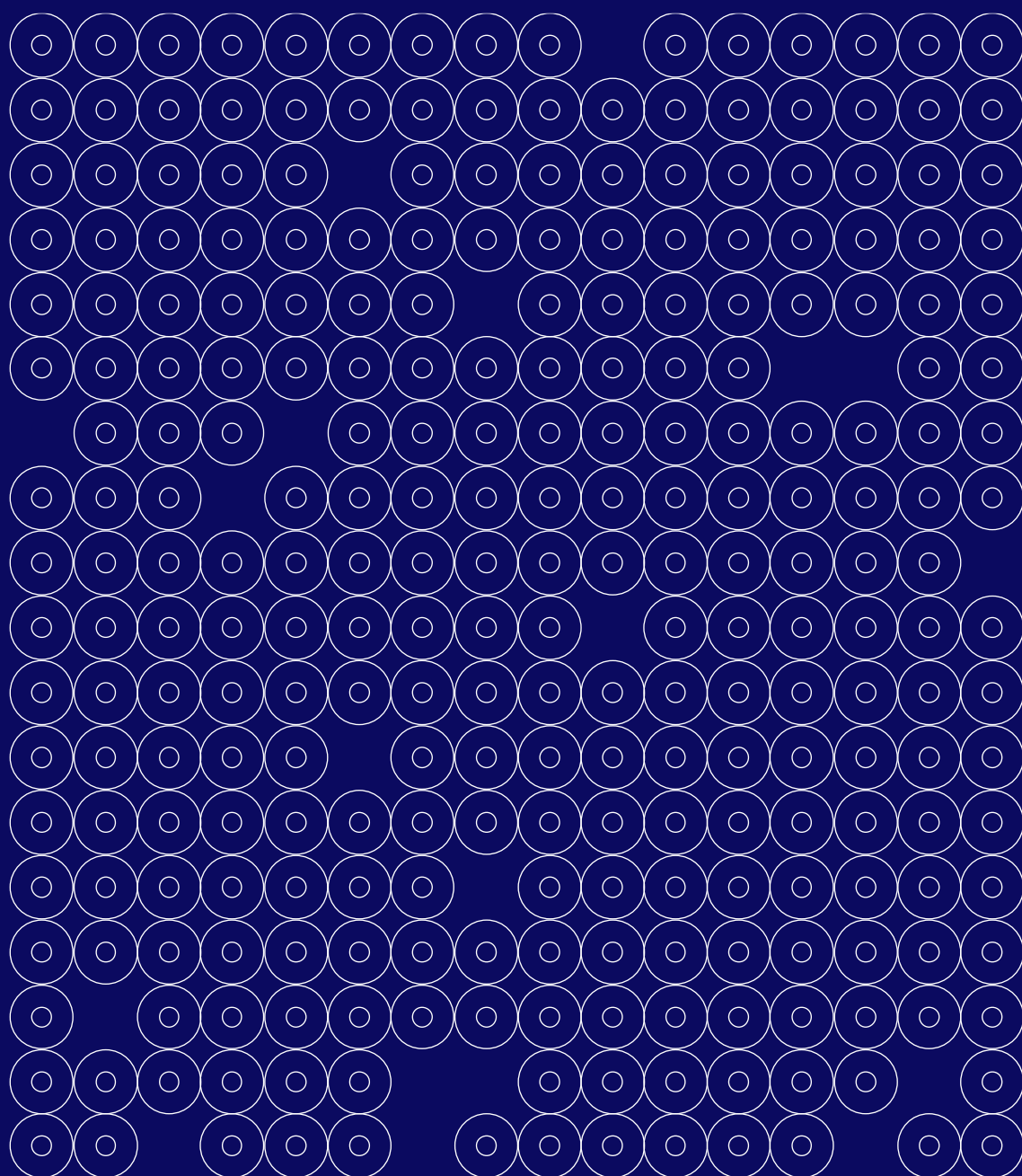


Hacking AMR 2019

Stockholm, 13-15 December 2019



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 **jpiamr**
Joint Programming Initiative
on Antimicrobial Resistance

