Spearhead
Innovating against AMR

SPEARHEAD and beyond: Sustaining the fight against antimicrobial resistance

17.11.2025

Funded by Innosuisse

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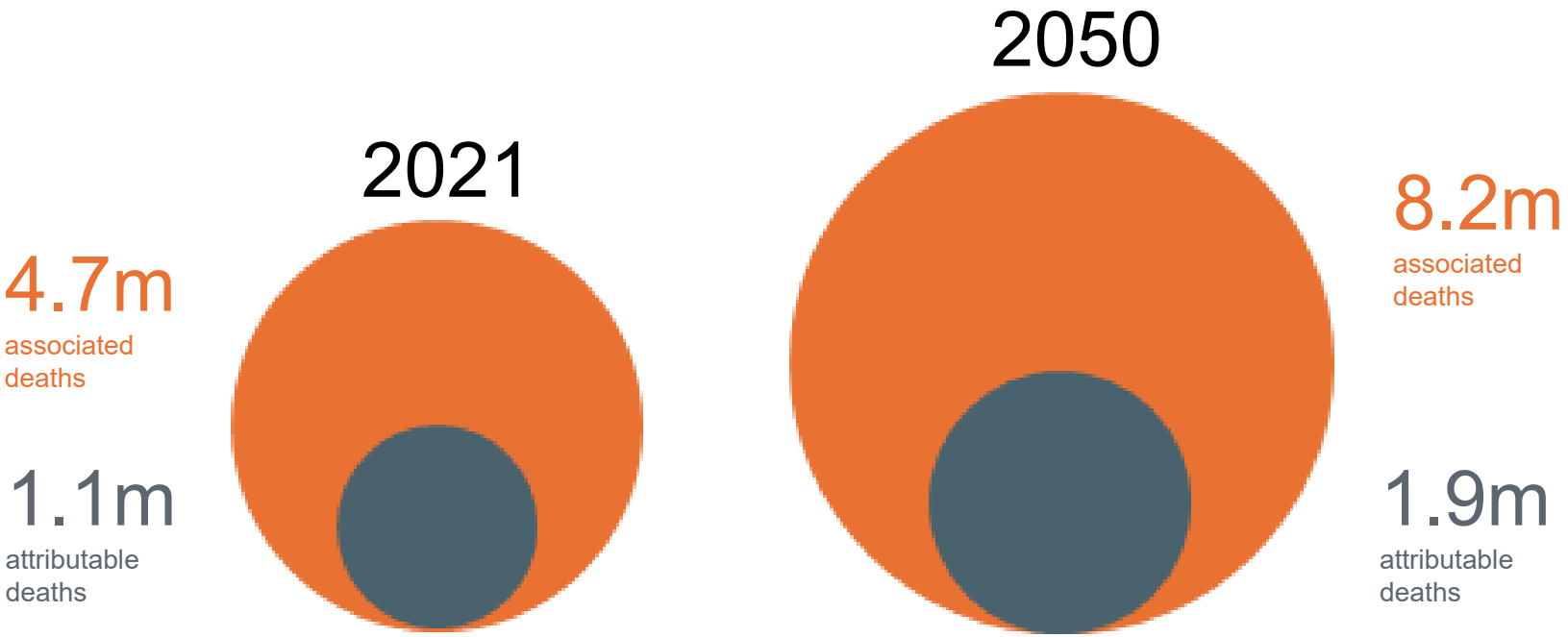
Welcome words

Christoph Nabholz, SwissRe, **Saara Malkamäki**, University of Basel

AMR attributable/associated mortality



Source: VizHub - MICROBE (healthdata.org), accessed November 2025

Swiss Re Life & Health Reinsurance market overview

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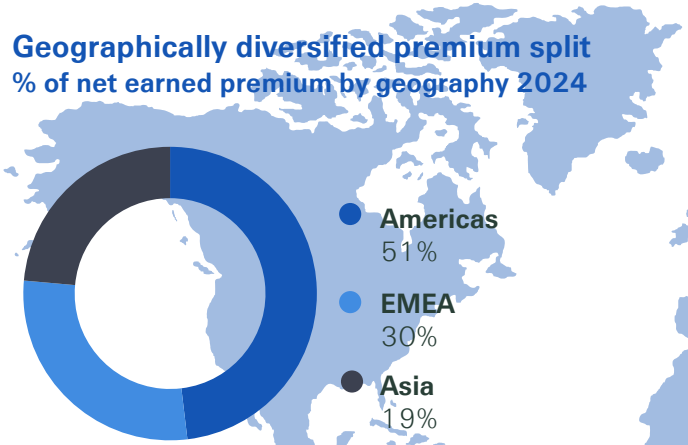

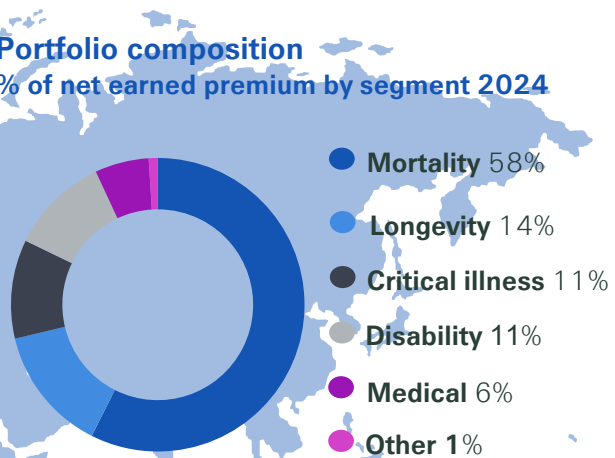

Financial year 2024

earned **USD 17.1 bn** in premiums / fee income

reinsured **212 million** policies

paid out **USD 15.5 bn** in claims

protecting **278 million** people

Swiss Re

SPEARHEAD

A unique 360 digital approach powered by artificial intelligence to fight Antimicrobial Resistance #AMR

Research Services · Allschwil, Basel-Country · 271 followers · 11-50 employees

Douglas & 30 other connections follow this page

Message | ✓ Following | ···

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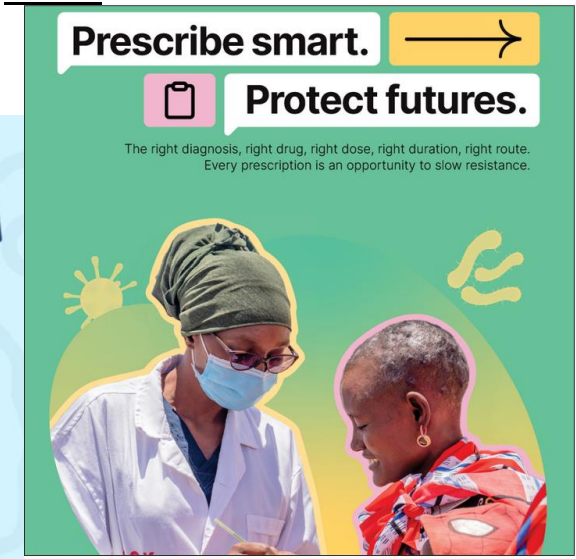
WHO:
https://www.who.int/campaigns/world-amr-awareness-week/2025

SPEARHEAD's LinkedIn page:
linkedin.com/company/spearhead-amr



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09:40-09:45

Voice of Patients

Ginevra Terenghi, University of Applied Sciences and Arts of Southern Switzerland

Voice of Patients

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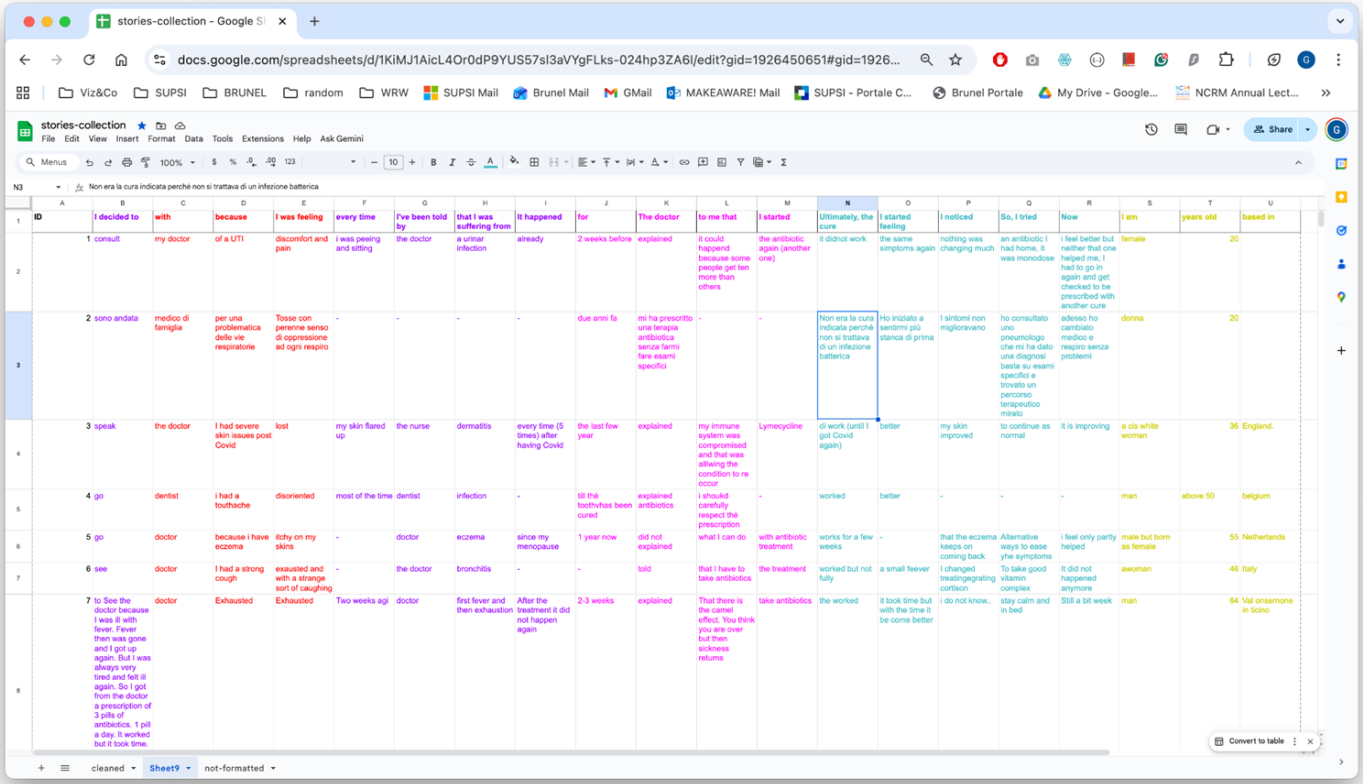
I decided to (go, see, call, text or speak?) – (who have you consulted regarding your sickness?) because (what symptoms did you have?). I was feeling (how were you feeling?) every time (when were the symptoms happening?). I've been told by (who did provide you with the diagnosis?) that I was suffering from (what were you suffering from?). It happened (again or never again?) for (for how long have you suffered?). The doctor (explained or not explained?) to me that (what did the doctor say?). I started (what treatment did you have?). Ultimately, the cure (did the cure work or not?). I started feeling (what effect did the treatment have on you?). I noticed (have you noticed any side effects?). So, I tried (have you looked for any alternatives?). Now (how do you feel?). I am (is there a gender that best describes you?) (how old are you?) , years old , based in (where do you live?).

Voice of Patients

I decided to consult with my doctor (⑩) because of a UTI (✧ UTI: very sad and distressed from the pain, crying every night because the discomfort wouldn fuahf sfhaefhfksf ehfuiehfouiehfi). I was feeling discomfort and pain every time I was peeing and sitting. I've been told by the doctor (⑩) that I was suffering from a urinary infection. It already happened 2 weeks before. The doctor explained to me that it could happen because some people get them more than others. I started the antibiotic again (another one). Ultimately, the cure did not work. I started feeling the same symptoms again. I noticed nothing was changing much. So, I tried an antibiotic (⑤) I had at home, it was monodose. Now I feel better, but neither did that one help me; I had to go in again and get checked to be prescribed another cure. I am female, 20.

Voice of Patients

diagnosis symptoms treatment follow-up demographics



ID	I decided to	with	because	I was feeling	every time	I've been told by	that I was suffering from	It happened	for	The doctor	to me that	I started	Ultimately, the cure	I started feeling	I noticed	So, I tried	Now	I am	years old	based in
1	consult	my doctor	of a UTI	discomfort and pain	i was peeing and sitting	the doctor	a urinar infection	already	2 weeks before	explained	it could happend because some people get ten more than others	the antibiotic again (another one)	it didnot work	the same simptoms again	nothing was changing much	an antibiotic I had home, it was monodose	i feel better but neither that one helped me, I had to go in again and get checked to be prescribed with another cure	female	20	
2	sono andata	medico di famiglia	per una problematica delle vie respiratorie	Tosse con perenne senso di oppressione ad ogni respiro	-	-	-	-	due anni fa	mi ha prescritto una terapia antibiotica senza farmi fare esami specifici	-	-	Non era la cura indicata perché non si trattava di un infezione batterica	Ho iniziato a sentirmi più stanca di prima	I sintomi non miglioravano	ho consultato uno pneumologo che mi ha dato una diagnosi basta su esami specifici e trovato un percorso terapeutico mirato	adesso ho cambiato medico e respiro senza problemi	donna	20	
3	speak	the doctor	I had severe skin issues post Covid	lost	my skin flared up	the nurse	dermatitis	every time (5 times) after having Covid	the last few year	explained	my immune system was compromised and that was allwing the condition to re occur	Lymecycline	di work (until I got Covid again)	better	my skin improved	to continue as normal	it is improving	a cis white woman	36	England.
4	go	dentist	i had a touthache	disoriented	most of the time	dentist	infection	-	till thé toothvhas been cured	explained antibiotics	i shoukd carefully respect thé prescription	-	worked	better	-	-	-	man	above 50	belgium
5	go	doctor	because i have eczema	itchy on my skins	-	doctor	eczema	since my menopause	1 year now	did not explained	what I can do	with antibiotic treatment	works for a few weeks	-	that the eczema keeps on coming back	Alternative ways to ease yhe symptoms	I feel only partly helped	male but born as female	55	Netherlands
6	see	doctor	I had a strong cough	exausted and with a strange sort of caughing	-	the doctor	bronchitis	-	-	told	that I have to take antibiotics	the treatment	worked but not fully	a small feever	I changed treatingegrating cortison	To take good vitamin complex	It did not happened anymore	awoman	46	Italy
7	to See the doctor because I was ill with fever. Fever then was gone and I got up again. But I was always very tired and felt ill again. So I got from the doctor a prescription of 3 pills of antibiotics. 1 pill a day. It worked but it took time.	doctor	Exhausted	Exhausted	Two weeks agi	doctor	first fever and then exhaustion	After the treatment it did not happen again	2-3 weeks	explained	That there is the camel effect. You think you are over but then sickness returns	take antibiotics	the worked	it took time but with the time it be come better	i do not know..	stay calm and in bed	Still a bit week	man	64	Val orsernone in ticino

Voice of Patients

For months I lived with stomach pain and constant bladder infections. Every meal made me anxious because I knew it would hurt again. Doctors kept changing antibiotics and supplements, but nothing really changed. I started realising how much the stress in my life was affecting my body. When I began therapy, I could finally talk about the fear behind the pain. Now I'm learning to listen to myself, and things are slowly getting better.

[P112]

Voice of Patients

While travelling, I started feeling pain when peeing and constant tiredness. I didn’t know where to go or who to ask for help, everything felt unfamiliar. The local doctor didn’t speak much English and gave me antibiotics right away. They helped at first, but I soon felt nauseous and unsure if it was the right cure. Being far from home made it harder to trust what I was told or find clear information. Now I always try to be prepared, drink more water, and look after myself when I travel.

