yellow Alarm Duration:

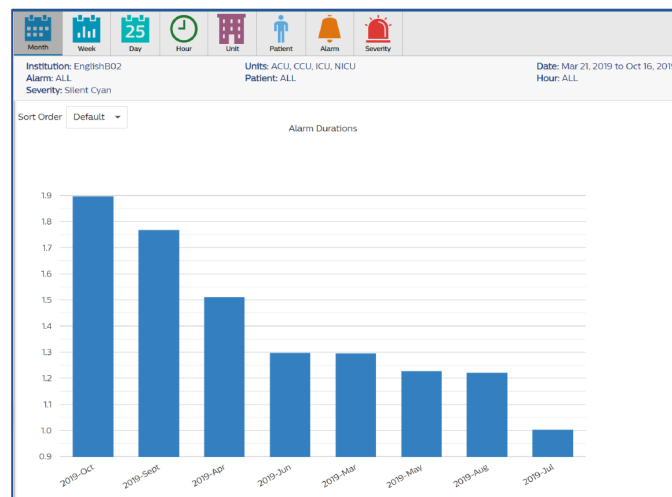


For Short yellow, the average alarm duration is on the order of 3 minutes.

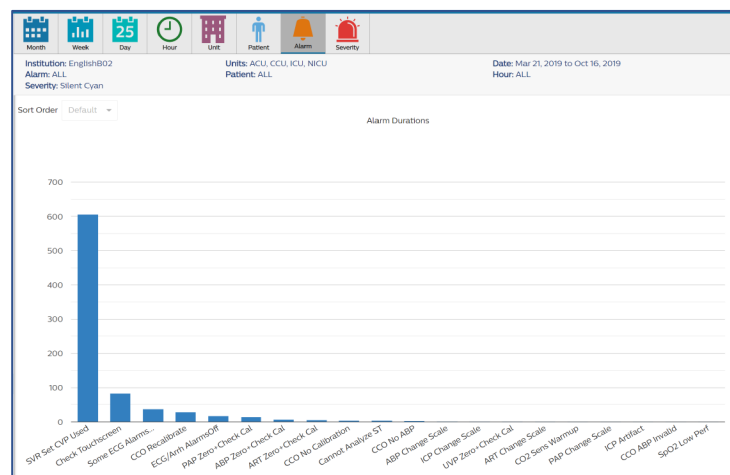
Short Yellow Alarm Duration



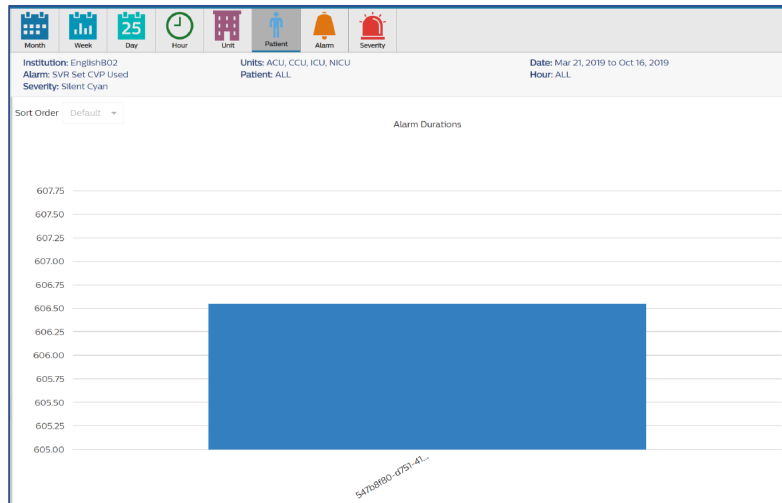
For silent Cyan alarms, the average alarm duration is less than 2 minutes



