

ICUBAM: ICU Bed Availability Monitor Solution for COVID-19

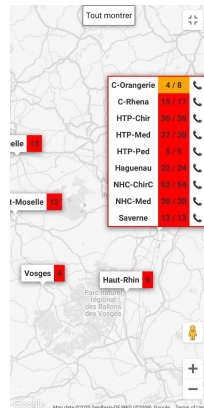
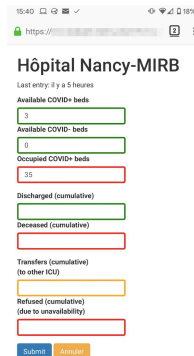
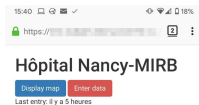
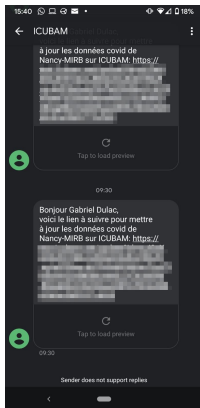
Inria, Google Research, École polytechnique, CHRU de Nancy, IRMAR, CNRS, Université Paris-Saclay, École des Hautes Études en Sciences Sociales

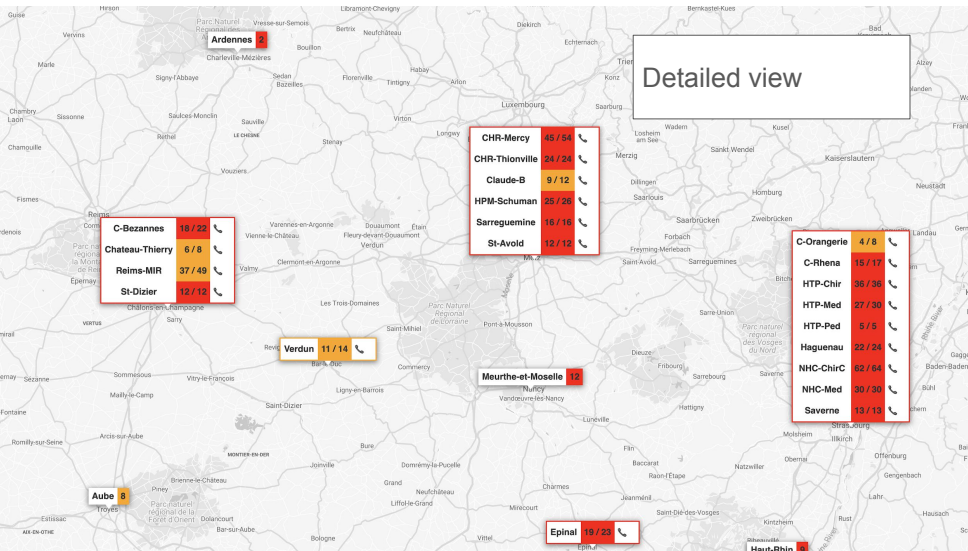
<https://icubam.github.io/>

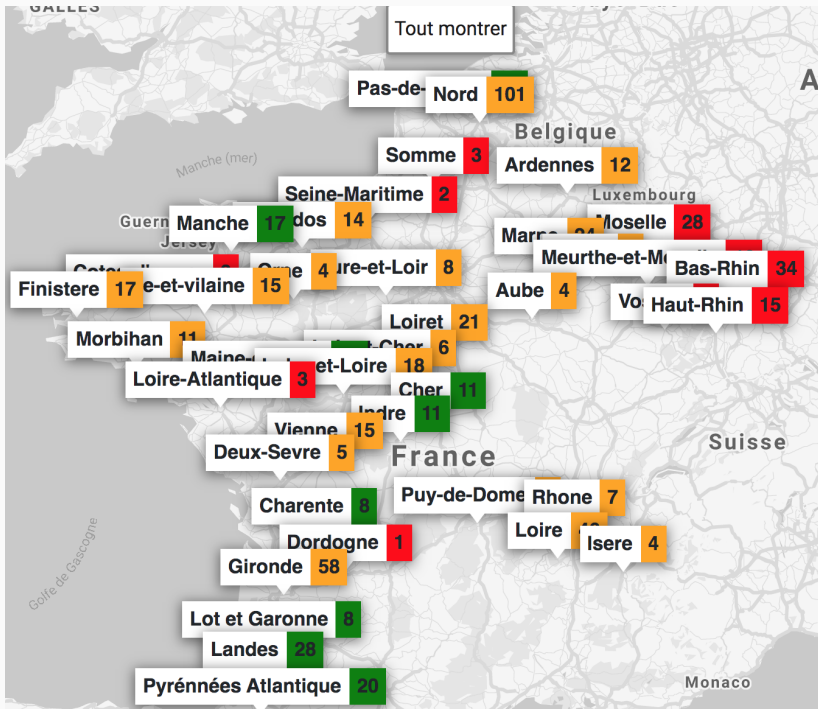
Genesis of ICUBAM

- Mid March 2020, ICU Saturation in Grand Est region
- Urgent need for findHugues ICU beds in a deteriorating situation
- Bed availability constantly changing and not up to date
- 18 March, Antoine Kimmoun (intensivist) centralized the information over multiple ICUs by WhatsApp + Spreadsheets
- 22 March, automate information gathering and dissemination by developping ICUBAM (in 48 h)
 - ⇒ Real-time information & vizualization on ICU beds availability
- 25 March, ARS Grand Est uses ICUBAM & ROR (work with Pulsy)

~15 seconds to insert information



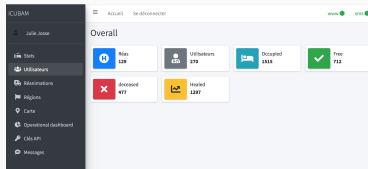




Operational tool for rescuscitators in times of crisis

- Within 2 weeks, ICUBAM covers 1/3 of ICU beds: 130 ICU wards, 40 départements, > 2,000 ICU beds
- Tool has been recognized to have the most recent data on bed availability. Most data <1h
- Flexible: add new features (réa hors murs/private sector, etc.); large or inconsistent entries trigger warnings; If the last input was more than a day ago, a warning is displayed to make it clear that the reported number might not be up to date
- Open-source, and pushing for one-click deployment
- Backend integration with health ministry datastores to provide information upstream or synchronize with other sources of truth.

Dashboard



Operational dashboard



Dashboard

