



The Challenger: Superbugs

Multi-Drug Resistant Organisms (MDROs) are an international health issue due to the morbidity, mortality and healthcare costs arising from their proliferation in healthcare environments, leading to an estimate of around 2,609,911 yearly new cases of healthcare-associated infections in the European Union/European Economic Area alone¹. Early detection is considered one of the foundations for the fight against the MDRO menace², and medical technology has focused on reducing both the "time" and "sampling" factors on the identification of microorganisms in patients³, whilst increasing interoperability with electronic notification systems². However, a much older war affects the incidence of infectious diseases in a healthcare context: hygiene⁴. A technology that detects the environmental presence of a high-risk microorganism, in real-time, can reduce costs and the subsequent prevalence of infections by allowing for more accurate terminal cleaning procedures and identifying contaminated patient zone surfaces^{4,5}. An added ability to target both patients and healthcare professionals, and the contribution to environmental and hand hygiene, could be a major game-changer for healthcare institutions that adopt such a technology.

Reducing time of detection of specific microorganisms and allowing physicians to be aware of their presence in healthcare environments, including patient and physician-level detection in real-time, is the commitment of the Anti-SUPERBUGS project. To achieve this, companies will be presented with ASB's guidelines and requirements to design and manufacture the most suitable technology.

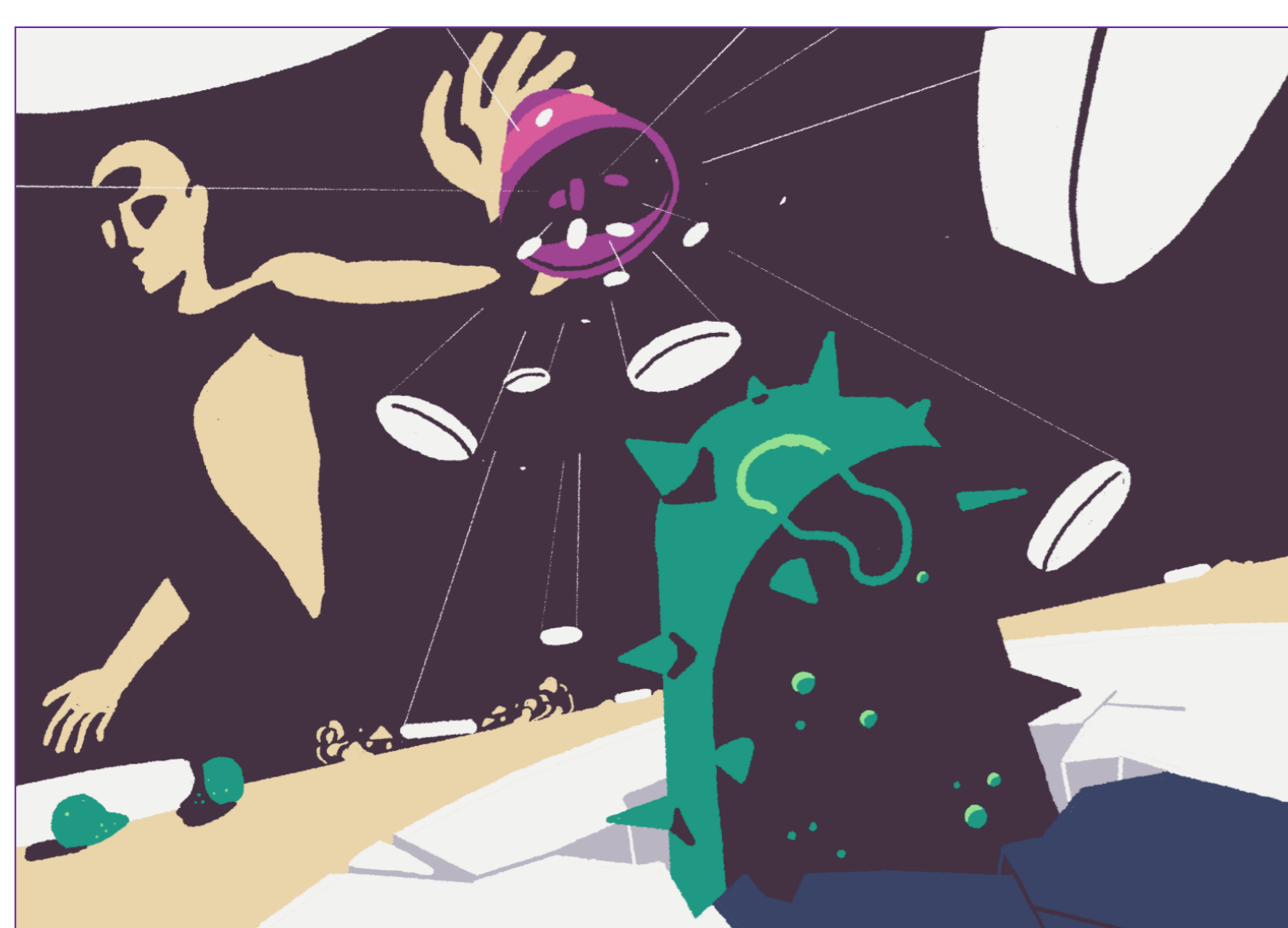


Figure 1. Superbugs appear due to selective pressure by antibiotic saturation. This project is also working towards the necessary prevention of further infection and antibiotic misuse¹ by allowing a workflow that leads to adequate and timely antibiotic therapy, and a thorough, albeit not constant, surveillance of the healthcare settings, patients and practitioners.

Tools for defining the Challenge's requirements

Consortium level:

- "Wouldn't It Be Good If..." focus groups
- Dissemination activities
- State of the Art analysis

Regional level:

- Questionnaires directed at healthcare staff (medical staff, nurses, researchers, laboratory aides) and informatics experts
- Literature review and European and regional data regarding most prominent microorganisms
- Individual interviews with healthcare practitioners
- Meetings with directors from Medical Institutes, Hospitals and Central Laboratories