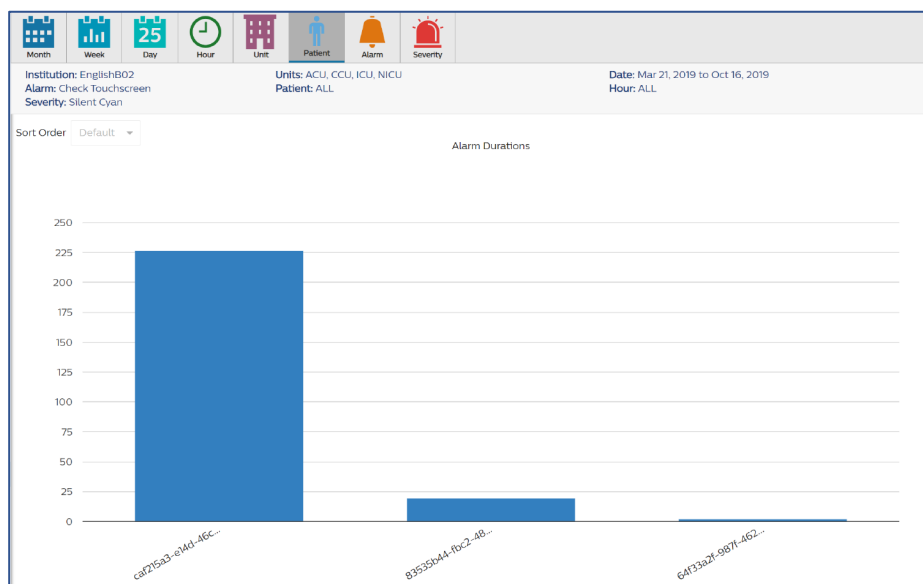
Viewing by Alarm shows few outliers: SVR Set CVP Used, Check Touch Screen and Some ECG Alarms off.



For SVR Set CVP Used alarm, viewing this alarm by patient yields a single outlier patient that has a 100% of this alarm.



For Check Touch Screen alarm, viewing this alarm by patient yields outlier patients that constitute the vast total of this alarm.



Alarm Silence Responsiveness

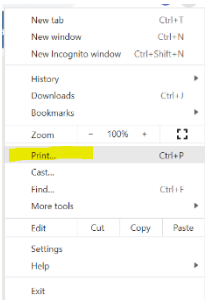
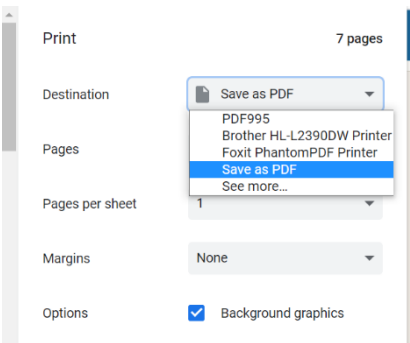
The alarm silence metric is a representation the **average alarm silence responsiveness** of caregivers. It provides insights into the effectiveness of responding to alarms. Long response times may indicate that caregivers are unable to respond to alarms timely. When correlated with staff to patient ratio during night shifts or weekends, it may identify resource bottlenecks.

[illegible]

Reporting and Printing

Any chart in CIM or AIM can be printed or saved to PDF using the browser’s built-in functionality. This is a “what you see is what you get” (WYSIWYG) report.

The user can choose either ‘Save as PDF’ select an installed printer to print a hardcopy if a printer is connected.



print
or

CIM:

Patient List:

Using the browser’s “print” menu on the “find patient” page, results in a report of the displayed patients.

Find Patient

Last Name:

Gender:

Start DOB:

Start Available Data:

First Name:

Unit Label:

End DOB:

End Available Data:

ID:

Bed Label:

Institution:

MGH2020MGH
CMHHospital04AIMTestMGH_Boston

Search

Clear

Export

☐	Patient Name	Date Of Birth	Unit_Bed	Institution	Lifetime ID	Encounter ID	Alternate ID	Start Available Data	End Available Data	Action
☐	WARD, BERNARD	6/15/1981 D	hztUnit_1_hzb36	AIMTest	9345030			06/15/2020 06:56 EDT	06/15/2020 07:42 EDT	View
☐	THOMAS, ANDRE	6/15/1945	hztUnit_1_hzb51	AIMTest	3893220			06/15/2020 05:49 EDT	06/15/2020 07:42 EDT	View
☐	ANDERS ON, GREG	6/15/2008	hztUnit_1_hzb38	AIMTest	9918056			06/15/2020 04:38 EDT	06/15/2020 07:42 EDT	View
☐	PETERS ON, DAN	6/15/1997	hztUnit_1_hzb51	AIMTest	2329665			06/15/2020 03:32 EDT	06/15/2020 05:48 EDT	View
☐	JACKSON, MITCHELL	6/15/1997	hztUnit_1_hzb20	AIMTest	7916207			06/15/2020 03:08 EDT	06/15/2020 07:42 EDT	View
☐	LOPEZ, JUSTIN	6/15/1955	hztUnit_1_hzb18	AIMTest	8893165			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	View
☐	WOOD, RODNEY	6/15/1970	hztUnit_1_hzb36	AIMTest	1961590			06/15/2020 03:02 EDT	06/15/2020 06:56 EDT	View
☐	EDWARDS, FRED	6/15/2004	hztUnit_1_hzb49	AIMTest	5883356			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	View
☐	JAMES, PEDRO	6/15/1931	hztUnit_1_hzb31	AIMTest	1017183			06/15/2020 03:02 EDT	06/15/2020 07:42 EDT	View
☐	WHITE, PERRY	6/14/1934	hztUnit_1_hzb3	AIMTest	2141158			06/14/2020 23:51 EDT	06/15/2020 07:42 EDT	Failed
☐	YOUNG, ALFRED	6/14/1925	hztUnit_1_hzb25	AIMTest	6764865			06/14/2020 23:41 EDT	06/15/2020 07:42 EDT	View