Hacking AMR 2019

Background	1
Goal	1
Financial support.....	1
Attendees.....	1
Collaborations	4
Communications	4
Hackathon results	5
Prize.....	5
Direct and indirect outcomes	5
Conclusion.....	6
Appendix 1 – Registration numbers and participants profiles	7
Appendix 2 - Projects summaries	8
<i>Mission Prescription</i>	8
<i>The waiting room game</i>	9
<i>MediRest</i>	10
<i>AntiBx</i>	11
<i>AMR Predictor</i>	12
<i>AMR EQUIP</i>	13
<i>Evolving Threat Detector (ETD)</i>	14
Appendix 3 – Participants list.....	15
Appendix 4 – Speakers, Mentors, Judges, Funders, Planning Committee and Support	17
Appendix 5 – Communications products and tools.....	20

Hacking AMR 2019 – REPORT

Background

As part of the JPIAMR Roadmap of Actions 2019-2024, JPIAMR proposed holding a hackathon-type event under the umbrella of JPIAMR-Virtual Research Institute (JPIAMR-VRI) for engaging the younger generation of scientists and others around the challenges of antimicrobial resistance (AMR). This event was proposed by the JPIAMR Scientific Advisory Board (SAB) in March 2020 to encourage novel solutions, and outside the box thinking, in order to collaborate, dream up and create solutions to improve human, animal environmental health and raise awareness to the challenges of Antimicrobial Resistance.

Goal

The **Hacking AMR 2019** Planning Committee constructed the theme of this event around “Finding digital solutions to fight Antimicrobial Resistance (AMR)” and brought together a broad range of phenotypes of people that do not typically find themselves in the same workspaces.

Hacking AMR 2019 was developed as an intense, hands-on, fun, creative, 2.5-day event that sought to produce innovative digital work products/mock-ups/prototypes that could bring concrete, actionable solutions to address the many serious challenge of AMR, all of which could be implemented under the JPIAMR-VRI.

Financial support

Hacking AMR 2019 was funded by Sweden, Canada and Denmark, as well as JPIAMR. A consultancy firm experienced in running Hackathons in the health and biomedical sector ([Hacking Health Foundation](#)) was engaged, and the consultants also provided the SPARKBOARD platform that was used by participants to connect with one another, share information and ideas, form teams and vote for the People Choice Award. In addition, several JPIAMR Member States generously offered Travel Awards to several participants attending this event.



Figure 1: Funders and collaborators of **Hacking AMR 2019**

The University of Edinburgh and the Uppsala Antibiotic Centre (UAC) provided in-kind support by taking part in the Planning Committee, event photography and podcast communications. The Swedish Research Council also provided in-kind communication resources.

Attendees

Participants: The Planning Committee aimed to obtain a good balance between the science expertise and the digital world expertise, between geographical locations and to work towards for gender balance of participants, mentors and judges. In this context, the Planning Committee made every effort possible to reach out outside of the usual JPIAMR channels in order to regroup the best offering of complementary skills sets (Appendix 1, Table 1).

Hacking AMR 2019 received great traction and was able to quickly reach its targeted registration goal of 50 participants. The Hackathon received a lot of support on social media from various stakeholders who found this opportunity to be valuable enough to share amongst their community. The outreach made to stakeholders outside of our regular channels had great results on the registration, the variety of skills and also contributed to finding remote mentors that added to the quality of the support provided to participants.

Overall, the Hackathon received 71 registrations from 17 countries by the time registration was closed. Ultimately, the event ran with a total of 40 participants from eight countries after accounting for drop-off rate. The list of participants can be seen in Appendix 3, Table 3.



Guest speakers: Two members of the JPIAMR Scientific Advisory Board, Dr. Till Bachmann (University of Edinburgh) and Dr. Eric Brown (McMaster University), gave keynote speeches to provide an overview of the global AMR situation and give inspiring words of wisdom to all.



Guest speakers and mentors – Till Bachmann and
Eric Brown



Mentors: Mentors with different expertise, skills and interests provided input to the projects. Mentors were from many different locations, including local mentors from Sweden, as well as Europe and beyond. Mentoring was planned for two-hour blocks per day from each onsite mentor but onsite mentors were so generously committed that they provided nearly continuous mentorship throughout the entire weekend which made a significant impact amongst the



On-site mentoring



Remote mentoring

teams. In addition, the facilitated access to remote mentors, allowed the provision of an even greater expertise and participants got great inspiration, validation, alignment and help, and were able to fact check much of their ideas and get guidance to develop content. The mentors were also very helpful in managing time and ensuring that teams were narrowing their ideas and focussing on solvable problems from the ideas in the high intensity environment. Furthermore, having remote mentors available for two-hour blocks worked very nicely and all of the remote mentors were greatly utilised by teams. Remote mentoring was coordinated by staff through Zoom accounts with only very minor technical challenges to report.