[P32]

Voice of Patients

My doctor said I had another urinary infection and gave me antibiotics. At first they helped, but soon the same symptoms returned. I kept changing medicines and became resistant to one of them. Now I get these infections more often and try to manage them better. It’s tiring but at least I know what signs to watch for.

[P21]

Voice of Patients

I ended up in the hospital because the pain in my belly was unbearable. They said it was just a urinary infection and gave me antibiotics. I got weaker every day, my throat and skin started to burn. A healer finally told me to see a urologist, and they found a stone. After the surgery I recovered, but it took years to feel normal again.

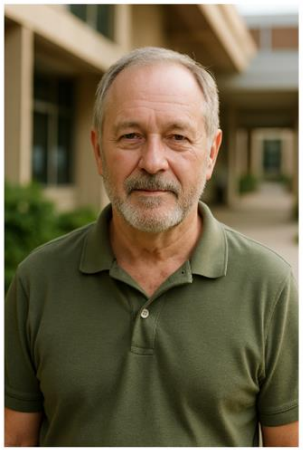
[P16]

Voice of Patients

[P112]

[P32]

[P21]



[P16]

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09:45-10:10

Keynote: Reducing the 80% - a community healthcare perspective on AMR

Gail Hayward, Nuffield College, Oxford University

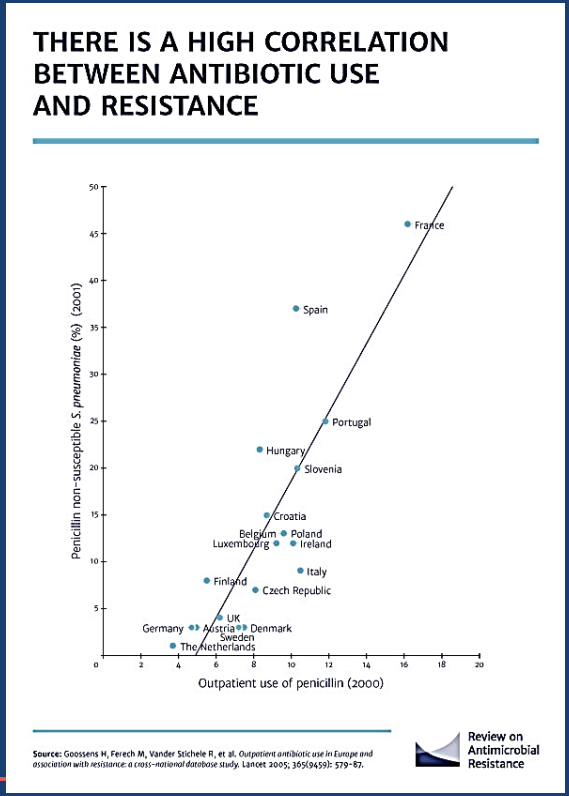
NIHR | HealthTech Research Centre Community healthcare

Reducing the 80% - a community healthcare perspective on AMR

Professor Gail Hayward
Director, NIHR Community Healthcare Healthtech Research Centre
Nuffield Dept of Primary Care Health Sciences, University of Oxford

Antimicrobial stewardship challenges in community care

- Frontline gatekeepers ~ 90% of UK NHS contacts
- Approximately 80% of all antibiotic prescriptions – at least 20% inappropriate
- Antibiotic prescriptions in community settings drive resistant infections and hospitalisations



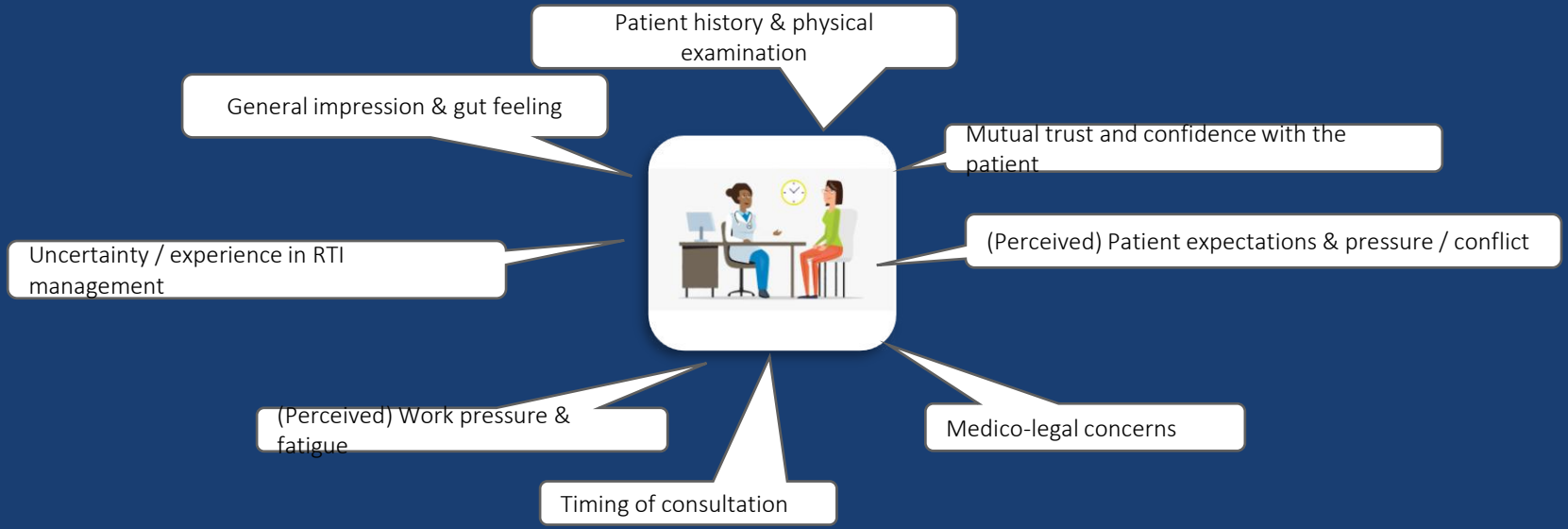
Acute Respiratory Tract Infections

- Acute Respiratory Infections (ARIs) such as cough and sore throat account for 46% of antibiotics prescribed in primary care
- Most infections are self-limiting, including bacterial infections
- Randomised Trials have shown that antibiotics offer no benefit over placebo for children and younger adults with lower respiratory tract infection
  - acute uncomplicated LRTI judged to be infective in origin, excluding patients where pneumonia was suspected clinically
  - Older adults trial 'AFLOAT' currently recruiting

- ARI presentations across European countries **do not differ significantly,** however antibiotic prescribing does.

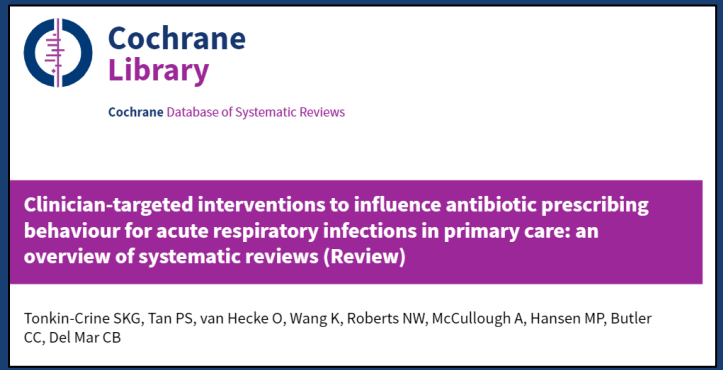
Antibiotic prescribing is a behaviour

- Multiple influences on clinician antibiotic prescribing behaviour.
- To change behaviour you need to target these influences

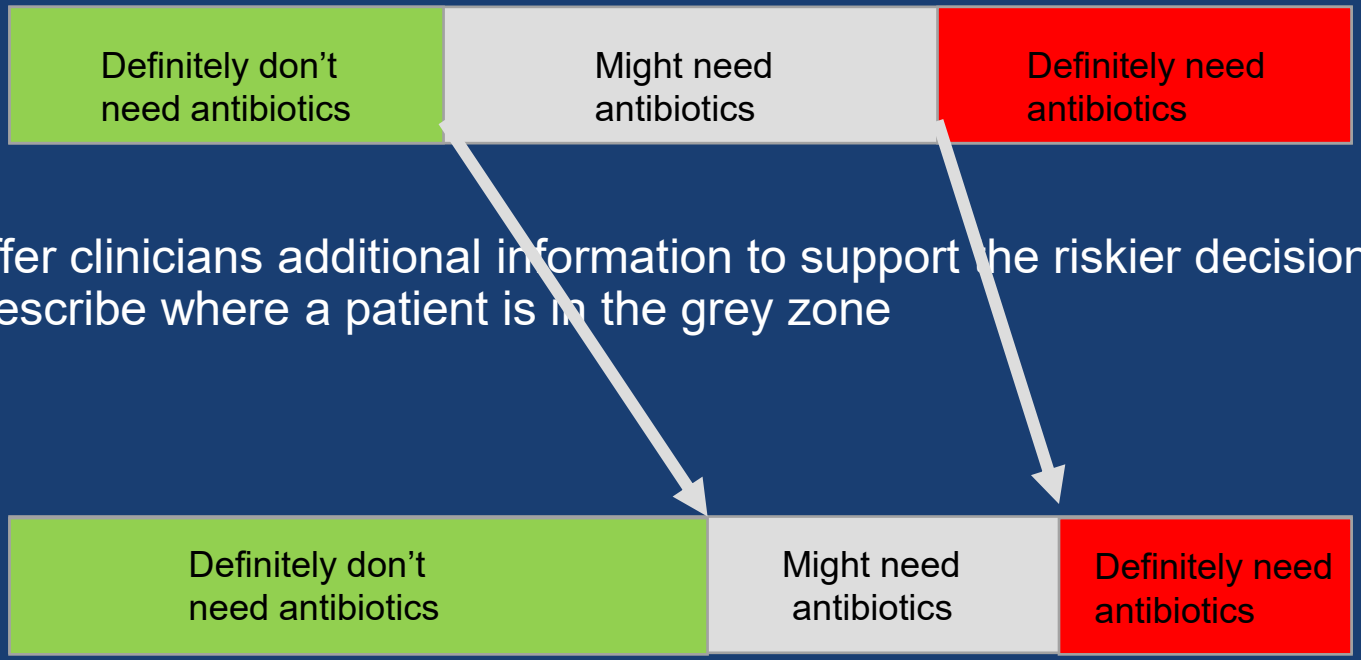


Behaviour change interventions

- Audit and feedback
- Enhanced communication skills training for clinicians
- Reminders/computer pop-ups
- Patient information leaflets
- Educational meetings/outreach visits for clinicians
- **Diagnostics**
- Shared decision making aids
- Financial incentives
- Delayed prescriptions
- Mass media campaigns



Diagnostics may not change behaviour in the way we might hope…



- Offer clinicians additional information to support the riskier decision Not to prescribe where a patient is in the grey zone

However in research..

- Observed to
  - help reassure clinicians and patients about NOT prescribing when that was already the clinical decision,
  - prompt clinicians to prescribe when they might not have without the test result

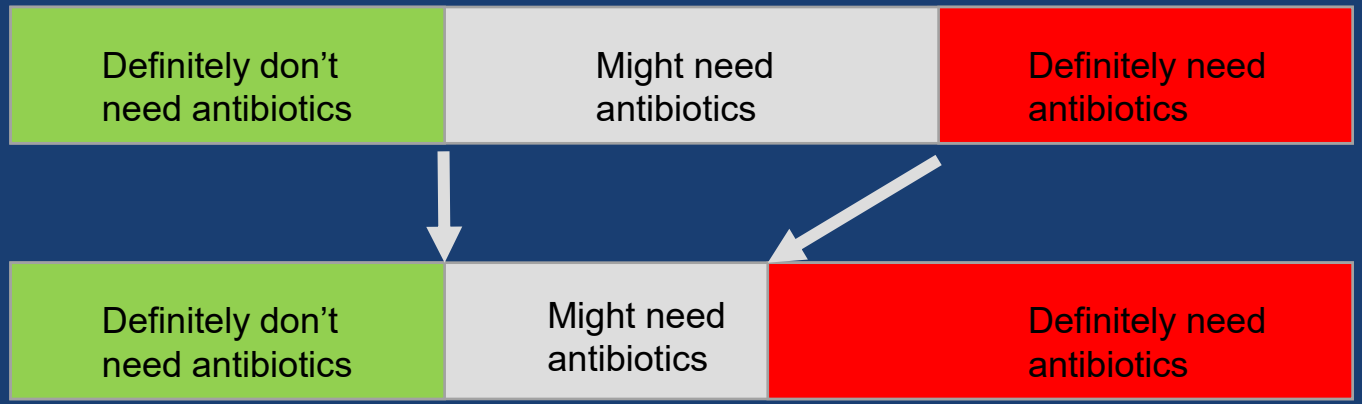
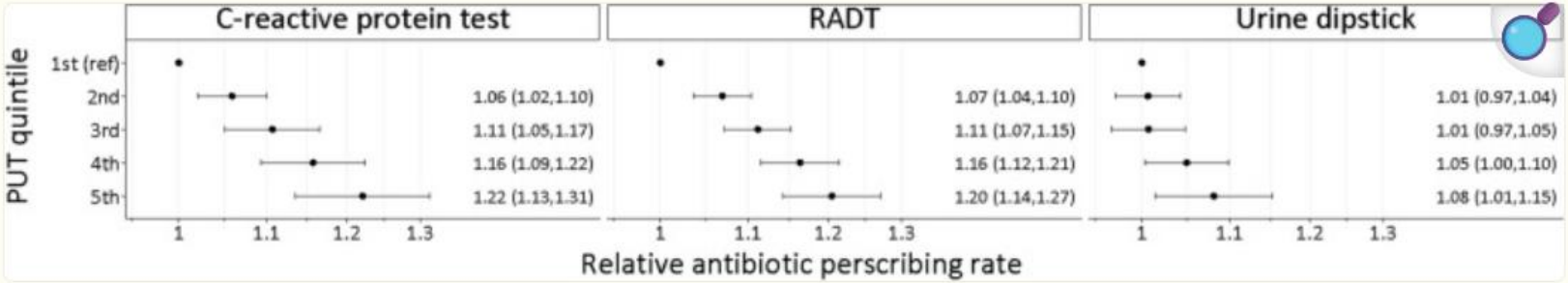


Fig. 4.