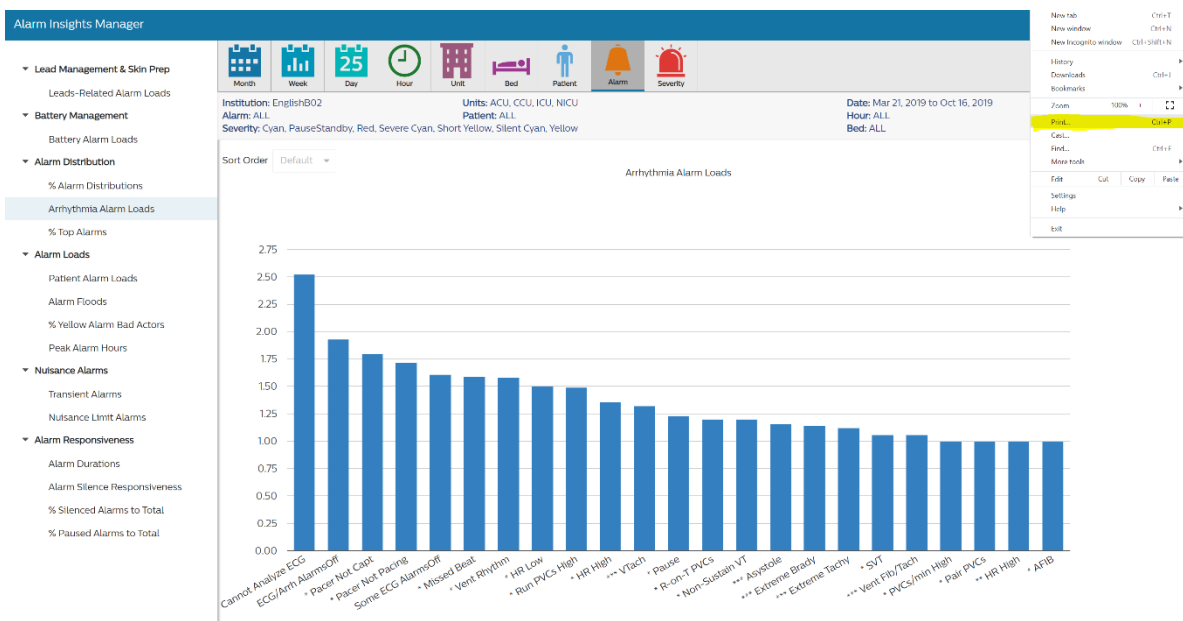
Patient Data:

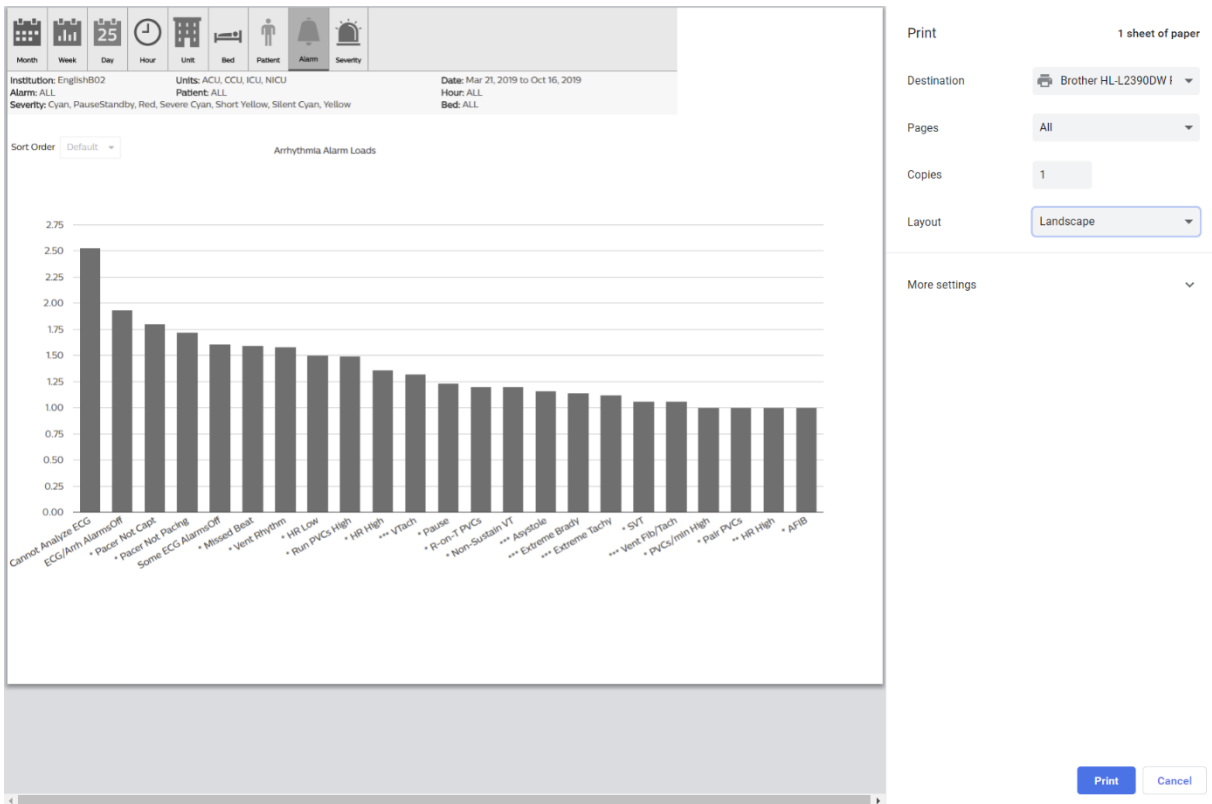
Using the browser’s “print” menu in the patient data page results in report similar to the following report.



AIM:

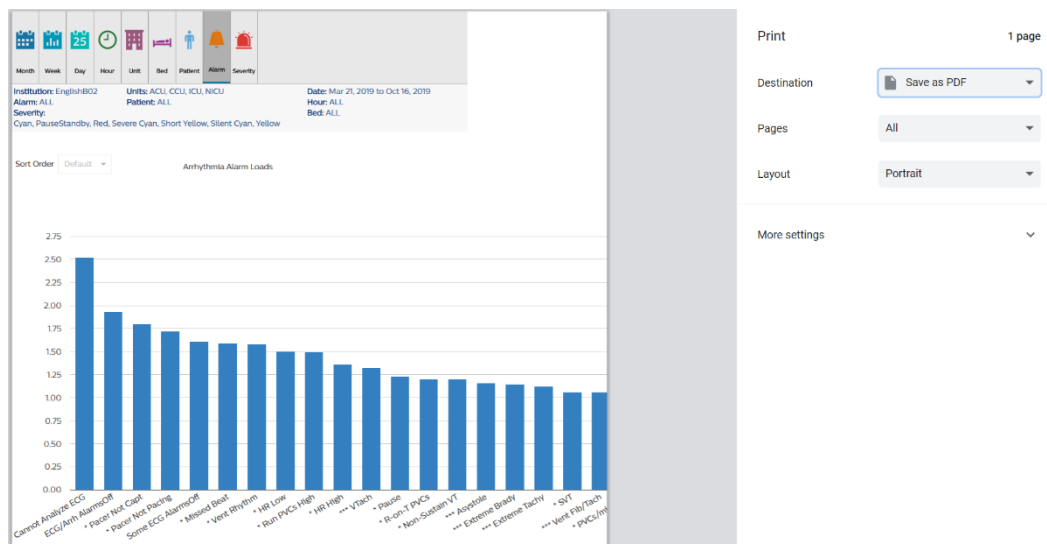
Similarly, for AIM, reports are provided on a WYSIWYG basis. The following are some examples of AIM chart reports.