Judges: The Jury for this competition consisted of five key individuals carefully selected for their expertise (refer to Appendix 4). The judges arrived on the Sunday and were provided with a briefing on the JPIAMR-VRI as well as an evaluation guide that assisted them in executing their task based on the following criteria: desirability, feasibility, viability and impact. Bonus points were awarded for the quality of the presentations.



Judging panel

Collaborations

Hacking AMR 2019 was able to benefit from rich cross-fertilization of other JPIAMR activities such as the support from the Scientific Advisory Board members (Drs Eric Brown, Till Bachmann and Annegret Schneider), several BEAM Alliance members (a Network funded under the JPIAMR 4th and 8th calls), the Uppsala Antibiotic Centre, the University of Edinburgh (awarded funding under the JPIAMR 4th and 8th Calls) as well as AMR Insight (a contact from the IRAADD Network meeting in the JPIAMR 8th Call). As the Hackathon progressed, a great collaborative spirit even between opposite teams could be observed. For example, one team helped another by providing access to a much needed and relevant dataset and even received advice on how to interpret and analyse their mining results.

Communications

It became clear that a good communication strategy before, during and even after this type of event would be key to its success. JPIAMR used an unprecedented level of communication effort both with an increase in frequency as well as volume on social media, in addition to publications on JPIAMR website and Newsletters. Several videos and even a podcast were produced and nourished the audience's interest before, during and after the event. See Appendix 5 for more details the communication components and for a list of promotional push provided by various stakeholders.

Furthermore, although the Hackathon initially seemed to be a difficult new endeavour for JPIAMR, the Planning Committee decided to dare to be innovative in how to do things for this event and took on the challenge to live stream the pitch session on Facebook and the results were worth the extra effort.

Hackathon results

On the first night of the Hackathon, 11 different ideas were pitched which resulted in seven teams forming after a few of the initial teams merged to work on diverse digital solutions to AMR. (see Appendix 2 for summaries of the ideas and prototypes details). It is noteworthy that teams were actually able to come up with various prototypes in the form of websites, apps, games and videos, in the short time period of 48 hours.

The judging duties proved to be quite difficult for our judging panel as all seven final projects were well thought through and had a high potential for assisting in the AMR fight. Ultimately, the Grand Prize was awarded to the **Mission Prescription** team. Both the Judges' honourable mention and the People Choice award went to the **Waiting Room Game** team.



Mission Prescription Team

Prize

The spirit of Hacking AMR 2019 in something that truly has a great impact and is not only a win-and-forget event, is that post-event mentorship was of the outmost value and provided much more benefit than a monetary prize. Post-event mentors have been engaged to support the winning team in driving forward and refining their hackathon idea. The Planning Committee engaged in discussions with potential post-event mentors (private sector and non-for-profit organisation) and was able to secure two of them who have generously agreed to provide 5 to 15 hours of mentorship sessions with the winning team over the next six months. The companies that have agreed to take on this role are:

- [LYO-X GmbH](#) (Matthias Machacek and Jannik Vollmer)
- [FASTinov SA](#) (António Ornelas-Soares)

Direct and indirect outcomes

- Interesting potential solutions for AMR could be added to the JPIAMR-VRI Digital Platform.
- The mentorship model was successful and should be explored further by JPIAMR.
- Hacking AMR 2019 built some new capacities, including giving JPIAMR experience in organising hackathons
- The Hackathon created an opportunity for people to connect, generating new relationships with collaborators.
- Numerous member state researchers attended a hackathon for the first time and got to experience this new cutting-edge type of meeting.
- JPIAMR and JPIAMR-VRI received significant visibility and support, including but not limited to social media.
- The Hackathon showed collaboration amongst various JPIAMR activities and stakeholders.



Conclusion

Hacking on the Digital World within the AMR fight was seen as innovative and intriguing, and was an opportunity for not only JPIAMR-VRI, JPIAMR and collaborators to obtain visibility but also to highlight the global AMR issue. The theme selected not only showed insight from JPIAMR but also courage to organise an event for which no one could predict the outcome.