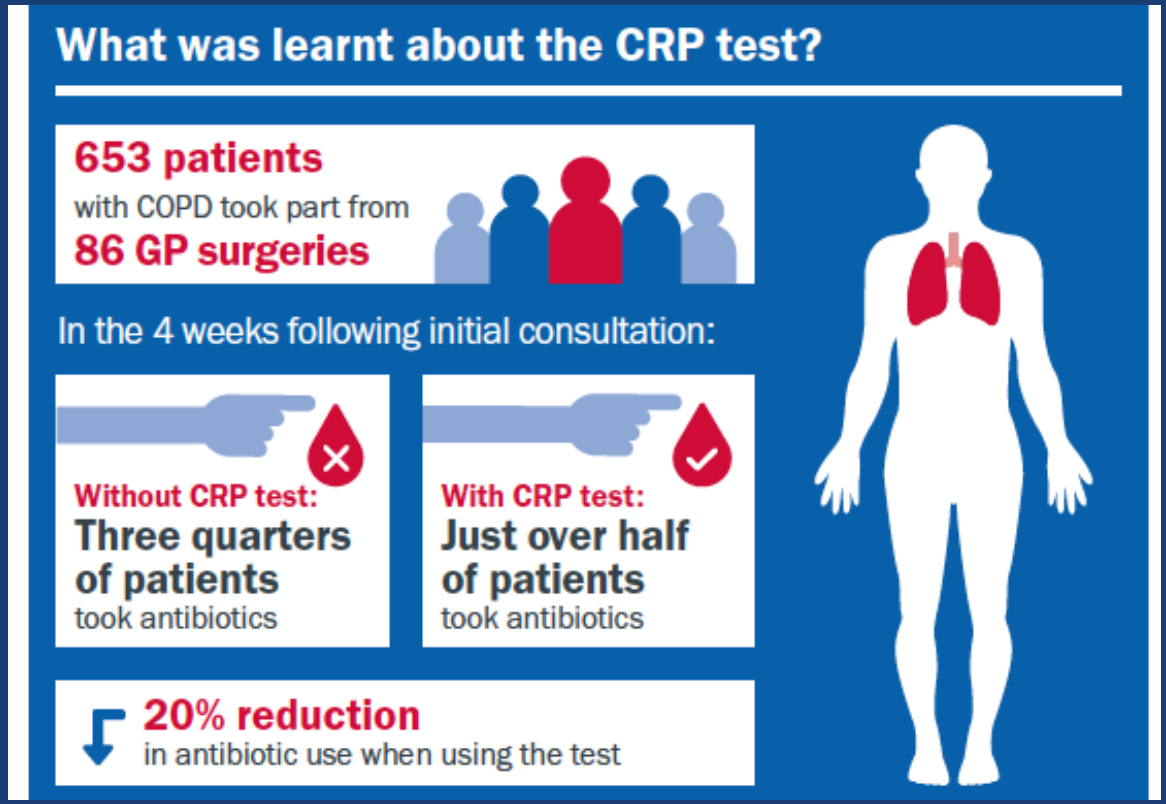
Christensen LD, Vestergaard CH, Keizer E, Bech BH, Bro F, Christensen MB, Huibers L. Point-of-care testing and antibiotics prescribing in out-of-hours general practice: a register-based study in Denmark. BMC Prim Care. 2024 Jan 23;25(1):31.

Opportunities – Acute Respiratory Tract infection

- Contexts where most patients currently get antibiotics
  - COPD
  - Epidemic GAS / Pharmacy First

- Positive identification of viral respiratory pathogens

PACE study


What was learnt about the CRP test?
653 patients
with COPD took part from
86 GP surgeries
In the 4 weeks following initial consultation:
Without CRP test:
Three quarters of patients
took antibiotics
With CRP test:
Just over half of patients
took antibiotics
20% reduction
in antibiotic use when using the test

Epidemic infections

Pharmacy led sore throat test and treat service

- Of 27441 STTT consultations in a year, 9308 (33.9%) occurred during December 2022.
- Following announcement of increased iGAS incidents,
  - **increase** of 1700 consultations
  - **decrease** in supply rate of 13.9 antibiotics per 100 RADT (95% CI: −18.40 to −9.40).. Referral rates to other primary care or emergency settings remained below 10% throughout the study period

Mantzourani E, et al A pharmacy-led sore throat test and treat (STTT) service: antigen testing and antibiotic supply rates during the period of heightened public awareness of Group A Streptococcus infections. J Antimicrob Chemother. 2024 Feb 1;79(2):354-359.

Positive identification of viral respiratory pathogens

RAPID-Dx - RCT comparing viral diagnostic panel guided care to usual care for RTI now complete and pending publication…

Combining different types of tests? PRUDENCE RCT comparing combined biomarker and pathogen POCT guided care to usual care now complete and pending publication

Future approaches to ARI

Prognostics – when are antibiotics needed to avoid complications and hospitalisation from bacterial infection, and when will the body resolve this on its own?

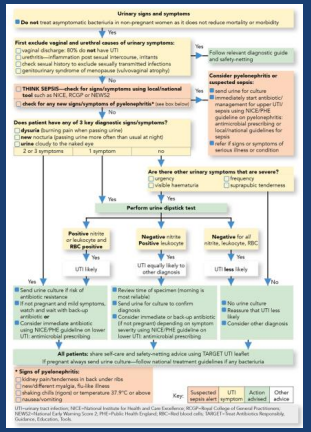
Better prevention / early treatment to avoid the need for healthcare contact ‘the best way to avoid an antibiotic is to avoid meeting a prescriber’

Opportunities: Urinary Tract Infection

- 6 million antibiotics prescribed for UTI in the UK annually
- Multidrug resistance is rising and has implications wider than ‘simple’ UTI – urosepsis, pyelonephritis
- Costs of UTI management £604 million in 2023-24 in the UK

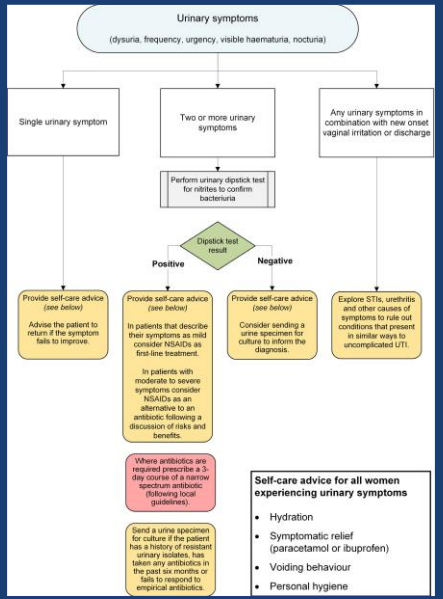
How do GPs currently decide who needs antibiotics?

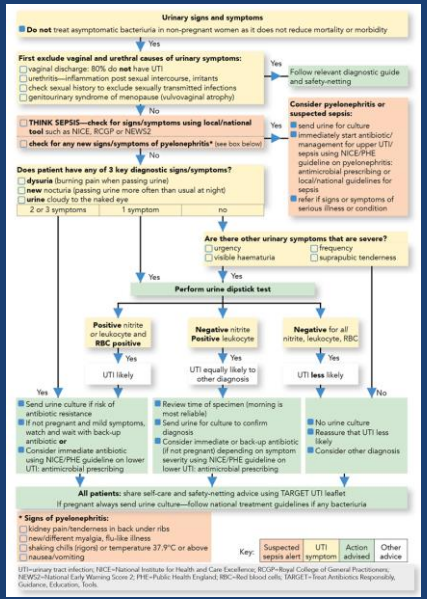
- Diagnostic Algorithms
- Dipstick
- Culture



How well do UK guidelines predict UTI?

We asked this question using data from 1062 women aged 18+ with suspected uncomplicated UTI





- SIGN guidance
  - hardly any women with a negative urine culture received antibiotics,
  - BUT only 13.7% of women with a positive culture received antibiotics

- UKHSA guidance
  - 81% of all women with positive culture received antibiotics,
  - BUT 61% of all women with negative culture received antibiotics

Conclusion: with symptoms and urine dipstick alone it is probably not possible to accurately predict urine culture

Fanshawe TR, et al Evidence-based appraisal of two guidelines for the diagnosis of suspected, uncomplicated urinary tract infections in primary care: a diagnostic accuracy validation study. J Antimicrob Chemother. 2023 Aug 2;78(8):2080-2088..

Dipstick

- Qualitative = interpretation can vary
- Multiple variables = unclear how to interpret
- Diagnostic performance poor in primary care
- Women with negative dipsticks randomised to antibiotics have more rapid symptom resolution

Urine Culture – an imperfect reference standard diagnostic

- Long delay to receiving the result: Patients often don't receive the result until antibiotic course complete
- 30% contaminated = clinically useless
- Cannot distinguish between infection and asymptomatic bacterial carriage
- May miss potential infecting bacteria

UTI Point of Care Tests

- Information available rapidly enough to guide prescribing – a point of prescription diagnostic
- Possibly….reduced risk of contamination because of immediate testing

How could point of care tests help?

- Bacterial presence and identification – by genetic markers or by imaging
  - Avoiding unnecessary antibiotics
  - Ensuring clinician considers alternative diagnoses (endometriosis, STIs, cancer)

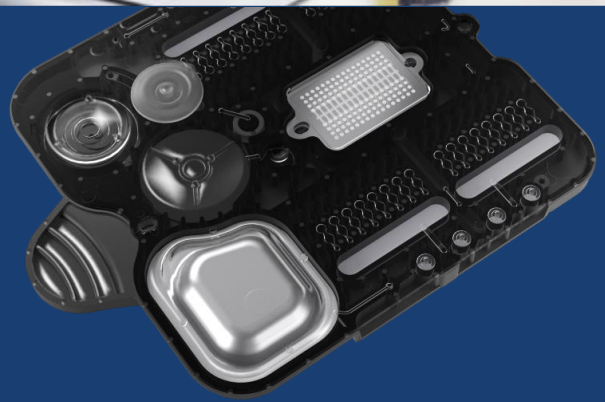
How could point of care tests help?

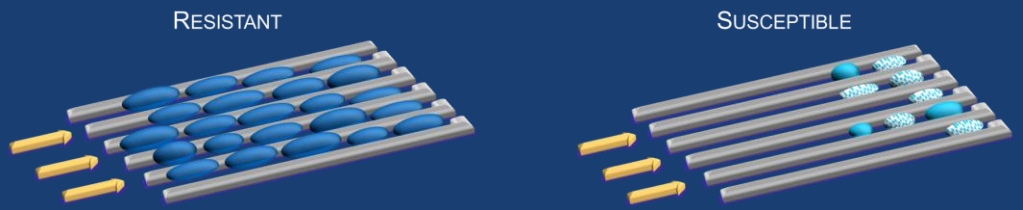
Antibiotic susceptiblity

- Ensures the antibiotic choice is guided by phenotypic susceptibility rather than guesswork based on regional data
- Supports usage of narrower spectrum antibiotics with less side effects which cannot be prescribed empirically

Sysmex-Astrego PA-100 AST

- Provides results in 30 - 40 min
- Estimates bacterial load in urine (CFU)
- Conducts an Antibiotic Susceptibility Test (AST)

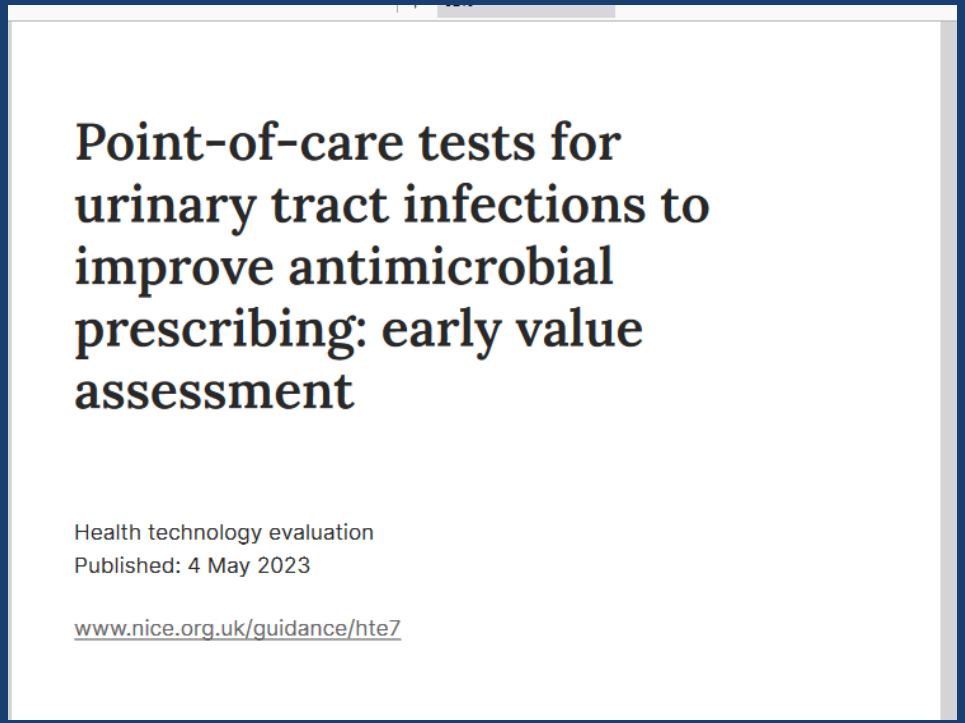




Host response

- Could overcome the challenge of distinguishing asymptomatic carriage from infection
  - particularly relevant for patients who do not experience or communicate typical symptoms
- We found: 66 biomarkers have been tested in 37 studies, no convincing evidence to date
-

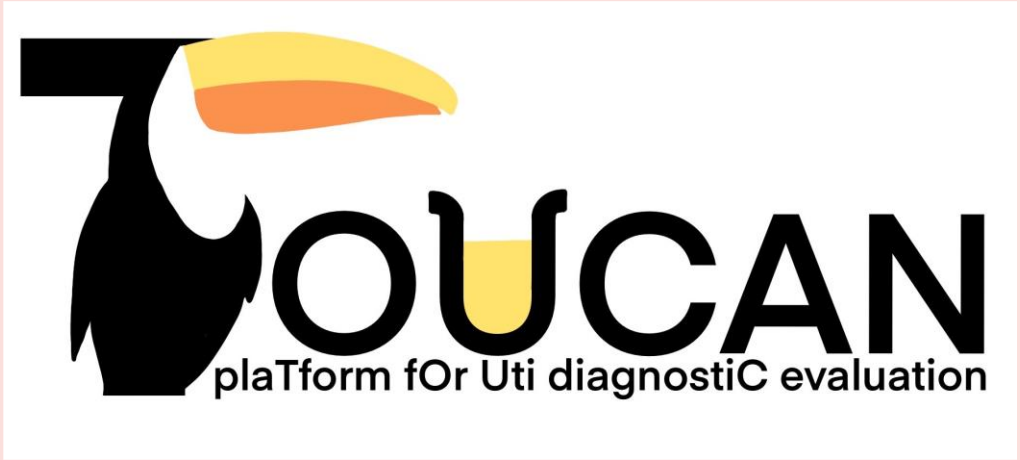
Why aren’t these tests already guiding care?



Point-of-care tests for urinary tract infections to improve antimicrobial prescribing: early value assessment

Health technology evaluation
Published: 4 May 2023

www.nice.org.uk/guidance/hte7


TOUCAN
plaTform fOr Uti diagnostiC evaluation

Platform diagnostic accuracy study

- Women can produce lots of urine..
- Efficient: Allows multiple diagnostics to be evaluated simultaneously with sample sizes appropriate for the performance and diagnostic capabilities
- Flexible:
  - Provides definitive diagnostic performance information for diagnostics in final form and close to market
  - Allows early stage diagnostic developers to obtain valuable clinically phenotyped R and D samples to inform their development
- Overcomes issues with the reference standard by using multiple tests in parallel.

TOUCAN
plaTform fOr Uti diagnostiC evaluation

- Adult Women presenting with suspected uncomplicated UTI
- Up to 3 point of care diagnostics performed on the sample
- Enhanced reference standard testing in a central study laboratory
  - Currently: >1000 women recruited, 4 tests evaluated and pending publication, 3 tests joining the platform in 2026
  - Looking for more industry partners..

Clinical effectiveness individually randomised trial in set up

evolution

Towards a future of diagnostic enhanced primary care stewardship

- Better evidence, ideally generated in efficient platform studies
- Economic arguments which take into account
  - Budget silos
  - A future without antibiotics
- Laboratory / clinical engineering / primary care partnerships to ensure safe successful primary care deployment
- Holistic behavioural implementation approaches to ensure they are used long term

Ideas / questions / want to collaborate?

- Gail.hayward@phc.ox.ac.uk

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10:10-10:35

Keynote - Current and future policies in AMR

Barbara Schedler Fischer, Federal Office of Public Health (FOPH), Switzerland's Ambassador for Global Health

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11:30-12:10

SPEARHEAD project: Summary and Results

Saara Malkamäki, **Hailey Kim**, University of Basel, **Christoph Meier**, University Hospital Basel (USB), **Lina Aerts**, UKBB, **Daniele Malpetti**, SUPSI Dalle Molle Institute for Artificial Intelligence (IDSIA) **Gilbert Greub & Alexandre Delfino**, Centre Hospitalier Universitaire Vaudois (CHUV), **Serena Cangiano**, SUPSI Design Institute, **Mark Lambiris**, European Center of Pharmaceutical Medicine (ECPM)









Why SPEARHEAD?