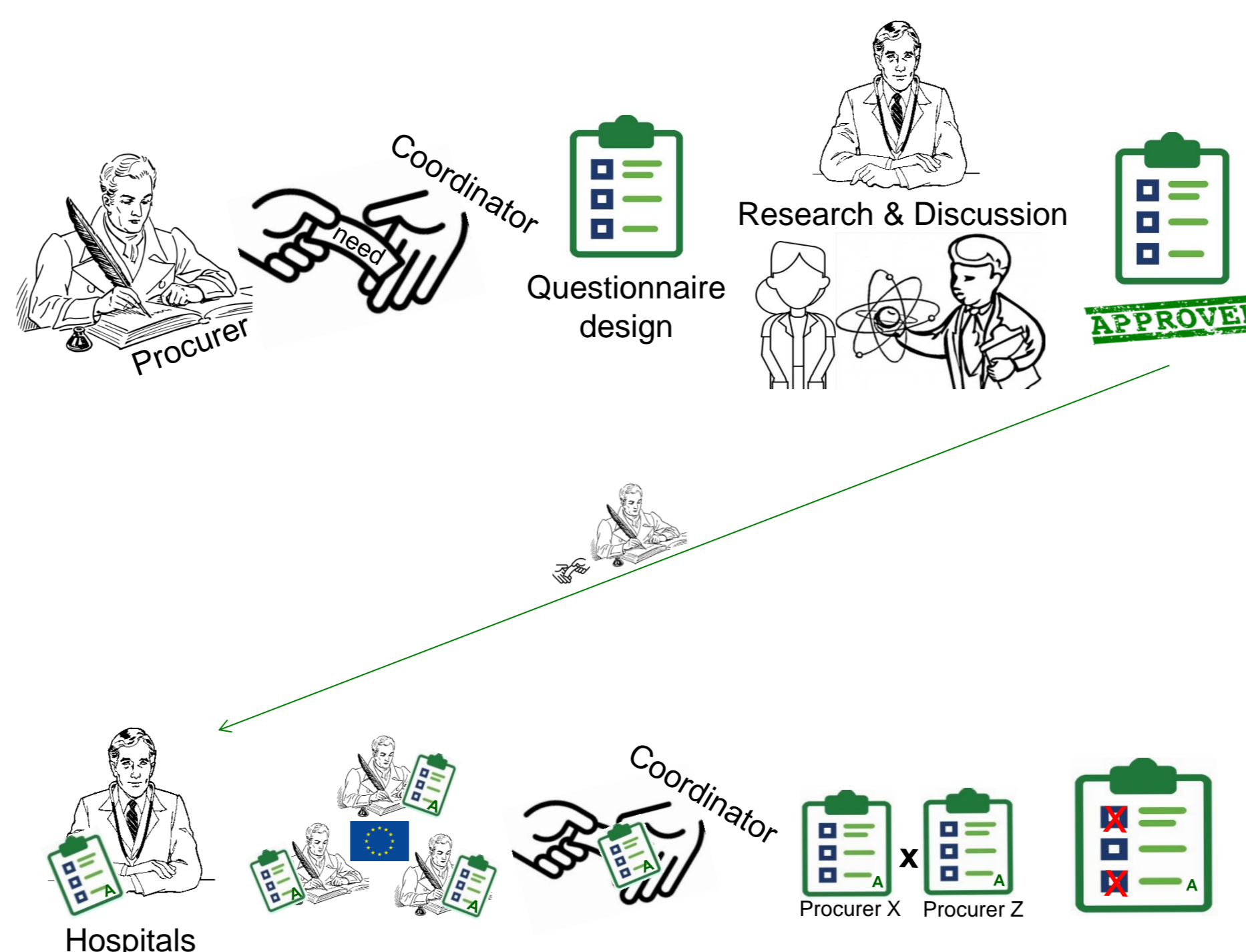


Gonçalo de Carvalho, expert biologist in resistances at the Catalan Institute of Oncology, explains the need for this project to consider the possibility of creating new modules that when applied to the technologies themselves enable new detections to be made which makes purchasing them even more attractive to health institutions by adapting them to their own needs.

The tender which will be opened to companies in the next few months forms part of the Pre-Commercial, Public Procurement programmes funded within the European Commission's H2020 framework of reference. All the information regarding the Antisuperbugs

Figure 2. Brussels (Belgium). First project review in April 2018. Meeting included most partners and the European Commission officials.

Challenges: uncovering and designing solutions



The challenges found by the Consortium:

What microorganisms should ASB focus on?

- Initial microorganism selection too broad
- Review of our produced needs by the European Commission
- R.: *Prioritize the minimum MDRO requirements of the technology*

How can the ASB's needs be viable for companies?

- Hierarchy of the regionally important microorganisms
- Grade system based on requirements fulfilled by companies:
 - Mandatory requirements: passing grade
 - Mandatory + Extra requirements: passing + extra grade
- R.: *Competitive procurement setting for best technological solution*

What type of technology can be expected of the ASB?

- Detection based on *volatile organic compounds (VOC)*
- Information and Communication Technology interoperable with Hospital Information Systems