Hacking AMR 2019 achieved its goals and was in alignment with the JPIAMR-VRI mandate to increase capacity and creating opportunities for people to network, while generating innovative avenues to fight AMR. The hackathon engaged the young generation of scientists as well as other participants that were not the stakeholders not typically seen in this space. **Hacking AMR 2019** generated out-of-the-box ideas that have a potential to be implemented within the JPIAMR-VRI. It gave an opportunity for people to meet and work together and finally, it increased awareness for the AMR issue, and visibility of the JPIAMR work and the JPIAMR-VRI efforts.

Hackathons are undeniably impactful and have considerable potential in becoming flagship events for JPIAMR-VRI.

Appendix 1 – Registration numbers and participants profiles

Table 1: Skills and expertise amongst the hackathon participants

Skills/Expertise*	Total	Skills/Expertise*	Total	Skills/Expertise*	Total
AI/computational Engineer	2	Undergraduate student	1	Start-up entrepreneur	4
Bioinformatics	3	Graduate student	9	Business development	1
Coding expert	3	Post-doc	7	Health economist	1
Developer	6	Scientist	4	Humanities	2
Software Professional	1	New academic researcher	9	Policy analyst	2
Data Engineer / Data Scientist	5	Provider/Clinician – AMR specific	3	Process design	1
Engineer/Biomedical Engineer	2	Provider/Clinician – non-AMR specific	2		
Digital transformation	1	AMR Programme management	1		
*participants could identify themselves to more than one category of skills/expertise				Total	56

Table 2: Registration numbers per country. One team decided to enrol a participant remotely to strengthen their team.

Country	Present	Participated remotely
Canada	5	1
Denmark	1	
Germany	6	
Japan	4	
Norway	1	
Poland	1	
Sweden	13	
United Kingdom	8	
Total	39	1

Appendix 2 - Projects summaries

Mission Prescription

Aim: To change how prescriptions are done in the family doctor's office to help improve antibiotic prescribing behaviour, and reduce inappropriate prescribing or misuse of antibiotics. Support doctors with a tool to monitor their own prescribing in relation to the rest of the medical community.

Prototype proposed: A platform that incorporates and combines community AMR rates and electronic medical record (EMR) data in order to effectively prescribe antibiotics for urinary tract infections for this first prototype but could be scaled to other infections. This platform can be used for decision support, quality improvement, public health surveillance and research in the infection space (while being scalable to other areas). It will nudge towards first-line antibiotics and make prescribing the appropriate antibiotic more efficient. The data is sourced from two million patient records within the Canadian Primary Care Sentinel Surveillance System Network (CPCSSN) that uses data from 17 different electronic primary care electronic medical records vendors across Canada. Data includes administrative (e.g. hospitalisations, ER visits, dispensed medications) and EMR data (e.g. lab, billing, medication prescribed including all antibiotics).

<https://jpiamr-prescription-ngevntkd6q-ew.a.run.app/>

Member states represented: Canada, Germany, Sweden and UK



The waiting room game

Aim: To improve public knowledge about antibiotic resistance and empower individuals to make a difference. To educate the public in an engaging way on the role they play in helping contain antibiotic resistance while they sit in the waiting rooms before meeting their health care professional.

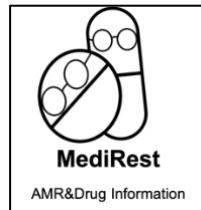
Prototype proposed: An educational role-playing low cost smartphone game that uses evidence-based information in an effective packaging. The game would be publicised to patients at a time when they are particularly receptive to healthcare messages. Enthusiastic primary care clinics could even provide tablets for patients to play the game on. Players go through scenarios, seeing the importance of the different choices they make in their own daily lives. The content includes core simple action-centred messages (e.g. hand hygiene, expectations for illness duration, taking antibiotic courses correctly, alternatives to antibiotics) mixed with interesting facts about antibiotics and antibiotic resistance (e.g. effects of antibiotics on gut bacteria, on environment)

Members states represented: Germany, Norway, Poland and Sweden

**Public's Choice
Award**

**Jury's Honorable
Mention Award**





Aim: To enhance and simplify information exchange of AMR information, drug shortage, and provide advice on alternative therapies to avoid use of inadequate treatment plans, especially in chronically infected patients.