To tackle silent pandemic of **antimicrobial resistance** with research-based **digital solutions** & **patient-centric** approach, addressing **stewardship** and **prevention**

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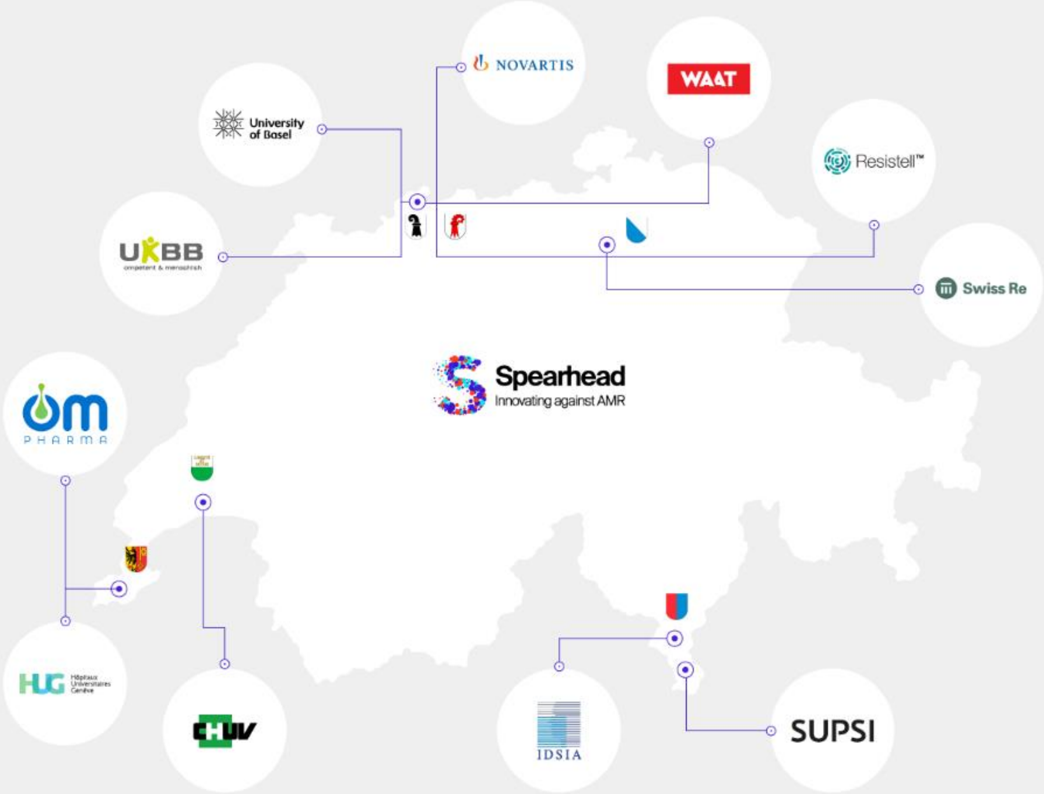
A unique Swiss-wide partnership between research & industry



Supported by: GARDP Global Antibiotic Research & Development Partnership | NCCR AntiResist | SWICA | UNIVERSITÉ DE GENÈVE | USI Università della Svizzera italiana

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OUR GOALS

Spearhead will leverage big data, machine learning, rapid diagnostics and digital media to help doctors make quick and effective treatment choices, and patients and citizens to become more confident in the usage of antibiotics.

Holistic approach to tackle AMR

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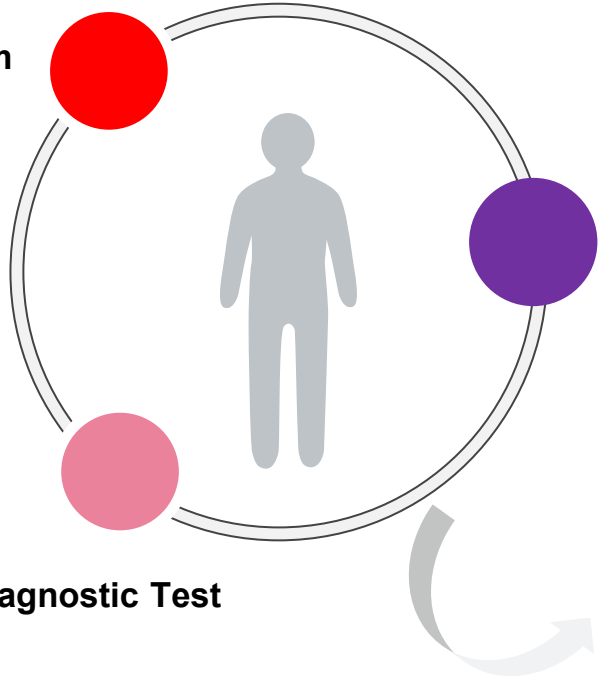
Prevention → **Stewardship**

SP1 **Real-time Monitoring System**

Federated Data Network

SP2 **Risk Prediction Model**

Advanced Rapid Diagnostic Test



SP3 **Civic Engagement**

SP4 **Health-economic Impact**

SP1: Real-Time Monitoring System: The Problem

30-35% of inpatient receive an antibiotic

30-60%
Rates of inappropriate antibiotic use in the tertiary care setting

Reasons for inappropriateness (examples):
- inappropriate indication
- inappropriate spectrum
- inappropriate dosage
- inappropriate duration
- intravenous to oral switch possible

Clinical Pharmacy:
Current ward round activities:
≈ 280 patients/month

Moulin et al. Antimicrobial Resistance & Infection Control (2022) 11:66, Point prevalence study of antibiotic appropriateness and possibility of early discharge from hospital among patients treated with antibiotics in a Swiss University Hospital
Gürtler et al. Swiss Med Wkly. 2019;149:w20135; Appropriateness of antimicrobial prescribing in a Swiss tertiary care hospital: a repeated point prevalence survey

SP1: Real-Time Monitoring System: The Innovation → DrugAlert

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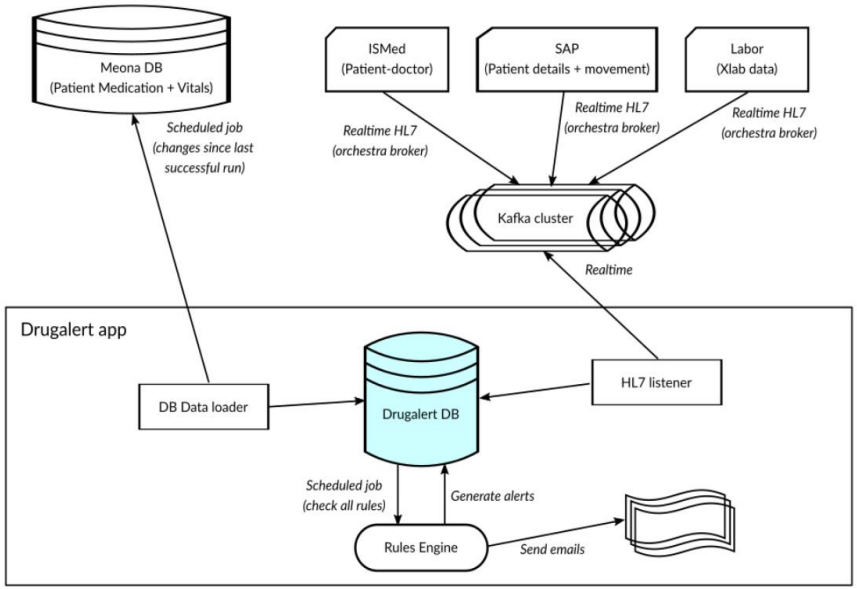
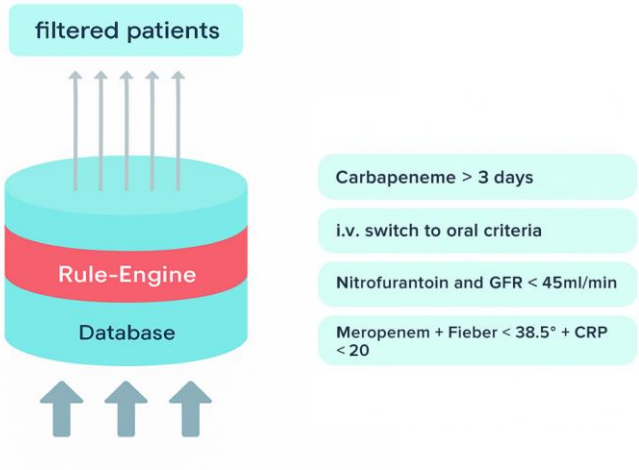
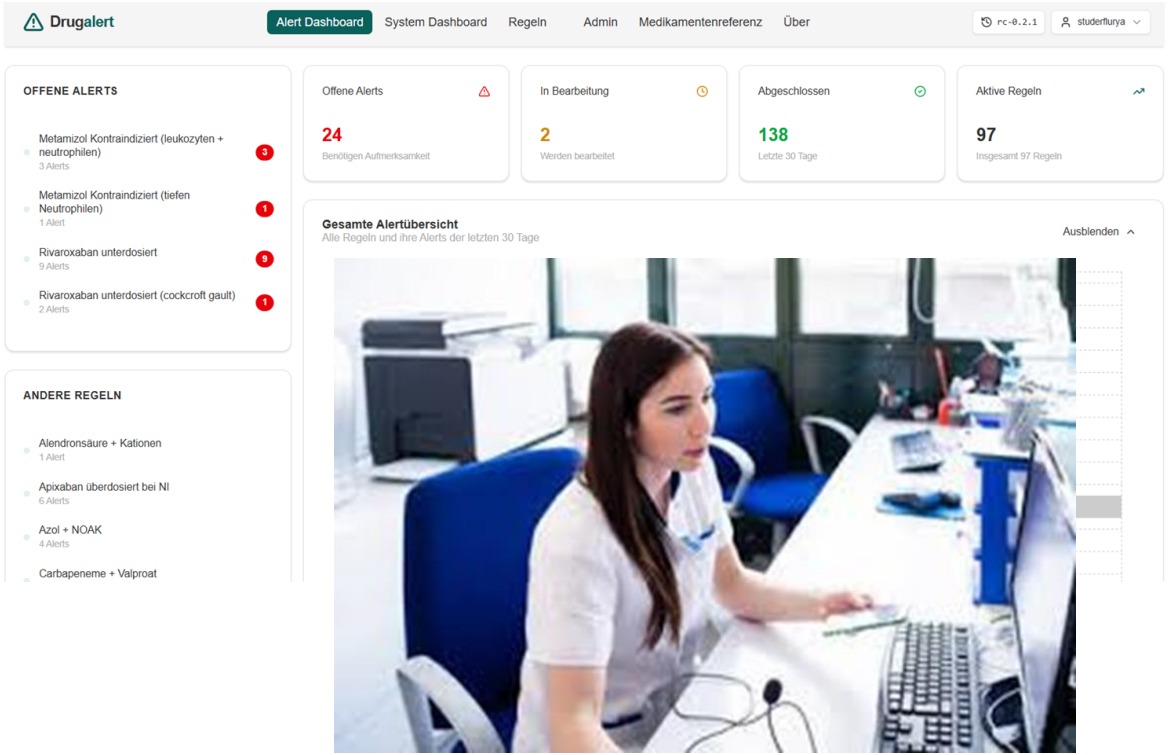
Backend



Frontend



SP1: DrugAlert: Key Results



Retrospective Analyses:
- 50% of inpatient receive at least 1 antibiotic
- 70% inital therapy remain unchanged

Prospective study:
- Intravenous to oral switch
- Inappropriate Duration

Mar-Aug 2025

> 18 years with UTI or pneumonia on internal medicine

Included records N = 363
- i.v. to oral switch N=213
- Duration N = 150

Ongoing analyses

Notification as Inhouse-Medical Device →

SP1: DrugAlert: what's next

- Inhouse - Expansion to other medication and clinics
- Microbiological testing as a mandatory procedure for the approval of an antibiotic therapy?

- Expansion to other institutions outside our hospital?

→ CE - Certification as Medical Device is needed

- IT Partner?
- Start-up's?
- Partner in Health Care or Health policies?

SP2b—NANOMUR

Rapid Antibiotic Susceptibility Testing for Urinary Tract Infections Using Innovative Nanomotion Technology

Alexandre Delfino, MD-PhD candidate

Prof. Gilbert Greub

Presentation in pair—Role play:

Alexandre Delfino as microbiologist

Gilbert Greub as physician

Background—Antibiotic Susceptibility Testing (AST)

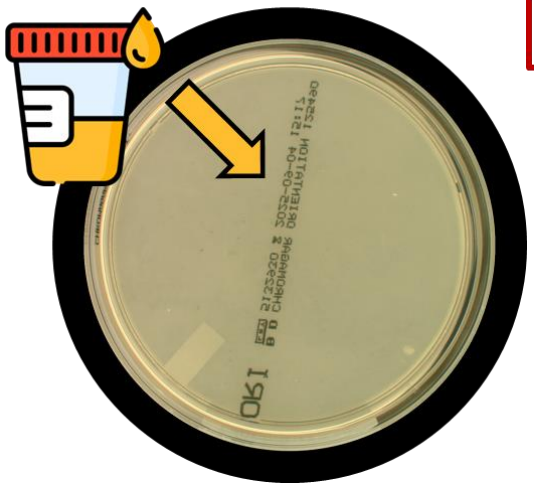
Culture

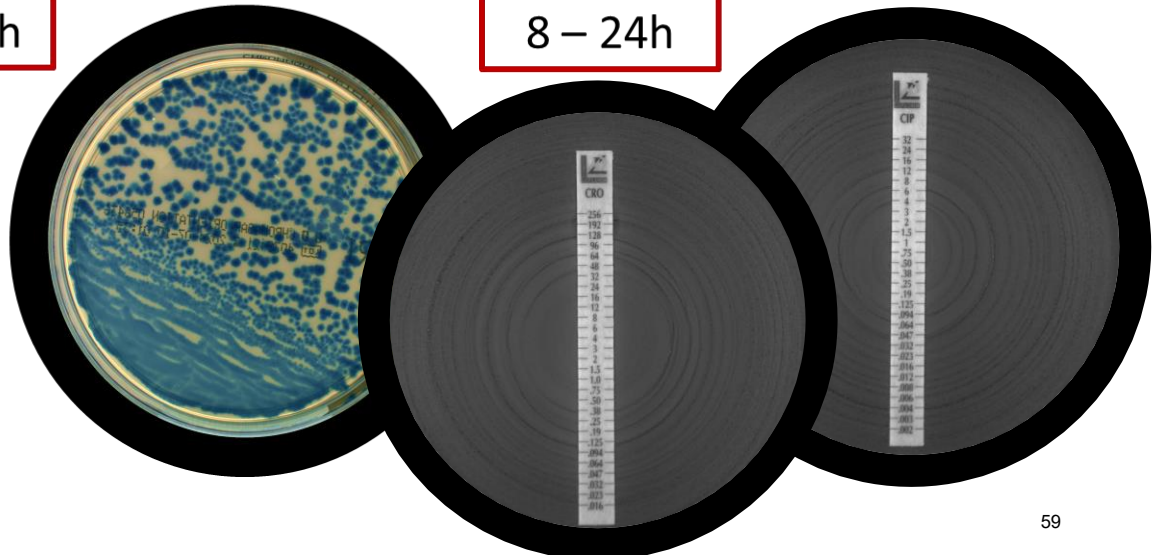
16 – 24h

Identification

8 – 24h

AST

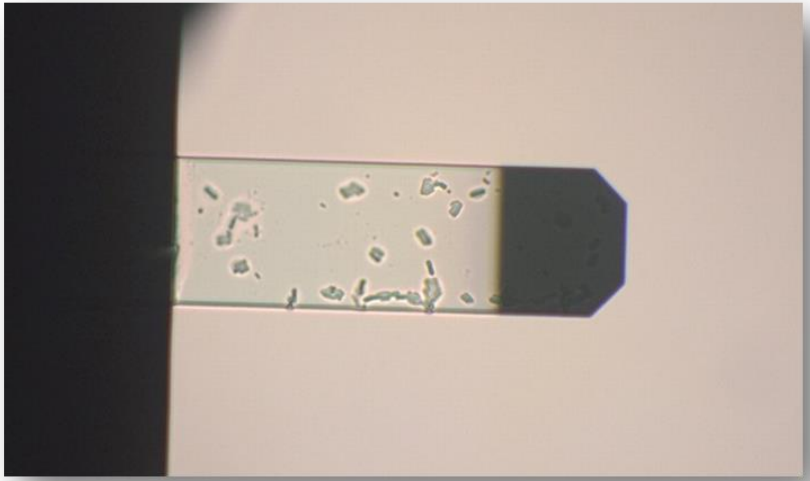




Background—Antibiotic Susceptibility Testing (AST)