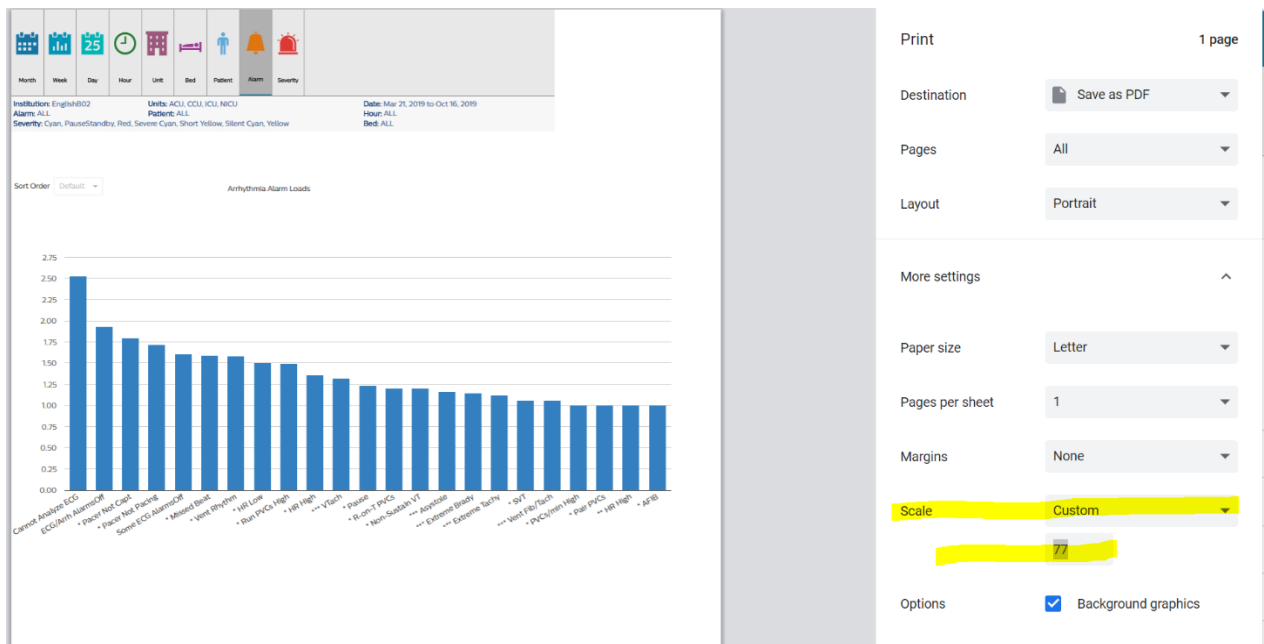


Note: Choose Layout = “Landscape” is the best setting for providing best results when both saving to PDF or printing a hardcopy to a printer.

In some cases where the screen resolution is lower than specified or the layout is set to Portrait, the chart may be clipped or overlapped. To solve this issue:

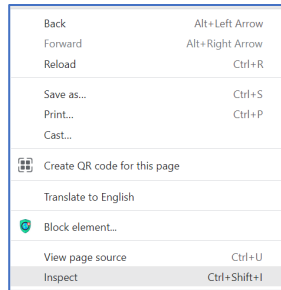


1. Expand the “More Settings” dropdown.
2. Select “Custom” Scale
3. Spin down the scale number while the chart automatically updates until the clipping or overlap is fixed.

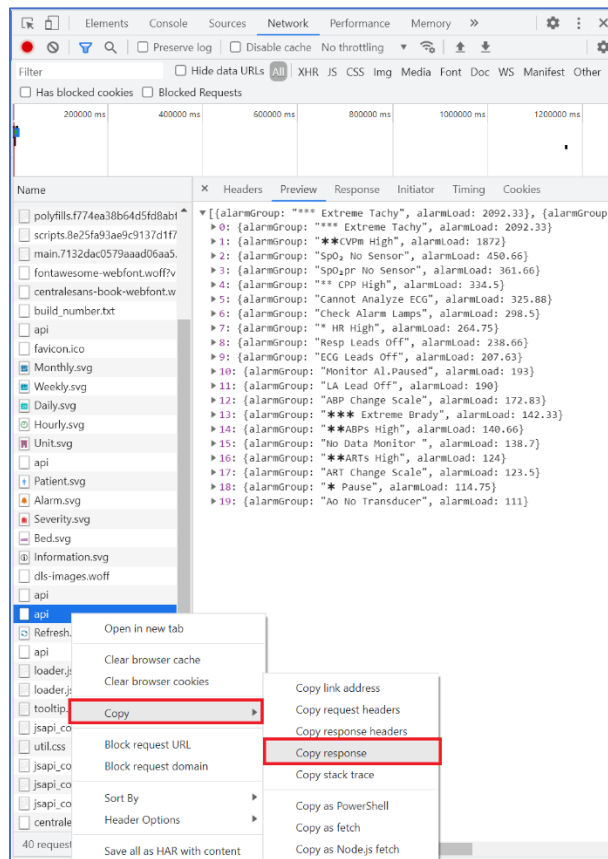


To export the data for any query:

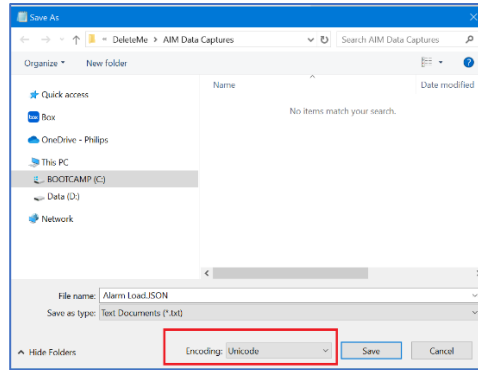
1. Right click anywhere outside the chart area with AIM, then select “Inspect”.