Prototype proposed: A real time information exchange database connected to a central storage model for obtaining recommendation for critical antibiotics or treatment alternatives available to circumvent stock outs and inconveniences resulting from shortages of valuable antibiotics. The database will be available through an application and website and will inform on availability and treatment information, clinical data and antimicrobial susceptibility and genomic resistance data, and will give an opportunity to care givers to communicate with each other.

This information can also be communicated to veterinarian institute for knowledge of resistance and they in turn can input information about resistance that have occurred on farms, in environment, animal or wildlife.

Member states represented: Finland, Germany, Sweden and UK





Aim: To build a progressively greater intelligence in a real time global data collection so that anyone can participate in R&D and exploit commercial copyright value associated with open research data while making such information accessible in an open source marketplace under an equitable approach. To fuel continual transparent R&D in AMR with stable investment and a secured supply chain to retain the best talent globally in order to provide equity of care.

Prototype proposed: Blockchain and cryptocurrency to combat AMR globally. Creating a decentralised research organization (DRO) for drug and diagnostic discovery for microbial infections. The DRO will allow anyone to stake and develop R&D and exploit commercial copyright value associated with open research data, while at the same time making such information accessible in an open source marketplace. Data imported in the system will be connected back to the importer in a blockchain and get a traceability to tag as their data. The data grows globally from all sources as more people from the ecosystem uses it

AntiBx could help health care professionals in LMIC improve their practice. It can allow access to feedback from experts on the quality of the data, how to input data in the system, get back results and show a solution to problem in a specific region, assist with publication on research outputs on open source platform. The app will bridge this gap by helping these people connect with others outside of LMIC and collaborate with others.

Member states represented: UK



AMR Predictor

Aim: To explore how machine learning can be utilised to hack AMR, to classify and predict new variants in AMR beta lactam resistant bacteria.

Prototype proposed: A method of prescribing antibiotics smartly by using trained artificial intelligence neuro-networks to perform inference accurately by an analysis of the DNA of a bacterium and determine whether it is resistant to any antibiotics currently known. The healthcare provider obtains a sample that is then sequenced and entered into the AMR Predictor program that informs on what antibiotic not to use due to resistance of this bacterium.

Member states represented: Japan, Sweden and UK



Aim: To provide a validated methodology and mechanism to implement a global system of economic incentives and rules for antimicrobial use (AMU) using quantitative analysis as universally accepted collective decision-making framework. To objectively measure the functional frame of reference for governments, antibiotic consuming industries, pharmaceutical industry, and research community to operationalize the concerted global AMR fight.

Prototype proposed: Use advanced multi-method modelling and a system thinking approach (big data, genomics, artificial intelligence, deep learning, blockchain, crowdsourcing) to quantify all the costs and benefits amongst and various economic interactions between all the parts of AMR spectrum to help policy makers to make the appropriate decisions

Combining real-time global AMR surveillance with a system similar to carbo offset credits using large questionnaires (which will enable users to not only use the model but feed into it), to create a powerful global environment for a just and efficient resource re-distribution to de-incentivise antibiotic abuse and stimulate progressive development (i.e. antibiotic use reduction, new antibiotics discovery or development of antibiotic alternatives).

Member states represented: Canada, Sweden and UK



Evolving Threat Detector (ETD)

Aim: To detect AMR genes within the microbial genomes and use results in clinical and public health settings in real time to help researchers, clinicians and public health specialists obtain consistent and robust contextual information needed to identify clinical/public health significance and make sense of the results.

Prototype proposed: Bioinformatic software to help AMR surveillance using mined AMR gene bank information that would answer questions such as:

- How the isolate compares to other similar isolates?
- Has a new AMR gene never seen in this organism been detected?
- Has a chromosomal AMR gene been mobilised on a plasmid?
- What is the evolutionary relationship between the new gene and the previously identified AMR genes of the same family?
- Does the isolate represent a new level of resistance?
- Is the isolate a newly evolved threat of global importance?

Reports will show in a comprehensive way the resistance mechanisms and resistance patterns, drug classes, gene location affected, qualitative assessment of the outbreak risk and import probability. This will assist the healthcare provider if this isolate or relative isolates warrant addition investigation or additional consideration for diagnostic care. Information will also be disseminated in an open space for global use.