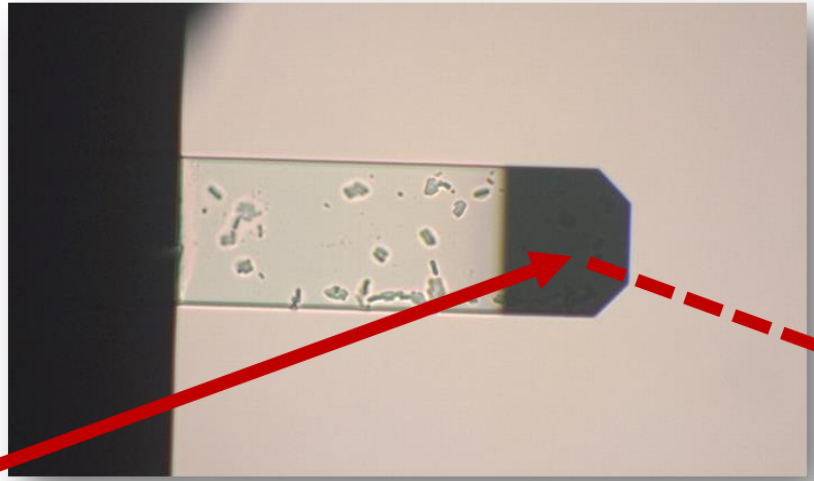
Total time-to-result ≈ 34 hours

Background—Nanomotion



Rectangular cantilever at microscopy

Background—Nanomotion



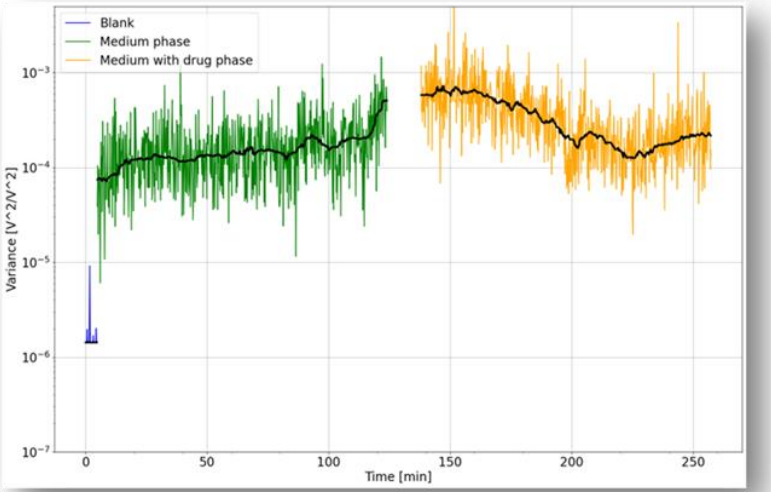
Rectangular cantilever at microscopy

Light source

Detector

=

Results—Time-to-result



Nanomotion Recording N004 - CRO

- **Blank phase** = medium only (LB ½)
- **Bac phase** = medium + bacteria
- **Drug phase** = medium + bacteria + antibiotic

Results—Time-to-result

Total time-to-result ≈ 4.5 hours

nature communications

Article

https://doi.org/10.1038/s41467-024-46213-y

Accurate and rapid antibiotic susceptibility testing using a machine learning-assisted nanomotion technology platform

Received: 1 June 2023

Accepted: 16 February 2024

Published online: 18 March 2024

Check for updates

Alexander Sturm[1], Grzegorz Jóźwiak[1], Marta Pla Verge[1], Laura Munch[1], Gino Cathomen[1], Anthony Vocat[1], Amanda Luraschi-Eggemann[1], Clara Orlando[1], Katja Fromm[1], Eric Delarze[1], Michał Świątkowski[1], Grzegorz Wielgoszewski[1], Roxana M. Totu[1], María García-Castillo[2], Alexandre Delfino[3], Florian Tagini[3], Sandor Kasas[4,5], Cornelia Lass-Flörl[6], Ronald Gstir[6], Rafael Cantón[2,7], Gilbert Greub[3,8] & Danuta Cichocka[1,8]

Results—Performance

- Trained on 81 urine samples (10 R)
- 3-fold cross-validation

Professor
Oliver Y. Chen

PhD student
Duy-Cát Cấn

	Precision	Sensitivity	F1 score	Accuracy	Specificity
Random Forest	95.83	97.18	96.50	93.83	70.00
SVM	89.87	100.00	94.67	90.12	20.00
Logistic Regression	93.33	98.59	95.89	92.59	50.00
Gradient Boosting	95.89	98.59	97.22	95.06	70.00
MLP	97.18	97.18	97.18	95.06	80.00

Conclusions

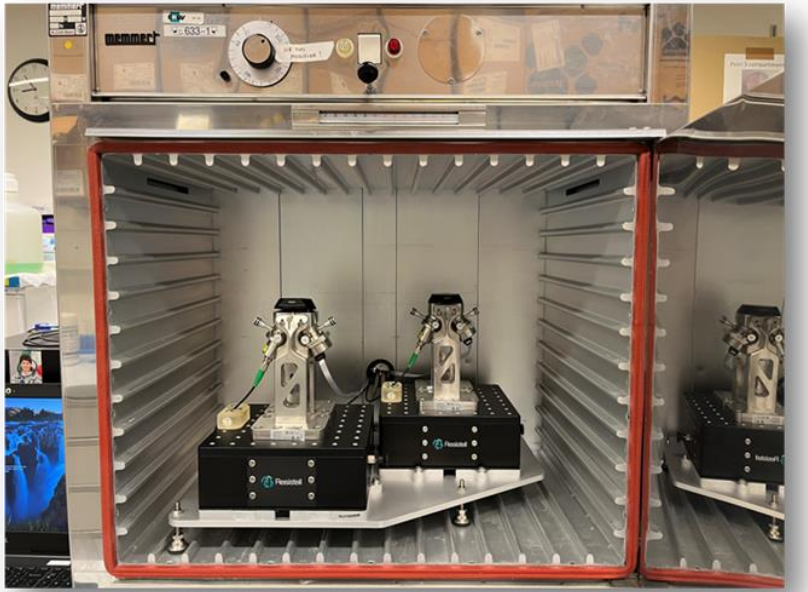
- Nanomotion is > 30 hours faster
- Performance is good
  - Depends on the machine-learning model

Conclusions

- Nanomotion is > 30 hours faster
- Performance is good
  - Depends on the machine-learning model

Future work

- Nanomotion experiment at 37°C
- Reducing recording time to 2 hours



Nanomotion device in incubator.

Acknowledgments

Prof. Greub's lab

Alexandre Delfino
Dr. Amanda Luraschi
Dr. Maria Georgieva
Solange Matos
Sébastien Aeby

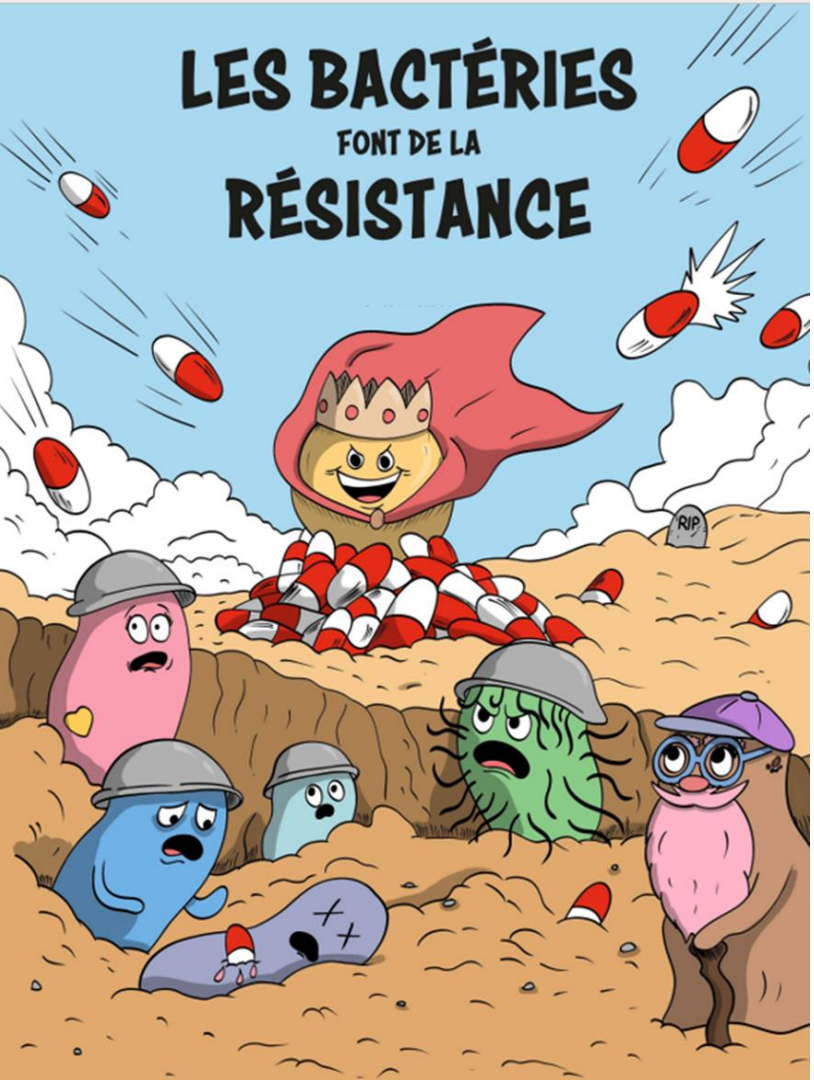
Prof. Chen's group

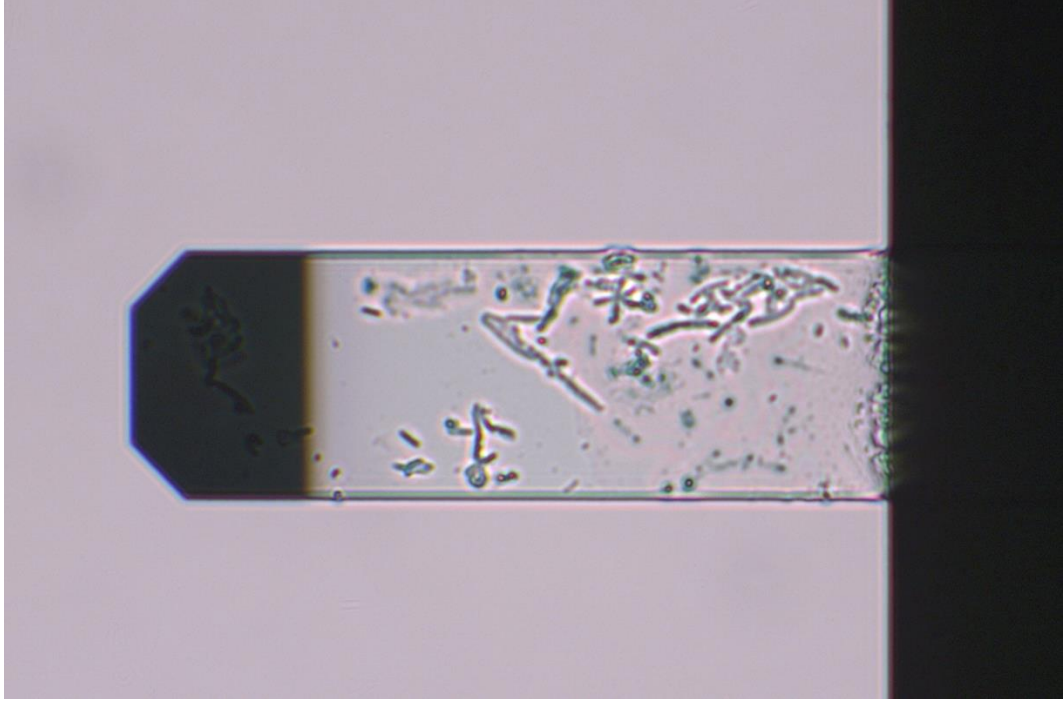
Professor
Oliver Y. Chen

PhD student
Duy-Cát Cấn

Resistell™

Dr. Alex Sturm
Dr. Danuta Cichocka





Thank you for your attention!

Les bactéries font de la résistance
C. Aubry et G. Greub
EPFL Press, 2026

SP2a - Risk prediction

Predicting antibiotic resistance risk in urinary tract infections using machine learning to support smarter empirical prescribing in hospitalised children and adults.

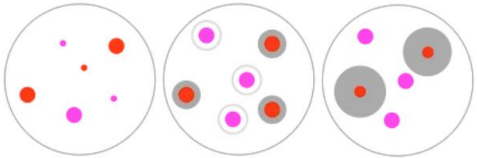
Daniele Malpetti and Lina Aerts

Clinical challenges in empiric antibiotic prescriptions for patients with UTI

Rapid decisions without susceptibility data

AB prescription needs to be **personalized** and take into account the medical history of the patient.

AB prescription based on the **antibiotic susceptibilities** of the infecting pathogen (antibiogram requires 48-72 hours).



Can a data-driven solution support more targeted empiric use of antibiotics?

SP2: Risk prediction model from clinical data

Spearhead
Innovating against AMR

Can antibiotic resistance be effectively predicted based solely on **patient history** and routinely performed **laboratory tests**?

Evidence from literature

SCIENCE TRANSLATIONAL MEDICINE | RESEARCH ARTICLE

ANTIBIOTICS

A decision algorithm to promote outpatient antimicrobial stewardship for uncomplicated urinary tract infection

Sanjat Kanjilal[1,2], Michael Oberst[3], Sooraj Boominathan[3], Helen Zhou[4], David C. Hooper[5], David Sontag[3]*

nature medicine | ARTICLES

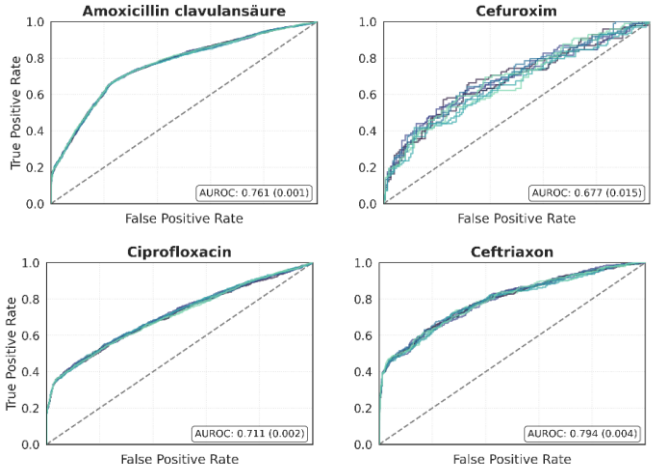
https://doi.org/10.1038/s41591-019-0503-6

Personal clinical history predicts antibiotic resistance of urinary tract infections

Idan Yelin[1], Olga Snitser[1], Gal Novich[2], Rachel Katz[3], Ofir Tal[4], Miriam Parizade[5], Gabriel Chodick[3,6], Gideon Koren[3,6], Varda Shalev[3,6] and Roy Kishony[1,2,4]*

Predictive performance is promising.