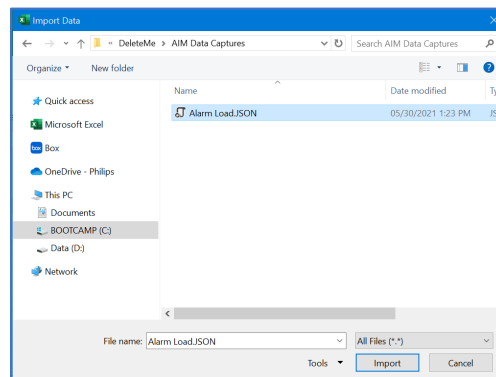
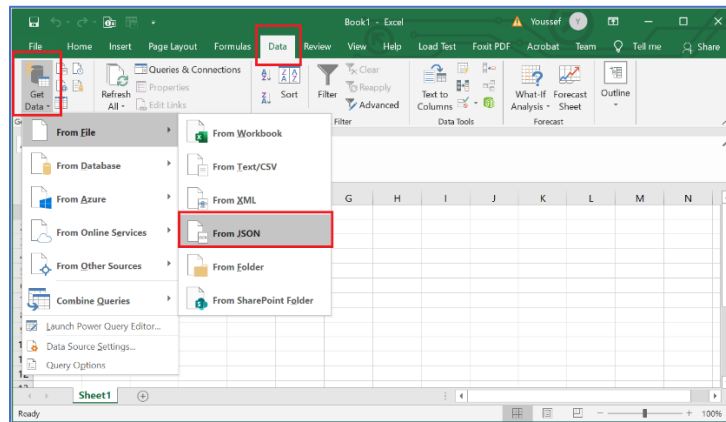
1. In the side window that appears, select the “network” tab, then Right-mouse click on the “api” item in the left side panel and select the ‘Copy response’ menu.



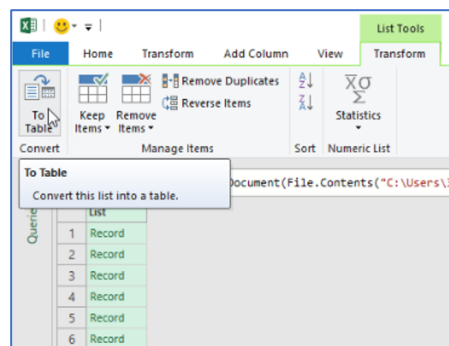
2. Open notepad.exe and paste the copied data into it. Then Save as .JSON extension using Encoding = Unicode.



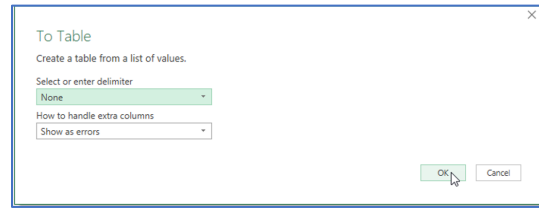
- Launch Excel. Select “Data” menu, click on “get Data” button, select “from File”, then select “From Json”.



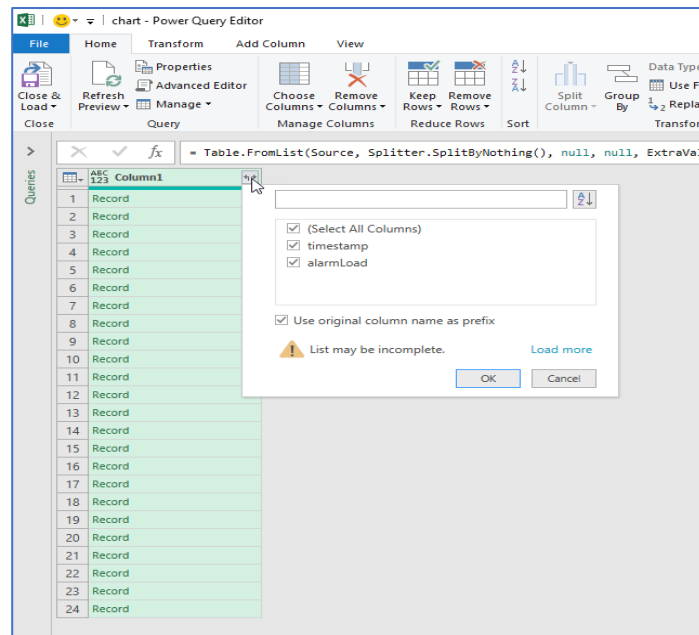
- This opens a Power Query Editor as shown below. Click on “To Table” menu as shown below.