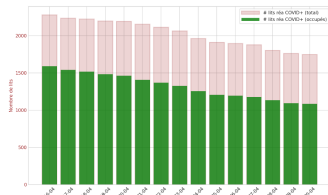
All regions ▼

Dashboard

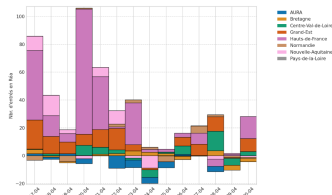
Covid+

Covid-

"Evolution du nombre de lits COVID+"

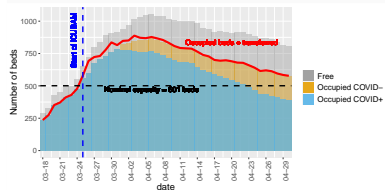
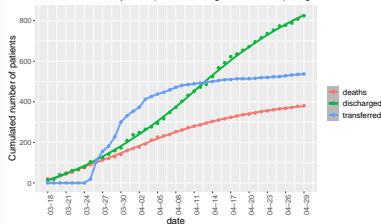


Number of new entries to ICU for COVID+



Real time monitoring

Cumulated number of patients (deaths, discharged or transferred) in region Grand Est



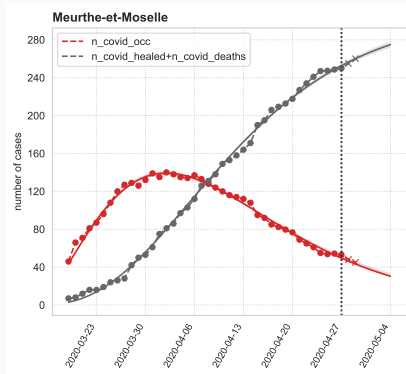
Following patients admission and outcomes (death, discharge, transfer):

- Evolution in admissions → system response to confinement measures
- Evolution in patients outcome → evolution in admission criteria/care (point where discharge rate increases while death rate decreases)
- Mortality rate of ICU stays

Evolution of supply and demand of CCBs:

- 501 to 1056 beds in 12 days, 600 patients had to be transferred out
- Low rate of discharges, second wave of admissions difficult to absorb
- Different départements evolved differently

Predicting CCB availability



- Mid-long term prediction with epidemiologic models (see M. Lavielle)
- Short-term (per day) prediction of the number of released CCBs (either due to death or discharge) using number of ICU admissions in the preceding days as explanatory features

Success and impact of Icubam

- **Data quality is a key challenge:** flexibility of the data collection, collect data directly from the intensivists
- Inter-disciplinary team of intensivists, engineers, researchers, statisticians, physicists and computer scientists
- Entire pipeline: data collection, analysis, communication of results in real-time to meet operational needs in an emergency context
- Used by physicians, health agencies, first responders etc.
- Better planning of resource needs and triage of critical care patients can have a substantial impact on patient care