Evidence in our data (USB)



But key questions remain: are there differences between **men** and **women**, between **adults** and **children**, or across other patient **subgroups**?

SP2: Risk prediction model from clinical data

Spearhead
Innovating against AMR

In adults, **past resistance** emerges as the strongest predictor of future resistance.

Across adults, being **male** consistently appears as a higher-risk factor than being female.

Pregnancy status also emerges as a relevant predictor contributing additional risk signals.

In children, **limited data** availability leads to weaker and less stable model performance.

In children, resistance history loses prominence, and **lab variables** become more influential.

Models trained on adults **generalize** to children, yielding reasonably good predictions.

Manuscript in preparation.

SP2: Risk prediction model from clinical data

SPEARHEAD AMR for UTI online predictor

Variable	Value
Age	49
Sex	F
Previous UTI	Yes
Variable 4	...
Variable 5	...
Variable 6	...

Calculate >> | Clear

Predicted resistance risk

Nitrofurantoin	20%
Fosfomycin	31%
Cefuroxime	44%

Watch & wait

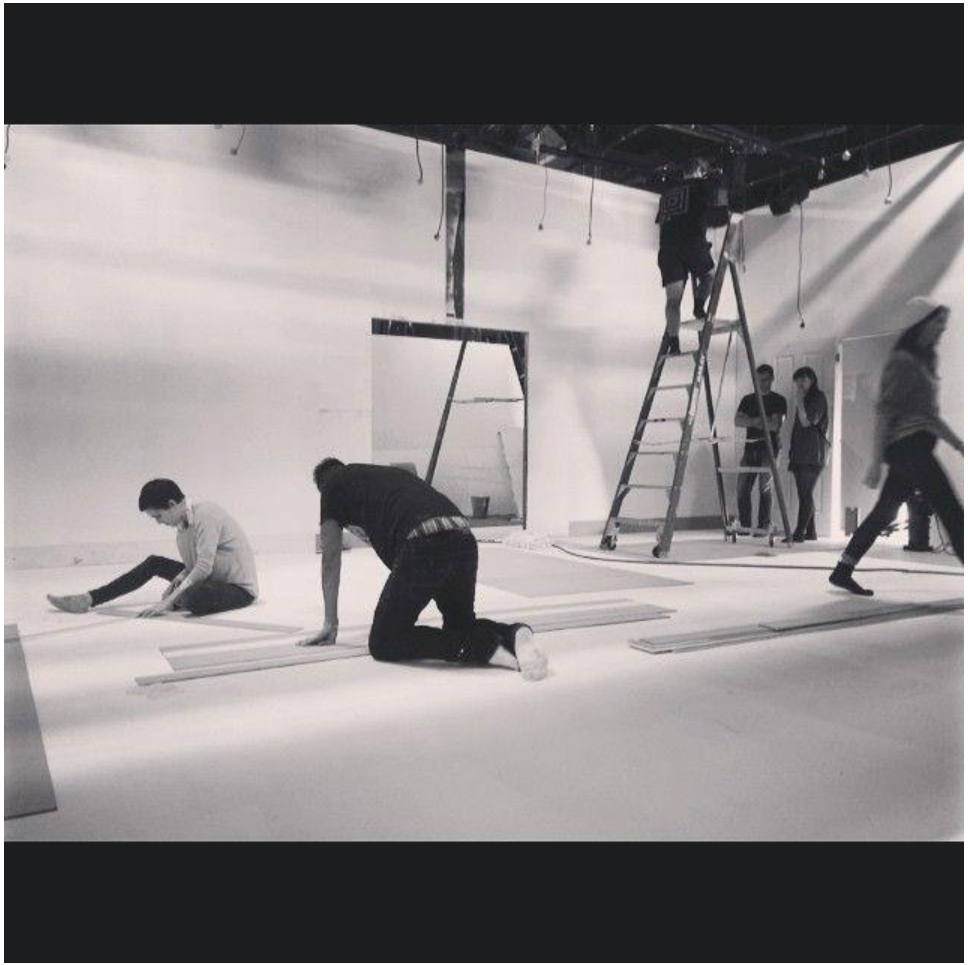
Spearhead
Innovating against AMR

A web interface to support clinicians with predicted resistance.

Use of a limited number of widely available clinical variables.

Currently under development.

Behind The Scenes



From vision to practice
– Building bridges for ethical AMR stewardship

Equity	Diversity & Inclusion	Fairness	Trustfulness
Fair representation across regions & communities	Multiple voices and perspectives shape the system	Privacy protected by design	Trust and communication between the people who build, regulate, and use it

Stakeholder journey

Equity, diversity, inclusion; privacy-preserving design.

FL framework built & published; secure aggregation proven.

IT teams, data scientists, lawyers, ethics committees, private companies, clinicians

No general consent, legal uncertainty, data heterogeneity

Feasibility successfully demonstrated. ML models developed for both children and adults, across age groups, sex, and pregnancy.

Conclusion

Our models perform well across **diverse patient groups** and show potential to support clinical decision-making and guide empiric antibiotic prescribing.

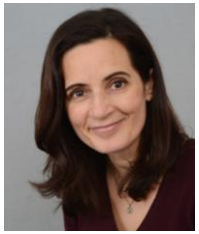
However, responsible innovation requires more than strong algorithms. Ethical AMR stewardship relies on three things: **data governance, collaboration, and trust.**

The future of AMR prediction isn’t just about machine learning, it depends on **building bridges** between technology, law, and people

On behalf of the team, Thank you for your attention!

Julia Bielicki, Prof. MD-PhD
Paediatric Infectious Diseases, UKBB

Laura Azzimonti, PhD
Senior Researcher and Lecturer, IDSIA, USI/SUPSI



Angela Huttner, Prof. MD-PhD
Infectious Diseases Division and director of the Clinical Investigation Unit, HUG

Lina Aerts, PhD
Researcher, UKBB

Suliman Bouizaguen,
Data Engineer, UKBB

Pia Neuschwander, PhD
Senior Data Engineer, USB/UKBB

Daniele Malpetti, PhD
Researcher and Lecturer, IDSIA, USI/SUPSI

Claudio Bonesana
Researcher, IDSIA, USI/SUPSI

Christian Berchtold,
Research Assistant, IDSIA, USI/SUPSI

Subproject 3:
Social Engagement and Awareness

Design Institute
Interaction Design Unit
SUPSI University of Applied Sciences and Arts
of Southern Switzerland

The on-boarding of the population is a fundamental strategy to tackle AMR and pandemics challenges. Informing, educating and creating awareness are key actions that are combined to implement effective AMR plans with a focus on the societal impact.

(The challenge as presented in our proposal)

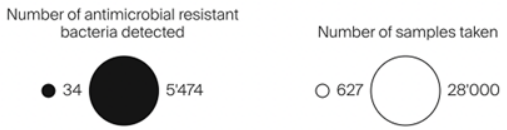
If engaging the population is an "emergency" in public health, is one-way science communication—from experts to citizens—really the solution? Drawing from bottom-up and transdisciplinary practices, we explored how to innovate public engagement by implementing and testing a participatory initiative focused on the active co-creation of knowledge with people and patients regarding UTIs, antibiotic consumption, and AMR.

MAKEAWARE!

Data pills ✿ and workshops ⑨ to raise awareness on ✦ antibiotic consumption and antimicrobial resistance

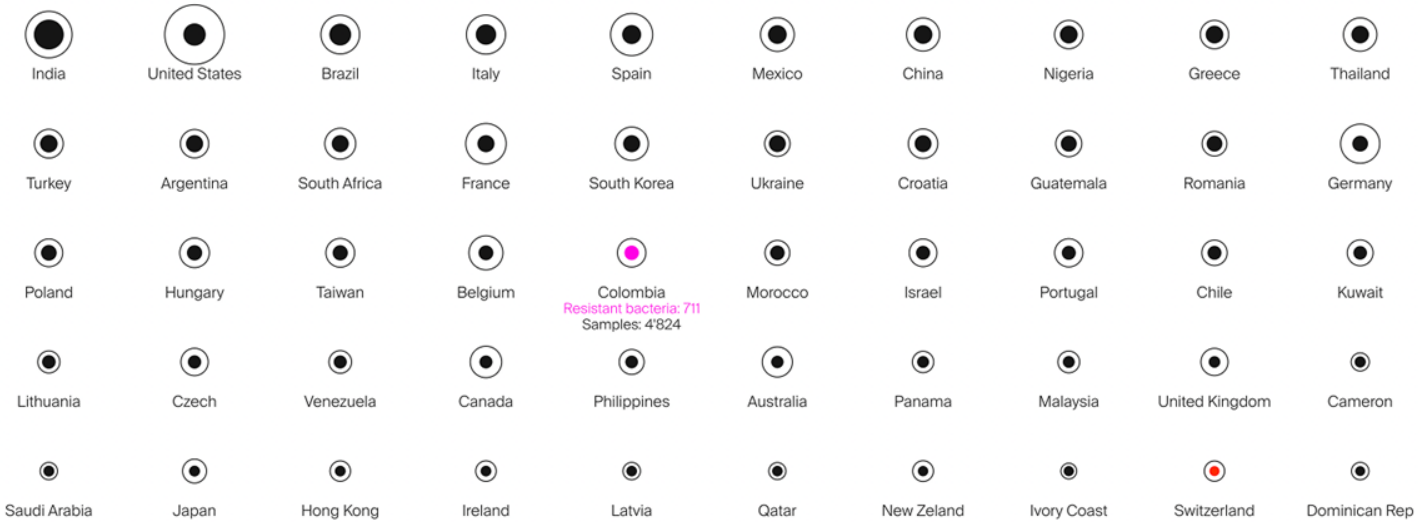
↓ PROJECT DESCRIPTION ↓

Number of resistant bacteria observed by country in 2020.



In 2020, Switzerland (•) has registered 158 antimicrobial resistant bacteria out of 1'958 samples taken.

Data source: Atlas by Pfizer



Designing methods and tools for fostering a citizen data co-creation approach on AMR and antibiotic consumption to raise awareness and to test and validate a model of people-led innovation and research in digital (public) healthcare.

(From education to health data literacy development)

Subproject 3: Societal Adoption and Engagement - **Transdisciplinary Workshops Protocols**

HOME WORKSHOPS STORY-COLLECTION TOOL DATABOOK CHATBOT PUBLICATIONS

Powered by SPEARHEAD

Design perspectives on digital healthcare

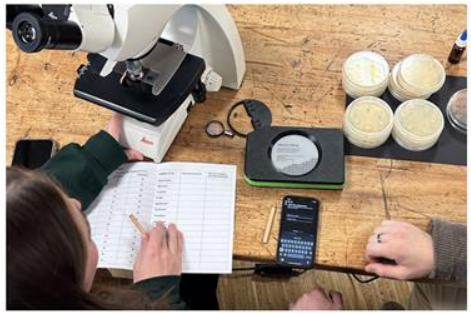
MAKEAWARE! final event

For this occasion, healthcare experts, designers, and researchers come together to share the results of the MAKEAWARE!-Spearhead project and exchange ideas on future research directions. Through panels and discussions, the seminar explores treatment practices, ethics, and innovation in healthcare from multiple disciplinary perspectives, fostering dialogue and collaboration to refine outcomes and inspire new approaches to addressing antimicrobial resistance.

EXPLORE

DiPLab - Digital Petri Laboratory

Interaction design for the antibiogram test

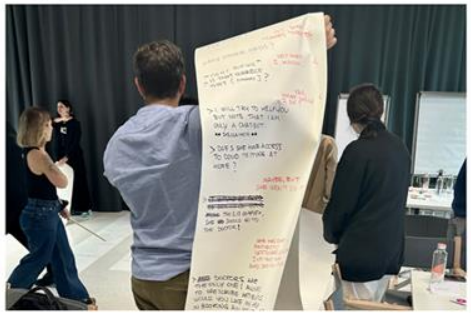


The workshop combines hands-on microbiology with interactive digital tools to make the science behind antimicrobial resistance accessible outside traditional laboratories. Participants work with DiPLab, a digital simulation of laboratory testing, to observe bacteria, explore how resistance is detected, and solve real case studies in groups. The format fosters collaborative learning, problem-solving, and discussion on responsible antibiotic use, enabling both educators and students to actively engage with this critical health challenge.

EXPLORE

OpenHealth datathon

Prototyping conversations at the Novartis Pavilion

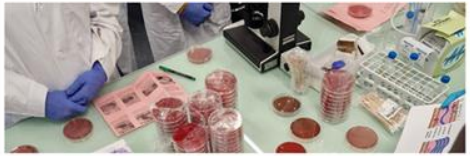


A multidisciplinary workshop bringing together participants from medicine, design, technology, and civic organisations to address antimicrobial resistance (AMR) and its impact on health. Working in teams, participants prototype a chatbot conversation aimed at supporting better antibiotic use. Through this process, they explore which data should be collected, what information is most valuable, and how personal experiences with antibiotic consumption and prescription can inform improved practices.