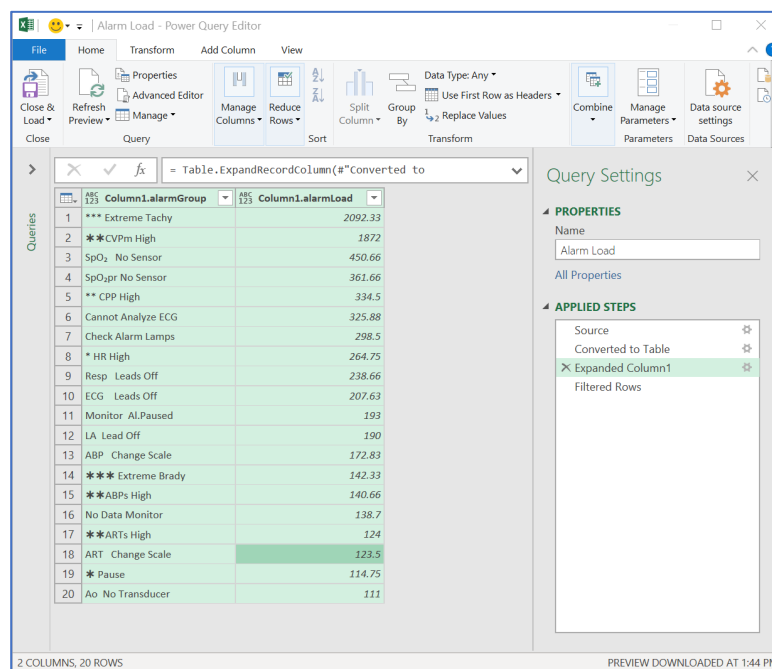
5. The following popup window appears. Press OK.



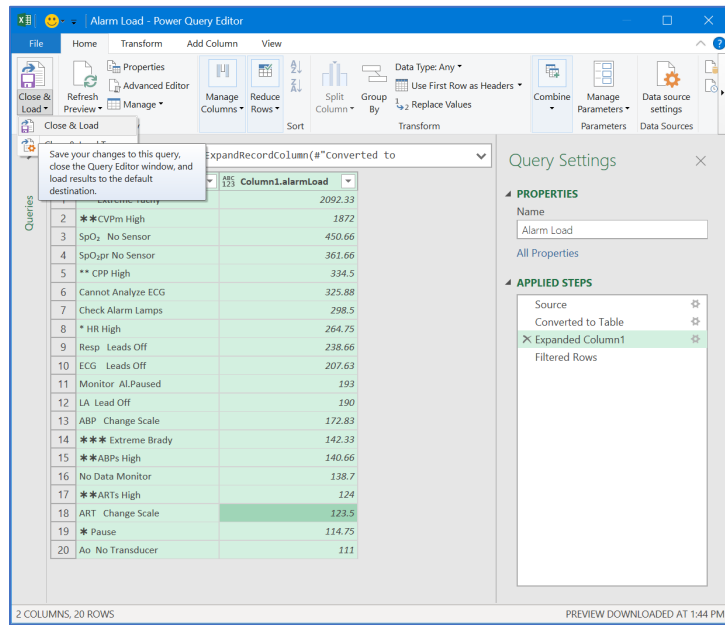
6. This changes the header name from “List” to “Column1” as shown below. Click on arrows beside “Column1” in the header.



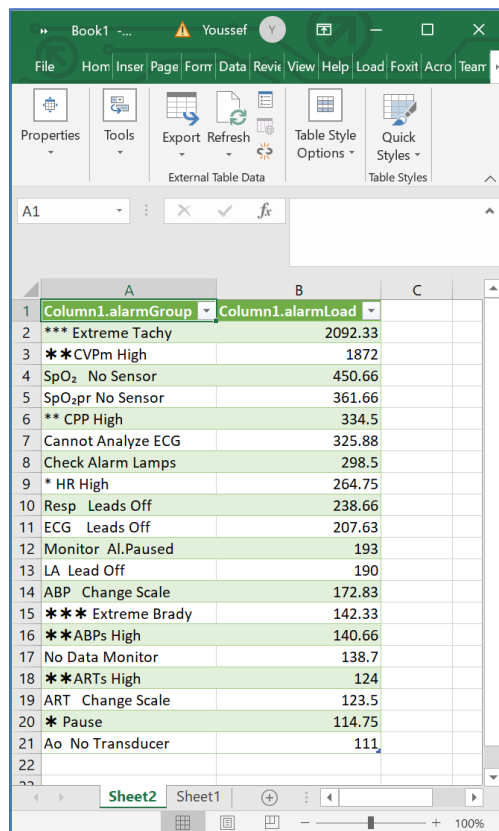
7. Select all the columns which need to be shown in the final excel sheet and click on “OK”.