Users of ETD could be used for searching for all similar strains and comparing their repertoire of AMR genes to those detected in their isolate which will allow identification of development of resistance new to that organism. Similarly, they can explore the evolution of this AMR gene relative to its homologues through phylogenetic analyses.

The ETD will automate and make reproducible the process of contextual analysis and highlight the most relevant and clinically significant findings using the large amount of publicly available resistance data and metadata from several databases and tools.

Member states represented: Canada and Japan



Appendix 3 – Participants list

Table 3: Participants of Hacking AMR 2019 and their country of affiliation

First name	Last name	Country
Lukas	Abraszek	Poland
David	Barber	Canada
Klaudia	Bielecka	United Kingdom
Evangelia	Daskalakis	Sweden
Harpal	Dhillon	United Kingdom
Oliver	Dyar	Sweden
Lennard	Epping	Germany
Shailesh	Garlapati	India
Daniel	Gavilan	Sweden
Ewan	Gray	United Kingdom
Igor	Grekov	Czech Republic
Jean	Hausser	Sweden
Rachel	Hickman	United Kingdom
David	Hinrichs	Germany
Kentaro	Itokawa	Japan
Eric	Juskewitz	Germany
Marcin	Kedziera	United Kingdom
Eleni	Kousari	United Kingdom
Janina	Krambrich	Finland
Natalie	Linton	Japan
Finlay	Maguire	Canada
Sid	Mookerjee	United Kingdom
Tomomi	Nakao	Japan
Marmar	Nekoro	Sweden
Louise	Norton-Smith	United Kingdom
Egle	Obcarskaite	Sweden
Simon	Otto	Canada
Amogelang	Raphenya	Canada
Elisabeth	Reithuber	Sweden
Erika	Saliba Gustafsson	Sweden

Johan	Seijsing	Sweden
Tsuyoshi	Sekizuka	Japan
Sumeet Kumar	Tiwari	Germany
Anatoliy	Trokhymchuk	Canada
Hermoine	Venter	Norway
Tinkara	Vozel	Sweden
Michael	Weber	Germany
Vendela	Wiener	Sweden
Björn	Windshügel	Germany
Sabrina	Wong	Canada



Appendix 4 – Speakers, Mentors, Judges, Funders, Planning Committee and Support

Opening session speakers

Till Bachman

JPIAMR SAB member
University of Edinburgh (UK)
AMR Scientist - Diagnostics, Academia

Eric Brown

JPIAMR SAB member
McMaster University (Canada)
Complex biology in bacterial survival
strategies, Academia

Onsite Mentors

Till Bachman

JPIAMR SAB member
University of Edinburgh (UK)
AMR Scientist - Diagnostics, Academia

Diarmaid Hughes

Uppsala Antibiotic Centre (Sweden)
Biology of AMR, R&D, Academia and
collaboration with Industry

Eric Brown

JPIAMR SAB member
McMaster University (Canada)
Complex biology in bacterial survival
strategies, Academia

John Gregory

Hacking Health Foundation (Canada)

Nicolas Piperno

Hacking Health Foundation (Canada)

Remote Mentors

Niv Bachnoff

Omnix Medical (Israel)
Development and commercialization of
antibiotic, Industry

Annegret Schneider

JPIAMR SAB Member
Robert Koch Institute (Germany)
Social-/behavioural-science, communication

Vidya Bhardwaj

Veterinary Diagnostic Laboratory, City
University of Hong Kong (China)
Microbiology Veterinarian, Diagnostics and
Research

Amanda Warner

Freelance Programmer (Sweden)
Learning and game designer and developer

Sebastian Dümcke

Clemedi (Germany)
Business development, bringing highly
complex products to market, Industry

Anna Zorzet

ReAct (Sweden)
AMR Policy

Judges

Linus Sandegren

Uppsala University (Sweden)

Maria Smith

AxFoundation (Sweden)

Marianne Sunde

Norwegian Veterinary Institute (Norway)

Maria Thuveson

Swedish Research Council (Sweden)

Jannik Vollmer

LYO-X (Switzerland)

Funders representatives on site

Mizuki Kawasaki

Japan Agency for Medical Research and Development (Japan)

Laura Plant

Swedish Research Council (Sweden)