EXPLORE

Visualizing the resistance

Antibiotic pills to answer questions



Perturbant fluids

Laboratory tools for collectiveness

Shape your symptoms

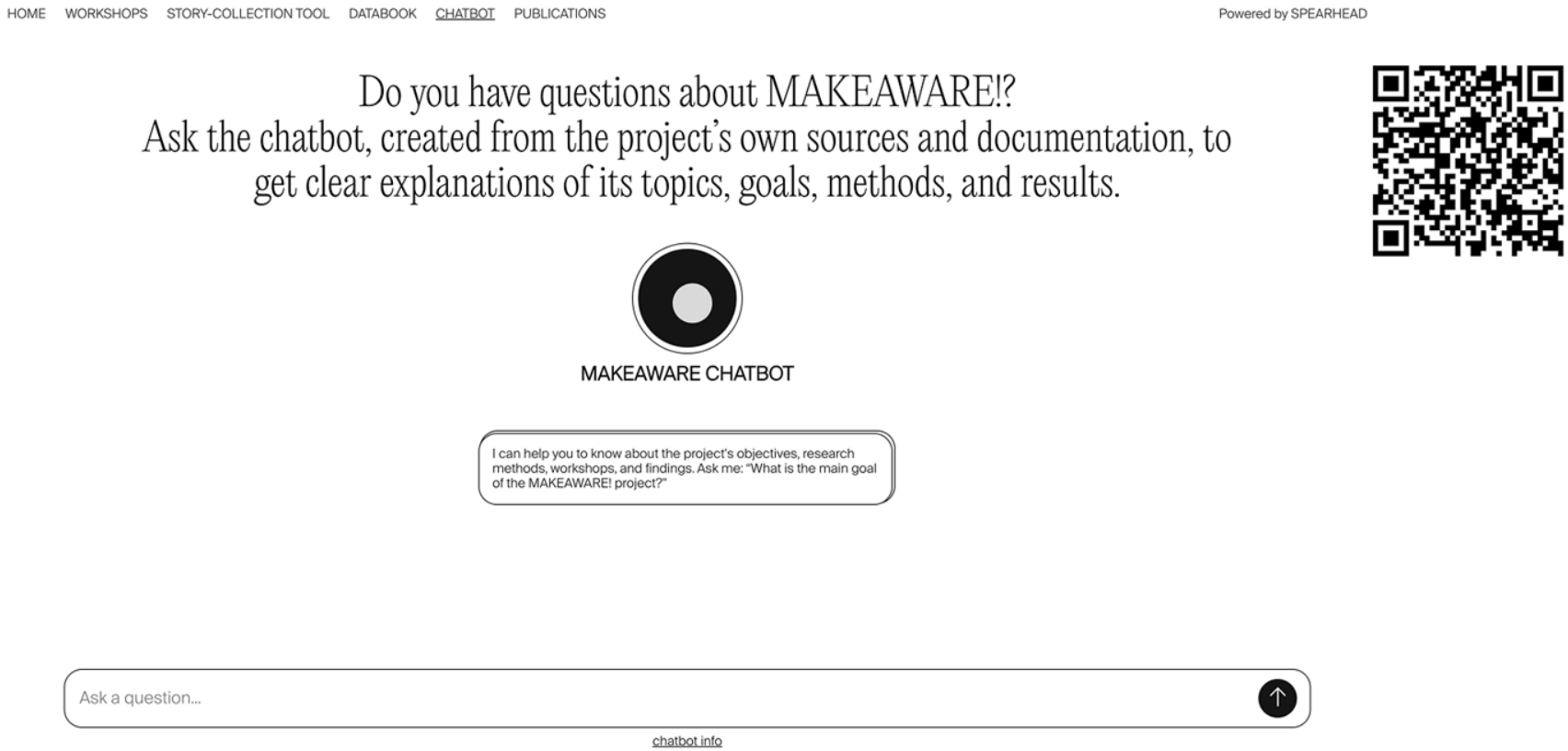
Physical variables for interpretation

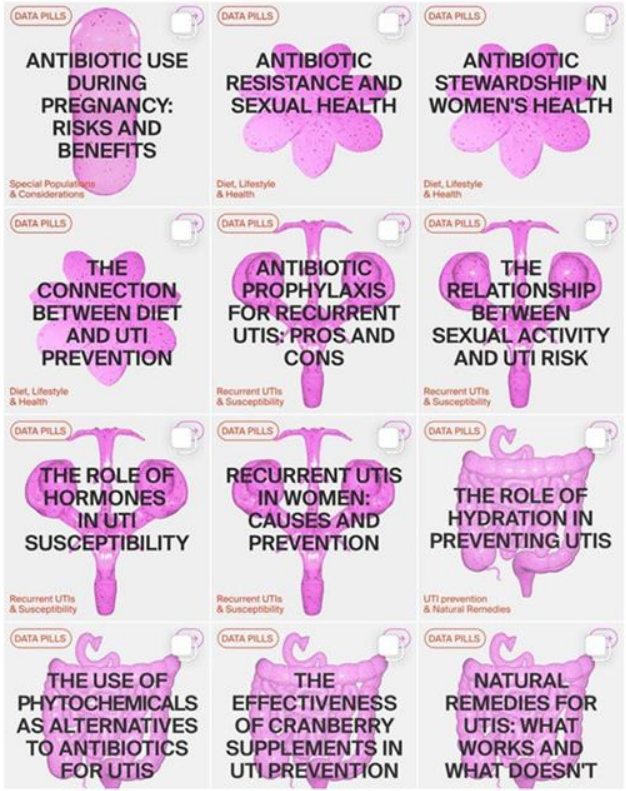

Designing future
patient-led conversations
OpenHealth datathon
21st June 2024
14.00-21.00
Novartis Pavillon
St. Johanns-Hafen-Weg 5
4056 Basel
spearhead-project.ch
Doctors, nurses, designers, technologists, patients and citizens together to collaborate and prototype solutions for antibiotic consumption and antimicrobial resistance.

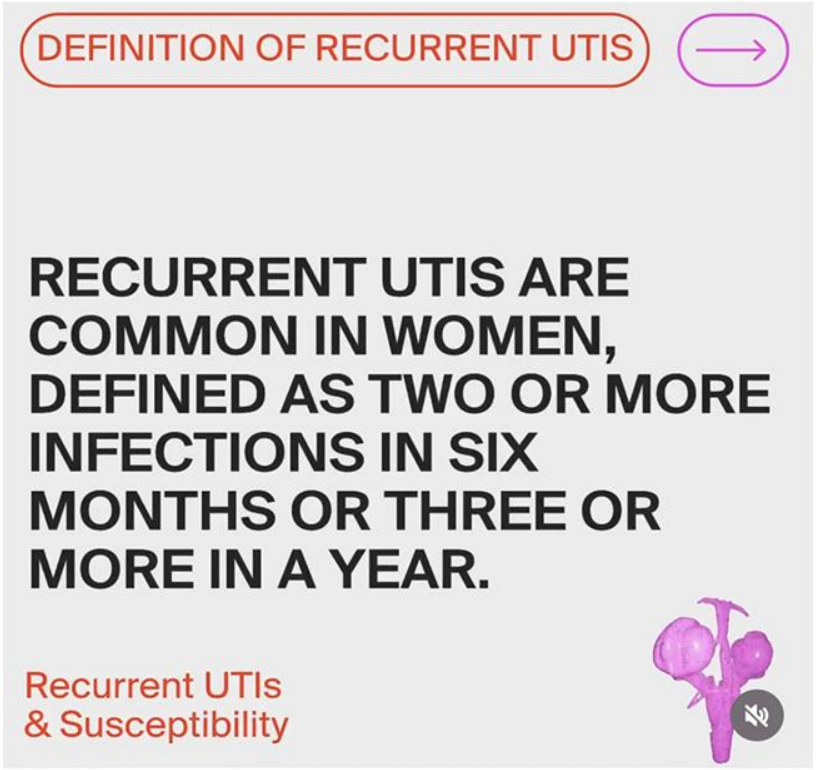
#108 I decided to fare molte visite e prendere diversi antibiotici e integratori - because avevo sempre mal di stomaco e ogni due settimane mi veniva la cistite. I was feeling sempre male, avevo dolori allo stomaco, e irritazioni sul viso every time che consumavo un pasto o andavo in bagno per urinare. I've been told by da diversi dottori specializzati that I was suffering from di gastrite e di cistite o di qualche infezione allo stomaco che mi stava provocando anche infezioni alle vie urinarie. It happened ogni giorno for circa quattro mesi. The doctor non mi ha spiegato to me that questo poteva essere legato ad un forte stress che stavo vivendo. I started diverse cure (16) di antibiotici e integratori. Ultimately, the cure niente era cam biato. I started feeling meglio quando esternavo i miei sentimenti. I noticed che situazioni di grande ansia della mia vita mi provocavano questi grandi dolori. So, I tried ad iniziare una terapia da uno psicologo.. Now mi sento molto meglio ma ho ancora tanta strada da fare.. I am sono una ragazza, 24 years old, based in italia..

#107 I decided to take an appointment (about 10 years ago, early 20s) with my family doctor (129) because I've had a nail funugs / mycosis that had been developing for some time (31) and which I had probably picked up from a family member. I was feeling kind of disgusted and afraid that it would get worse and spread even more every time I was looking at my foot. I've been told by my parents as well as the doctor (129) that I was suffering from nail mycosis (which I already knew). It happened just once, so it started in my late teens as far as I remember for a few years until I decided to treat it (I had tried other natural remedies and creams, but nothing had worked). The doctor confirmed to me that antibioticswould work in this case. I started the treatment (25) (✧) (I don't remember whether it was pills or a cream o r both). Ultimately, the cure did work. I started feeling emotionally better, although the process required a lot of patience. I noticed no side effects (16) (✧). So, I tried the only thing I added was some kind of detox regime, but I stuck to the antibiotics (✧). Now I feel (43) good and I'm very glad that I went through with this treatment (25) (✧) (it's the only time (31) in my life that I took antibiotics (✧), having been aware of the issue

Subproject 3: Societal Adoption and Engagement - **Chatbot**







reach 218,188
views 428,399
clicks 4339

If the on-boarding of the population is an emergency in Public Health, these are some of the key learnings that lead to solutions:

- Validated methods of citizen data co-creation beyond traditional data collection that challenge medicalized (non trandisciplinary) perspectives
- Novel interfaces for facilitating the active participation through health data literacy development
- experimental engagement tools enabled by emergent technologies (AI, conversational agents)

As an innovation outcome, Subproject 3 delivered the architecture of a digital infrastructure to enable the implementation of participatory research in public health: an experimental local AI infrastructure for protected and ethical computation of information generated by people and patients.

(A long term impact of the research)

Subproject 3: Societal Adoption and Engagement - **People**

Serena Cangiano
SUPSI Design Institute
Research lead

Ginevra Terenghi
SUPSI Design Institute
PhD student, project coordinator

Antonella Autuori
SUPSI Design Institute
PhD student

Matteo Subet
SUPSI Design Institute
PhD student

Marco Lurati
SUPSI Design Institute
Scientific collaborator

Davide Vitrano
SUPSI Design Institute
Designer

Zoe Romano
Pamela Principi
Cristina Fragoso
Alessandro Plantera
Alice Mioni
Isabel Farina
Giulia Tomasello

+ our consortium partners
and project leaders

SP4: Health economics & HTA

Spearhead
Innovating against AMR

ECPM
European Center of Pharmaceutical Medicine

NOVARTIS

Resistell™

Universität Basel

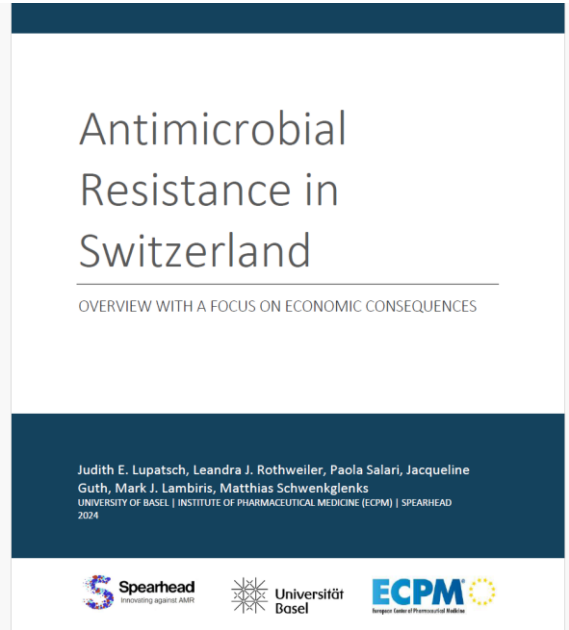
WifOR INSTITUTE

OM PHARMA

Universitätsspital Basel

CHUV Centre hospitalier universitaire vaudois

SP4: Antimicrobial Resistance in Switzerland: a report with focus on economic consequences



Available online

- Overall antibiotic use is comparatively low, but regional variation and inappropriate use persist.
- Evidence in Switzerland on the economic burden is scarce (mostly health-care costs and DALYs).
- Development of the SPEARHEAD One Health conceptual model which links micro behaviours, meso-level institutions and macro-level policies.
- Systematic review of interventions aimed at decreasing antibiotic use in Switzerland

SP4: Productivity changes in diseases affected by AMR

Spearhead
Innovating against AMR

Socioeconomic burden

Health Burden

- Identify disease incidence
- Health outcomes

Productivity impairment

- Link health outcomes to productivity (e.g. paid work)

Valuing lost/gained productive time

- Translate changes in productivity to monetary value

Lower uncomplicated UTIs (women)

We monetised the lost productivity in CHF per UTI episode.

COPD patients receiving streptococcal vaccine

We monetised the productivity gains in CHF per vaccinated patient, due to fewer COPD exacerbations.

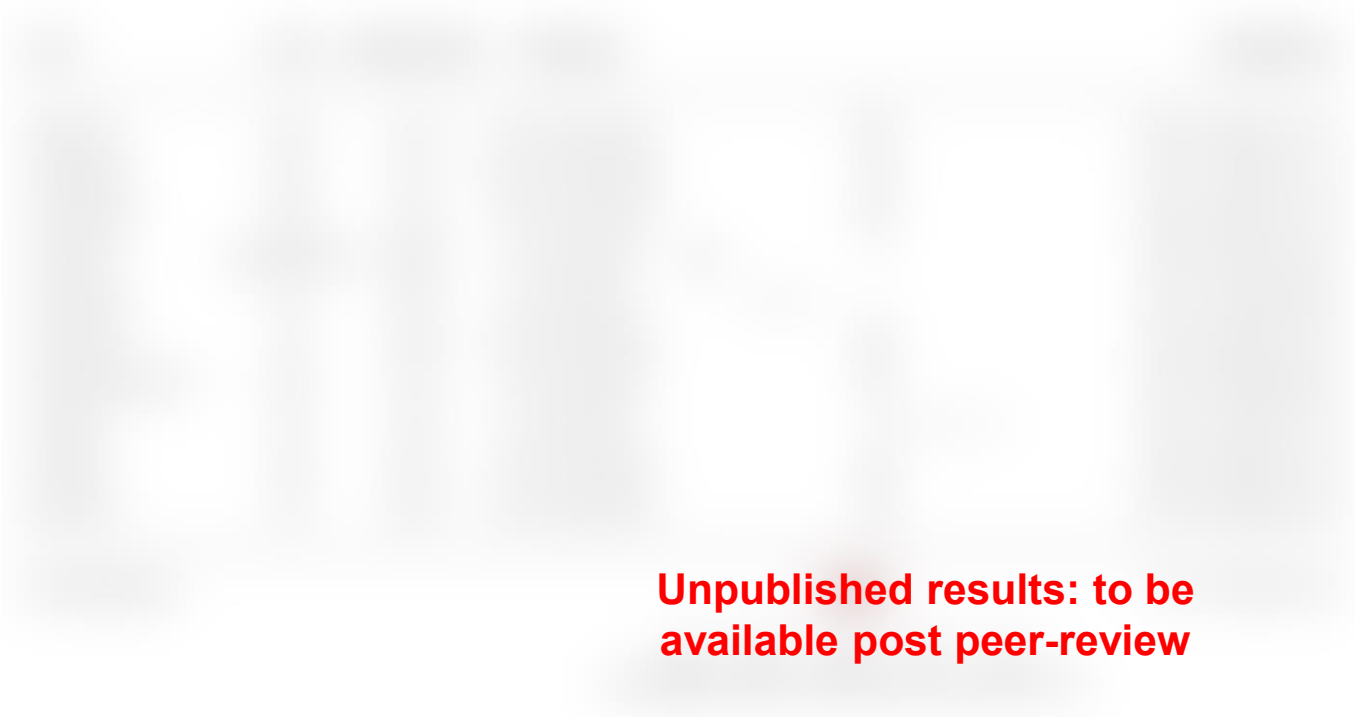
SP4: Cost savings from using DrugAlert (with SP1, USB)

Spearhead
Innovating against AMR

Estimated cost savings in work-hours (tool use hours) due to using DrugAlert:

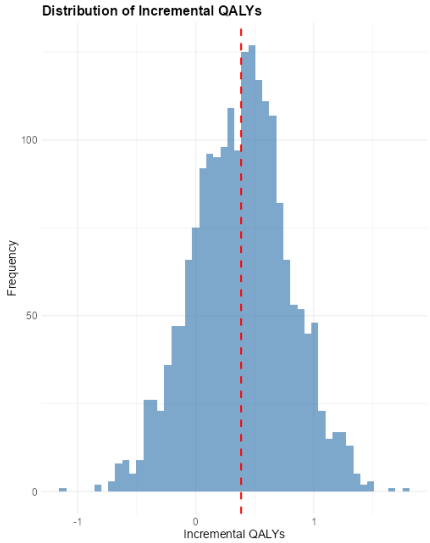
	TOTAL SAVINGS per 100 patients (CHF)	AVGE SAVINGS/ PATIENT (CHF)	SAVINGS/PATIENT-DAY (CHF)	TOTAL TIME SAVED per 100 patients (in workdays)	SAVINGS per 100 patients EQUIVALENT IN HOSPITALISATION DAYS
TREATMENT DURATION	1,628	62	5	1.4	1.7
IV-TO-PO SWITCH	2,276	75	9	1.1	2.5
DDIs	1,756	40	2	3.1	1.9
TOTAL	5,660	**57**	4	**5.6**	**6.1**