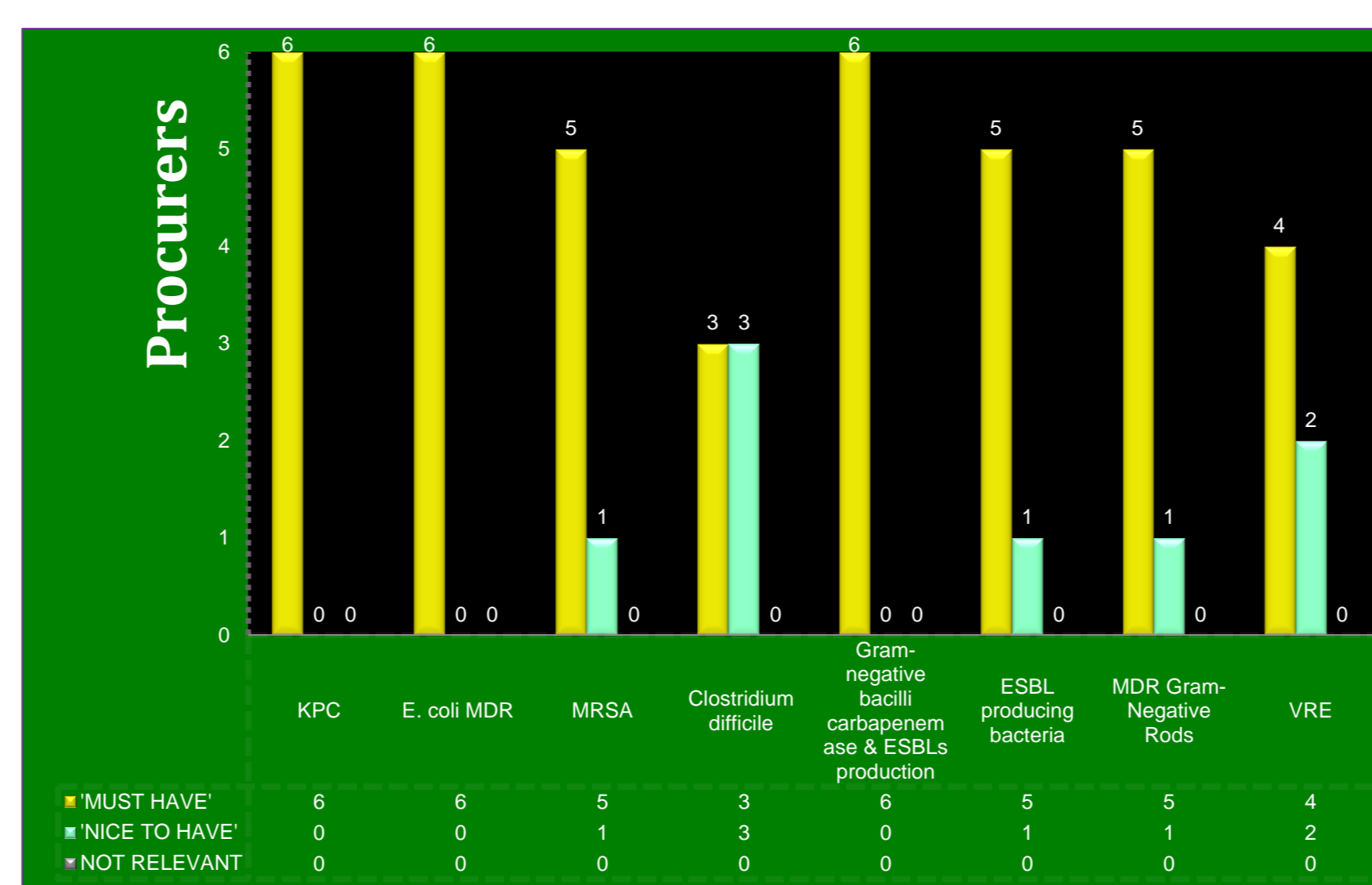


Figure 3. This graph showcases the microorganisms and types of resistances most relevant to the procurers: KPC: *Klebsiella pneumoniae* carbapenemase; E. coli MDR: *Escherichia coli* multi-drug resistant; MRSA: Methicillin-resistant *Staphylococcus aureus*; ESBL: Extended-spectrum Beta-lactamase; VRE: Vancomycin-resistant enterobacteriaceae. The voting system consisted of a 3 level point scheme: "MUST HAVE"; "NICE TO HAVE"; "NOT RELEVANT". Apart from this voting system, verbal discussion and voting based on research and regional needs regarding each of the microorganisms, along with current technological developments, were also taken into account.

