ICUBAM
ICU Bed Availability Monitor Solution for COVID-19

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https://icubam.net  April 2020
ICUBAM development and deployment
Context: Early March

Problem: ICU Saturation in Grand Est region.

Bed availability constantly changing and not up to date.

Information being centralized by WhatsApp + Spreadsheets

Solution: Automate information gathering and dissemination

* French Institute for Research in Computer Science and Automation
It takes ~15 seconds to update information

ICU Dr. receives a URL by SMS 2x/day.

Decide whether to see map or enter data.

Enter key data points.

View current bed availability on map.
Within 2 weeks, ICUBAM scaled to cover ⅓ of ICU beds across France

Open-source project, in collaboration with INRIA

ICUBAM’s goal is to provide real-time information on intensive care unit (ICU) bed availability in French hospitals. Data is directly obtained from doctors working inside ICU by sending them SMS with a HTTP link to a form that they can fill in 15 seconds.

Rapid uptake across network of hospitals

The solution was first deployed in late-March 2020, and now provides up-to-date capacity reporting for 130 ICUs and 2000+ COVID beds—representing approximately ⅓ of the national system and covering around 20 million citizens.

“Simple” tool provides critical reporting for COVID response

Tool has been recognized by the French MoH as having most recent data on bed availability. French deployment is being used to both feed data into MoH systems and also display information for first responders.
In response to the emergency, a group of contributors came together to build a free and open-source bed availability management system.

More info: https://icubam.net

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Real-time COVID+ ICU Bed Availability

The dashboard provides a high-level overview of availability across the country, and allows users to drill-down for detailed site information.
Direct interaction with ICU Doctors
Global engagement
The Brain team is working to deploy ICUBAM globally

Deployed:
France
Ecuador

In discussion:
Brazil
Chile
South Africa
How it works
How it works

SMS

Personalized link with token

set secure cookie

ICU Dr.

Access Denied

User without cookie

User without cookie
Efficient Deployment Strategy

- Only needs single ‘Super-Admin’.
- Decentralized signup.
- Regional PoC are autonomous in their region.
- Fully-fledged back-office.
- Built-in reporting.
- REST backend to extract data.
- Token-based access for MoH and first responders.
Add data by hand, import csv, browse, edit, etc.
Support custom imports for external data providers
Aparté
Analysis
Evolving patient admissions, but a functioning lockdown.

Figure 4: Daily number of COVID-19 ICU admissions for each *département* over the study period. Remark: the first value is disproportionate because it accounts for all patients of the period before the start of our data (March 18).
Extended stays with evolving mortality statistics.

Figure 5: Cumulative value for patient deaths, discharges and transfers in the Grand Est région between March 18th and 29th of April. We can see that death and discharge rates are initially similar, but eventually discharges rate increases while death rate decreases.
A saturated hospital system, even when running at 200% capacity.

Figure 7: Number of beds occupied by COVID-19+ patients, non-COVID-19 patients, and total number of free ICU beds (regardless of COVID-19 status). The red curve represents the number of occupied beds plus the number of patients transferred to another region. Note that data before March 25th does not contain the number of transferred patients.
Customized SEIR models can provide insights.

Figure 10: Flow chart of the SEIR type model with incubation compartment. In blue, the parts corresponding to the ICUBAM data on which the model is calibrated: number of patients in ICU, cumulative number of patients leaving the ICU (X for eXit, discharged and deceased patients).

Figure 11: Fit a SEIR model for département Meurthe-et-Moselle using data up to the 27 of April (vertical dotted line; data: circles) and with prediction for the following days (crosses: data on 28 and 29 of April). Model 'susceptible/exposed/infected/ICU/exit', with recovery (or death) period. Red: number of patients currently in ICU. Grey: cumulative number of patients either deceased or discharged from intensive care units.
Conclusion

- Innovative methodology - horizontal data distribution.