⇒ ICUBAM assists decision-making process by providing a framework to collect and analyze detailed and reliable data

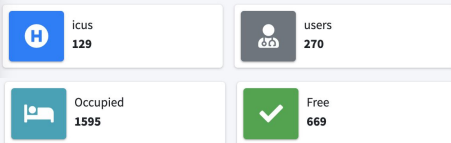
Model patient flows, anticipate bed needs, epidemic's evolution, welcome patients from submerged areas

- 1st wave stop ICUBAM in June 2020
- 2nd wave restarted in October 2020: request from Brittany, then BFC then stop in July 2021
- 3rd wave: request from Martinique in September 2021

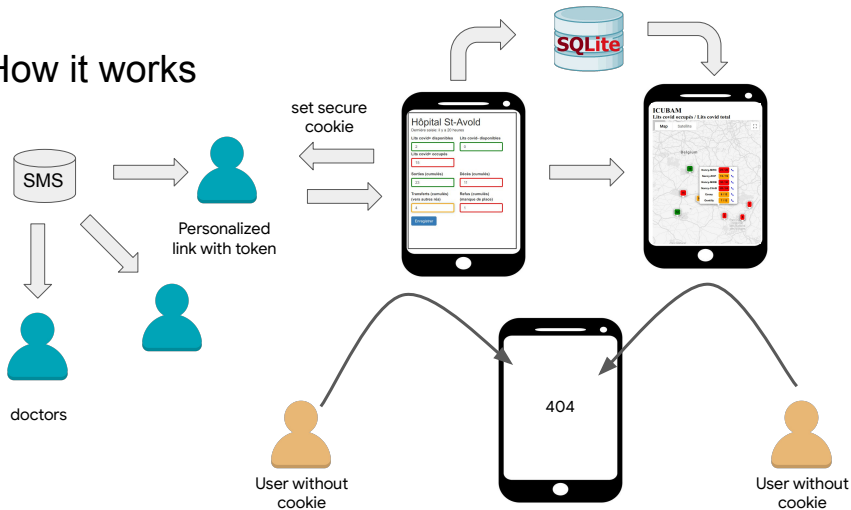
In response to the emergency, a group of contributors came together to build a free and open-source bed availability management system.

More info: <https://icubam.net>

* French Institute for Research in Computer Science and Automation

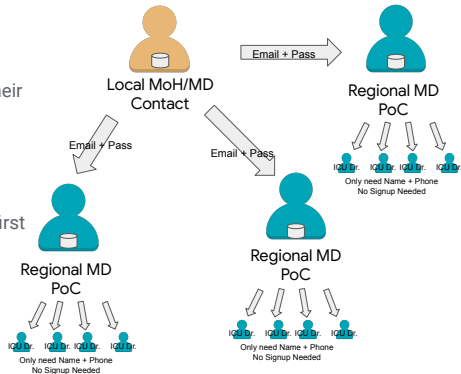


How it works



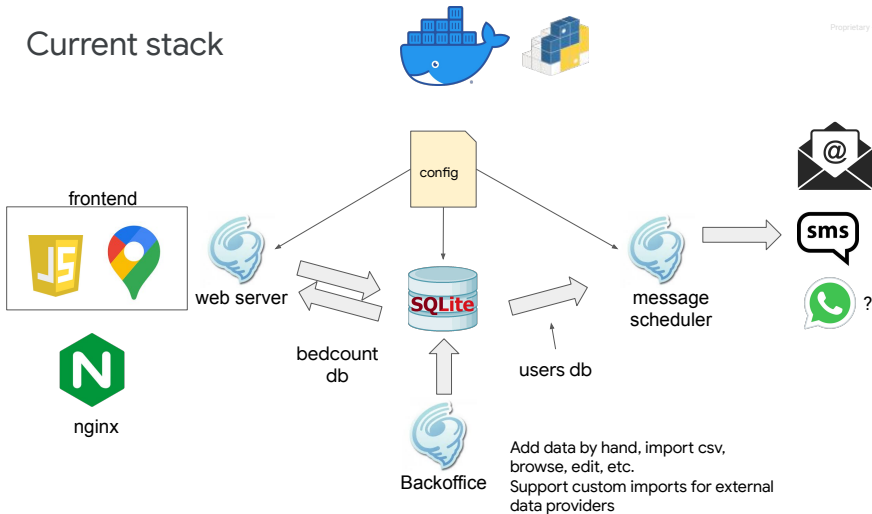
Efficient Deployment Strategy

- 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.



Current stack

Proprietary + Confidential



Google