8. Press the “Close and Load” button.



9. The data loads into excel as shown below.



Leads-Related Alarms

Label
BIS Lead Off
BIS Lead Off
Ao Noisy Signal
ART Noisy Signal
ABP Noisy Signal
PAP Noisy Signal
LAP Noisy Signal
RAP Noisy Signal
Invalid Leadset
<Pressure Label> Noisy Signal
<SpO2 Label> Erratic
<SpO2 Label> NoisySignal
SpO2T Erratic
SpO2T NoisySignal
!! <Lead Label> Lead Off
!! ECG Leads Off
!!! <Lead Label> Lead Off
<Lead Label> Lead Off
ECG Leads Off
ECG Noisy Elec <Lead Label>
ECG Noisy Elec <Lead Label>
<EEG Channel> Leads Off
<EEG Channel> Leads Off
<EEG Channel> Leads Off
<EEG Channel> Leads Off
!!! ECG Leads Off
ECG Noisy Signal
NMT Lead Off
EEG Leads Off
EEG1 Lead Off <Electrode Label>
EEG2 Lead Off <Electrode Label>
EEG3 Lead Off <Electrode Label>
EEG4 Lead Off <Electrode Label>
Leadset Unplugged
P1 Noisy Signal
P2 Noisy Signal
CP Noisy Signal
SpO2 Erratic
SpO2 Noisy Signal
Resp Erratic
Resp Leads Off

Battery-related Alarms

Label
!! Insert Battery
!!!Batt 1 Empty
!!!Batt 2 Empty
!!!Batt Empty
!!!Batteries Empty
!!!ExtBat Empty
!!Batt 1 Empty
!!Batt 2 Empty
!!Batt Empty
!!Batteries Empty
!!ExtBat Empty
Batt 1 Empty
Batt 1 Incompat
Batt 1 Low
Batt 1 Malfunction
Batt 1 Malfunction
Batt 1 Missing
Batt 2 Empty

Batt 2 Incompat
Batt 2 Low
Batt 2 Malfunction
Batt 2 Malfunction
Batt 2 Missing
Batt Empty
Batt Extensn Malf
Batt Incompat
Batt Low
Batt Malfunction
Batt Malfunction
Batteries Empty
Batteries Incompat
Batteries Low
Batteries Malfunct
Charge Batt 1 now
Charge Batt 2 now
Check Batt Temp
Check Batt Temp
ExtBat Empty
ExtBat Incompat
ExtBat Low
ExtBat Malfunction
ExtBat Malfunction
ExtBat Missing
!!cl Resp BatEmpty
cl Resp Batt Empty
cl Resp Batt Incmp
cl Resp Batt Low
cl Resp Batt Malf
cl Resp Batt Temp
cl Resp Check Batt
cl Resp Serv Batt
!!cl SpO2 BatEmpty
cl SpO2 Batt Empty
cl SpO2 Batt Incomp
cl SpO2 Batt Low
cl SpO2 Batt Malf
cl SpO2 Batt Temp
cl SpO2 Check Batt
cl SpO2 Serv Batt
!!!Repl. Tele Batt
!!!Tele Batt Empty
!!Tele Batt Empty
Battery Low
cl NBP Check Batt
cl SpO2 Check Batt
No SpO2T, Batt Low
Replace Tele Batt
Tele Batt Empty
Tele Battery Temp
Tele Service Batt
Tele Service Batt
!!! Batteries Low
PACE on Batteries
Replace Tele Batt
Tele Battery Low
Tele Battery Low

Arrhythmia-Related Alarms

* AFIB
* End AFIB

* End Irregular HR
* HR High
* HR Low
* Irregular HR
* Missed Beat
* Multiform PVCs
* Non-Sustain VT
* Pacer Not Capt
* Pacer Not Pacing
* Pair PVCs
* Pause
* PVCs/min High
* R-on-T PVCs
* Run PVCs High
* SVT
* Vent Bigeminy
* Vent Rhythm
* Vent Trigeminy
** HR High
** HR Low
*** Asystole
*** Extreme Brady
*** Extreme Tachy
*** Vent Fib/Tach
*** VTach
Cannot Analyze ECG
ECG/Arrh AlarmsOff
Some ECG AlarmsOff

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