Microbiological and technological objectives

General:

- Improve quality of hospital care process by:
 - detecting Hospital-Acquired Infection (HAI) microorganisms
 - inform about the spreading of infections within healthcare facilities
 - ICT prototype development
- Reduce costs of collateral healthcare effects
- Promote Research & Development activities in advanced ICT
- User and patient friendly
- Ecologically sustainable

Technological details:

- Real-time detection in hospital environments, patients, healthcare professionals and fomites
- Non-invasive sampling
- VOC-based detection
- Detection interoperable with the Healthcare Information Systems
- Detection linked with geolocation in healthcare facility
- Automatic/unmanned detection*

Targeted microorganisms:

- *Clostridium difficile*
- *Klebsiella pneumoniae* (+ Extended-Spectrum Betalactamase & Carbapenemase production)
- *Acinetobacter baumannii* (+ Multi-Drug resistance)
- *Staphylococcus aureus* (Methicillin resistance)

Pathogen	Inf. disease	VOC marker
<i>A. Baumannii</i>	VAP	1-undecene, nonanal, decanal, 2,6,10 trimethyl-dodecane, 5-methyl-5-propyl-nonane, longifolene, tetradecane, 2-butyl-1-octanol
<i>C. Difficile</i>	Ulcerative colitis, diarrhoea	Ethanol, Butanol, Isopropanol
<i>K. Pneumoniae</i>	Bronchitis, pneumonia	Butanaldehyde, octyl acetate, tridecanol, dodecanal, butanoic acid

Table 1. Microorganisms voted and agreed upon as minimal requirements: *Acinetobacter baumannii*, *Clostridium difficile*, *Klebsiella pneumoniae*; infectious disease that these microorganisms are associate to: VAP: ventilator-associated pneumonia; and the biomarkers for each of these microorganisms based on volatile organic detection (VOC).

*Optional in regards to the use of the technology, but mandatory as an option the technology offers

Conclusions

- Anti-SUPERBUGS is fighting a worldwide epidemic and revealing international medical urgent needs
- Anti-SUPERBUGS is using new procurement approaches to launch a challenge for competitive developers
- Anti-SUPERBUGS is improving on a novel technological medical market
- Anti-SUPERBUGS is integrating different technological systems and exploring a promising niche of interoperability



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Authors: Gonçalo Carvalho Rodrigues¹, Enric Limon Caceres¹, Jean Patrick Mathieu², Rossana Alessandrello², Esther Arévalo De Andrés², Ramon Maspons³, Josep Trenado Alvarez⁴, Laura Bugaña Hoffmann⁵, Emanuele Torri⁶, Sara Bedin⁶, Maren Christina Geissler⁶, Ulla Elofsson⁶, Dag Iver⁶, Beniam Ghebremedhin⁶, Robert Deisz⁷, Katherine Jeays⁸, Pablo Antonio Coret⁹, Esther Calbo Sebastian⁹, Lauren Gwen Fleming⁹, Carlota Gudiol⁹, Raquel Azor⁹, Mariela Martinez⁹, Núria Freixas Sala⁹, Miquel Pujol Rojo⁹, Petra A. Thürmann¹⁰, Parviz Ahmad-Nejad¹⁰, Stefan Wirth¹⁰, Christof Alefeld¹⁰, Ingo Klomp¹⁰, K. Rasche¹⁰, Sebastian G. Russo¹⁰

Filiation: ¹Institut Català d'Oncologia (ICO) and IDIBELL ²Agència de Qualitat i Avaluació Sanitàries de Catalunya (AQuAS) ³Sp Sveriges Tekniska Forskningsinstitut AB (SP) ⁴Universitätsklinikum Aachen (UKA) ⁵Sheffield Teaching Hospitals NHS Foundation Trust (STH) ⁶Provincia Autonoma di Trento (PAT) ⁷Hospital Mutua Terrassa (HMT) ⁸HELIOS ⁹Smart Procurement