Danielle Vitali

Institute of Infection and Immunity -
Canadian Institutes of Health Research
(Canada)

Planning Committee

Till Bachman

JPIAMR SAB member
University of Edinburgh (UK)

Eva Garmendia

Uppsala Antibiotic Centre (Sweden)

Édith Brochu

Institute of Infection and Immunity -
Canadian Institutes of Health Research
(Canada)
JPIAMR Secretariat

John Gregory

Hacking Health Foundation (Canada)

Nicolas Piperno

Hacking Health Foundation (Canada)

Anders Bjers

JPIAMR Secretariat (Sweden)

Laura Plant

Swedish Research Council (Sweden)
JPIAMR Secretariat

Technical support on site

Magnus Bohman

Swedish Research Council (Sweden)

Danil Lundbäck

Swedish Research Council (Sweden)

Appendix 5 – Communications products and tools

A. Documents and information

- [Registration page](#) with essential information and guidelines documents
- [Contextual backgrounder on AMR and Digital world](#)

B. Videos

Showreels: JPIAMR produced three showreel videos compiling interviews, teams' pitches and images of the Hackathon.

1. [Discover **Hacking AMR 2019**](#)
2. [Pitches from all 7 teams](#)
3. [Winning team interview](#)

Facebook Live Streaming made it possible for interested parties to attend the pitch session remotely and efficiently relayed the level of enthusiasm and energy that went on in the room while providing a great visibility to JPIAMR, JPIAMR-VRI and the funders.



Interviews: Two of the mentors and speakers of this event were interviewed and their videos were posted on YouTube and promoted on social media.

4. [Dr. Till Bachmann – Why is this Hackathon so important?](#)
5. [Dr. Eric Brown - How does he feel coming to **Hacking AMR 2019**?](#)

Twitter Vlogs: Every day of the Hackathon weekend, our consultant did short video messaging (vlog) on Twitter to maintain interest of the followers and announce what the day had in store for all of us at Hacking AMR 2019.

6. [Friday Hacking Health Vlog](#)
7. [Saturday Hacking Health Vlog](#)
8. [Sunday Hacking Health Vlog](#)

YouTube videos: A series of five videos were produced by Hacking Health to provide guidance to participants and mentors prior to the event.

9. [What is a hackathon?](#)
10. [Design thinking](#)
11. [Design thinking pathway](#)
12. [Excellent pitch](#)
13. [What to expect?](#)

C. Collaborations in promotion and dissemination

Several collaborations were instrumental in promoting our event and disseminating results which generated great momentum and visibility.

- [Podcast on Hacking AMR by Eva Garmendia, AMR Studio at Uppsala Antibiotic Centre](#)
- CIHR-Institute of Infection and Immunity (CIHR-III) e-bulletin articles on **Hacking AMR 2019**
- Numerous CIHR and CIHR-III Tweeter posts
- [Blog by John Gregory, Hacking Health Foundation on our event](#)
- [CIHR-III Travel Awards page](#)
- [Call out for mentors from AMR Insight](#)
- [News Item from AMR Insight](#)
- [Mention in the Florey Institute \(UK\) on a participant's bio](#)
- [Article on Karolinska Institutet](#)
- [Article on Cityu Veterinary Diagnostic Lab](#)
- [Article on LäkemedelsVärlden](#)
- Entries on events or news pages of the several stakeholders' websites:
 - [EC Horizon 2020](#)
 - [ECSMID](#)
 - [Swedish Research Council](#)
 - [Beam Alliance](#)
 - [UAC website](#)
 - [Cloud Infrastructure for Microbial Bioinformatics \(CLIMB\)](#)
 - [Centre for Infectious Disease Research and Policy](#)
 - [Health NCP Net 2.0](#)
 - [Lombardia LifeSciences](#)
 - [Hacking Health Foundation](#)

D. Promotional material

We created several promotional materials that were distributed to attendees of the event including a Grand Prize Award, Certificates of accomplishment, Honourable mention Certificates, People's Choice Winners Certificates and, of course, our fabulous T-Shirts.



The JPIAMR and the Planning Committee would like to express our deepest gratitude to funders, participants, mentors, judges, collaborators and everyone that made **Hacking AMR 2019** such a resounding success.



Photo credits:
Eva Garmendia, John Gregory and Laura Plant