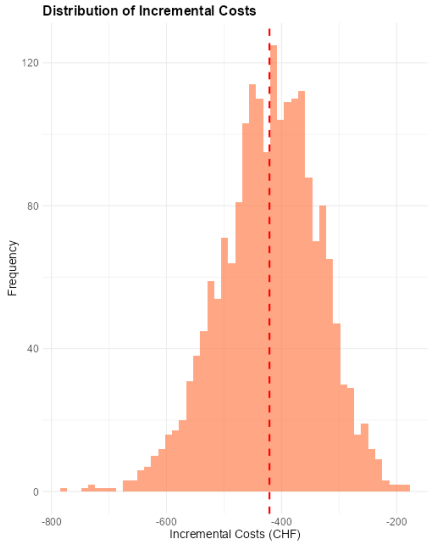
SP4: Association between earlier appropriate antibiotic therapy and mortality in hospitalised bloodstream infection patients: meta-analysis

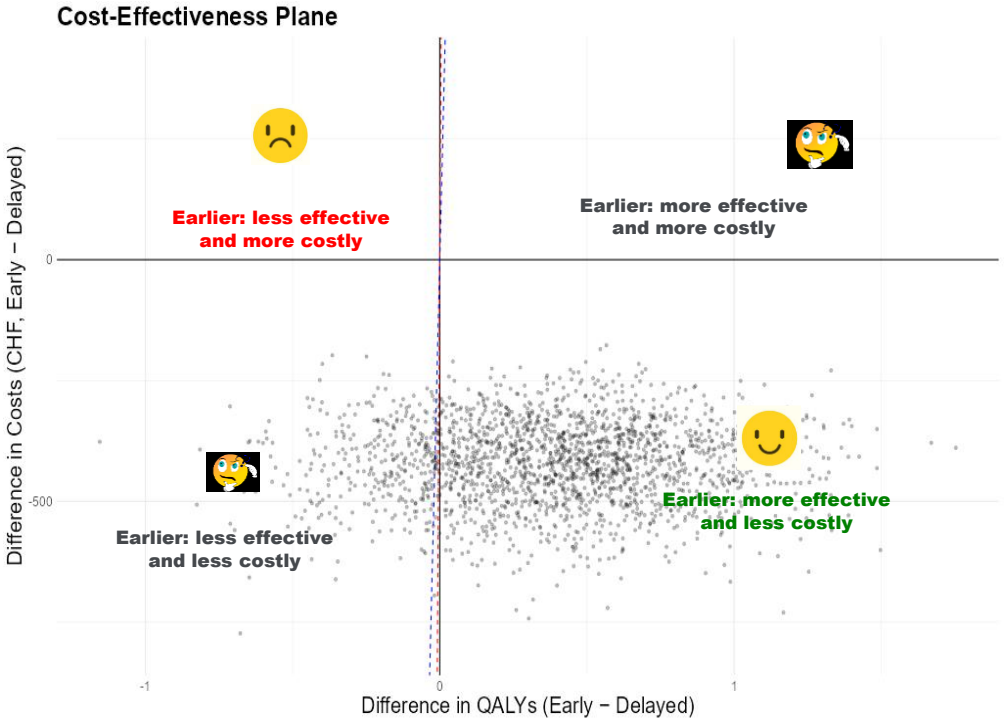


Unpublished results: to be available post peer-review

SP4: Cost-effectiveness of strategies that reduce time to appropriate antibiotic therapy in hospitalised BSI patients







SP4: Health economics & HTA

Sub-project lead:
European Center of Pharmaceutical Medicine,
University of Basel

Dr. Mark Lambiris

Dr. Judith Lupatsch

Mr. Youssef Akladios

Prof. Matthias Schwenkglenks

WifOR team:

Ms. Jennifer Branner
Dr. Platon Peristeris
Dr. Jasper Ubels
Mr. Christian Fischer
Ms. Christina Thomas
Dr. Maryna Ivets
Dr. Malina Mueller

Spearhead
Innovating against AMR

12:10-12:15

Morning reflections & afternoon highlights

Saara Malkamäki, University of Basel

Program

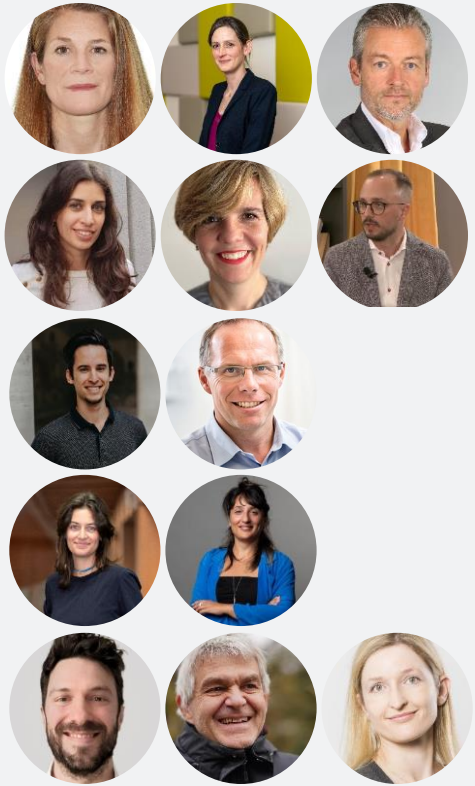
Time (CET)	Content	Speaker
13:15-14:45	**Workshops: SPEARHEAD and Beyond** • Real time monitoring for AMR • Machine Learning for Optimised Antibiotic Use • Nanomotion for antibiotic susceptibility prediction • Engaging community through innovative design methods • Economic impact of technological solutions to AMR	**Andrea Studer**, USB, **Cornelia Schneider**, USB, **Christoph Meier**, USB, **Lina Aerts**, UKBB, **Julia Bielicki**, UKBB, **Daniele Malpetti**, SUPSI IDSIA, **Alexandre Delfino**, CHUV, **Gilbert Greub**, CHUV, **Ginevra Terenghi**, SUPSI, **Serena Cangiano**, SUPSI, **Mark Lambiris**, ECPM, **Mattias Schwenkglenks**, ECPM, **Judith Lupatsch**, ECPM
14:45-14:55	Coffee break	
14:55-15:20	**Workshop summaries & key takeaways**	**Saara Malkamäki**, University of Basel and SPEARHEAD subproject representatives
15:20-15:45	**Keynote: Countering antimicrobial resistance (AMR) in a changing global health landscape: A smart, cost-effective approach**	**Peter Beyer,** Global Antibiotic Research and Development Partnership (GARDP)
15:45-16:00	Closing remarks	**Julia Bielicki**, University Children's Hospital Basel (UKBB), **Saara Malkamäki**, University of Basel, **Christoph Nabholz**, Swiss Re
16:00-18:00	Networking & Apéro	

Spearhead
Innovating against AMR

13:15-14:45

Workshops: SPEARHEAD and Beyond

Seminar Room 1	**Real-time monitoring for AMR** How can we optimize inappropriate antibiotic use?	**Andrea Studer**, **Cornelia Schneider**, **Christoph Meier**, USB
Seminar Room 2	**Machine Learning for Optimised Antibiotic Use** How can we target antibiotics better?	**Lina Aerts**, **Julia Bielicki**, UKBB, **Daniele Malpetti**, SUPSI IDSIA
Seminar Room 3	**Nanomotion for antibiotic susceptibility prediction** How to reduce the time to results?	**Alexandre Delfino**, **Gilbert Greub**, CHUV
Seminar Room 4	**Engaging community through innovative design methods** How can communities be engaged to increase awareness of AMR and antibiotic consumption through design methods?	**Ginevra Terenghi**, **Serena Cangiano**, SUPSI Design Institute
Garden Lounge	**Economic impact of technological solutions to AMR** What are the important components and prerequisites for an economic evaluation of an AMR technology?	**Mark Lambiris**, **Mattias Schwenkglenks**, **Judith Lupatsch,** ECPM



Spearhead
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Keynote: Countering antimicrobial resistance (AMR) in a changing global health landscape: A smart, cost-effective approach

Peter Beyer, Global Antibiotic Research and Development Partnership (GARDP)

Optimizing the product development partnership model for antibiotic resistance

Peter Beyer

Deputy Executive Director, GARDP

17 November 2025

GARDP: A Swiss Foundation with global reach

GARDP created by WHO and the Drugs for Neglected Disease initiative (DNDi)

2016

GARDP established as a Swiss foundation (GARDP Foundation)

2018

GARDP is a not-for-profit organization with an annual budget of ~32MN CHF and ~90 staff worldwide

TODAY

Bringing into focus what's most important in the antibiotic pipeline

Quality over quantity

Antibiotics that will make the most significant public health impact

Balancing priorities

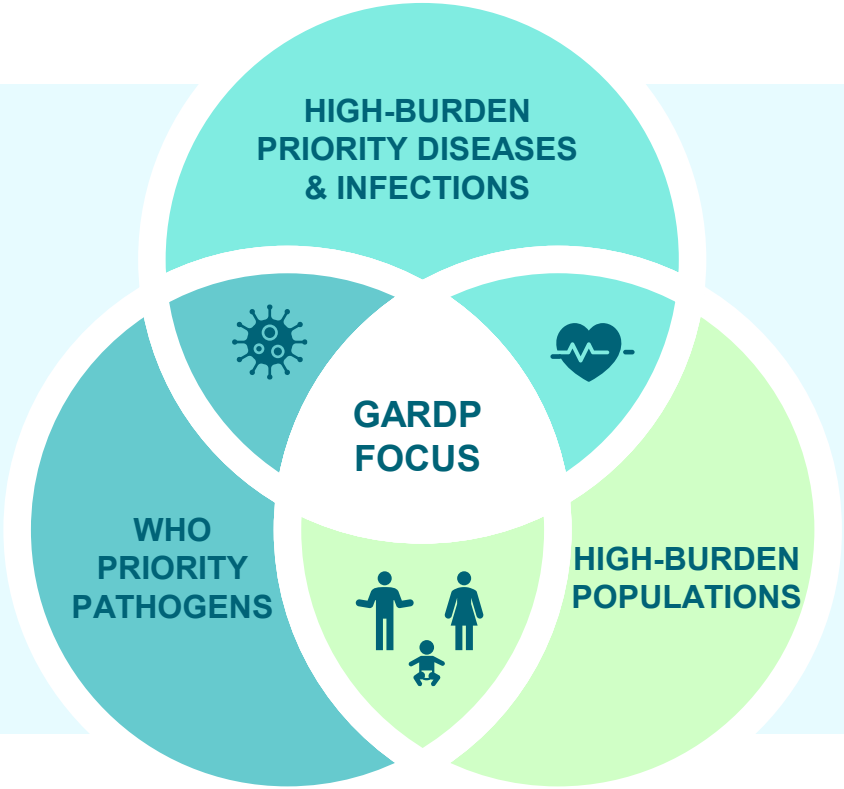
Priority pathogens AND disease burden

Longer-term and near-term solutions

Innovative antibiotics & optimizing current therapeutic tools

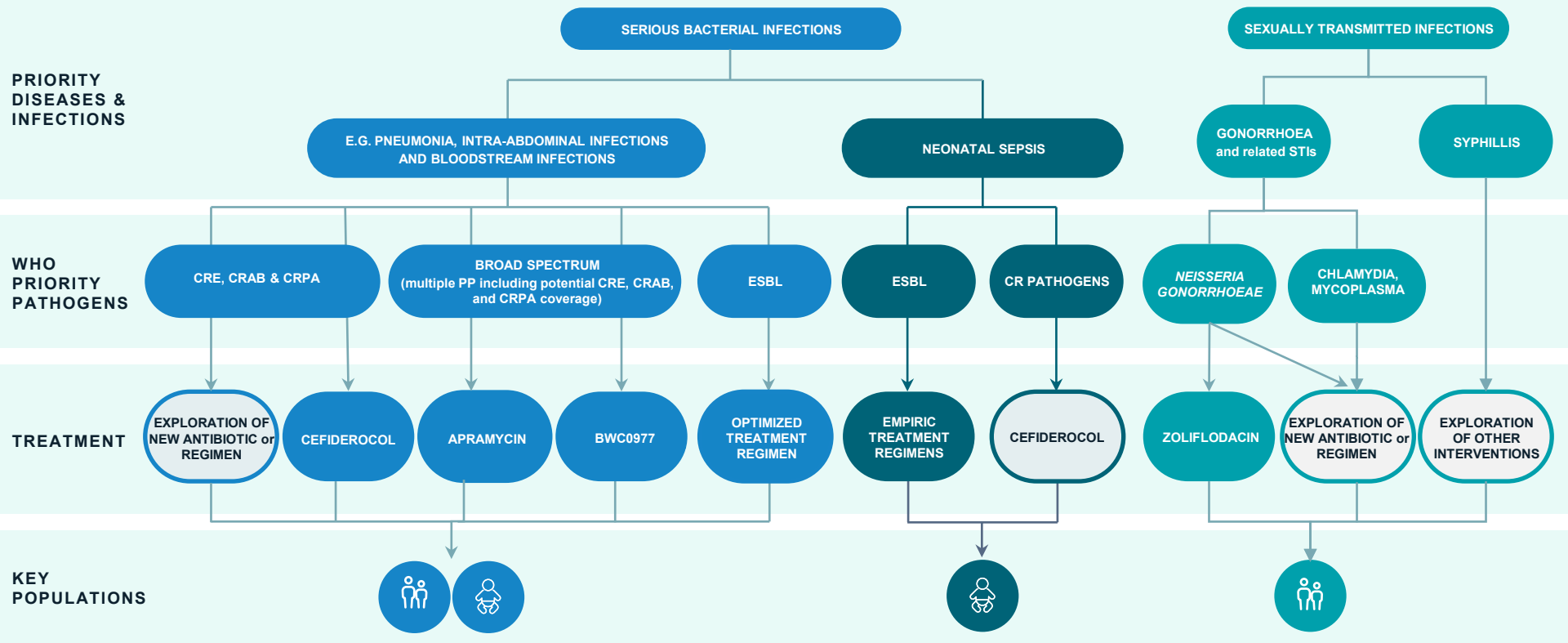
GARDP is refining its disease area strategy for future portfolio development

- Continued focus on **innovative antibacterials**
- Balance between **bacterial disease burden** & **AMR** (e.g. optimizing and enabling access to current therapeutic tools v. developing innovative new tools)
- Children (including neonates) face **different challenges** than adults
- **No expansion** to fungal infections



GARDP's expanding portfolio

CRE: Carbapenem-resistant Enterobacterales
CRAB: Carbapenem-resistant *Acinetobacter baumannii*
CRPA: Carbapenem-resistant *Pseudomonas aeruginosa*
PP: Priority pathogens
ESBL: Extended-spectrum beta-lactamases producing Enterobacterales
CR: Carbapenem-resistant



GARDP's starting point: license and collaboration agreements

- **GARDP = financial and scientific engagement + business development**
- **A flexible role in R&D**:
  - project driver/sponsor OR
  - shared leadership role ('co-development model') OR
  - supporting role only
- For innovative antibiotics: **License agreements are the sine qua non** for commercialization and access!

GARDP portfolio overview

- **Driven by disease area strategy**
- **Mix of innovative antibiotics** and optimizing **current therapeutic tools**
- **Six in-licensing agreements with partners**
    1. Cefiderocol (Shionogi)
    2. BWC0977 IV (Bugworks)
    3. BWC0977 oral (Bugworks)
    4. Apramycin (Juvabis, Uni. of Zurich)
    5. Zoliflodacin (Innoviva Specialty Therapeutics)
    6. Cefepime-taniborbactam (Venatorx Pharmaceuticals) – *project ceased due to technical difficulties*

Cefiderocol drug access project

SHIONOGI

License & technology transfer agreement

GARDP

Collaboration agreement

CLINTON HEALTH ACCESS INITIATIVE

Manufacturing sublicense agreement

OrchidPharma — A Dhanuka Group Company

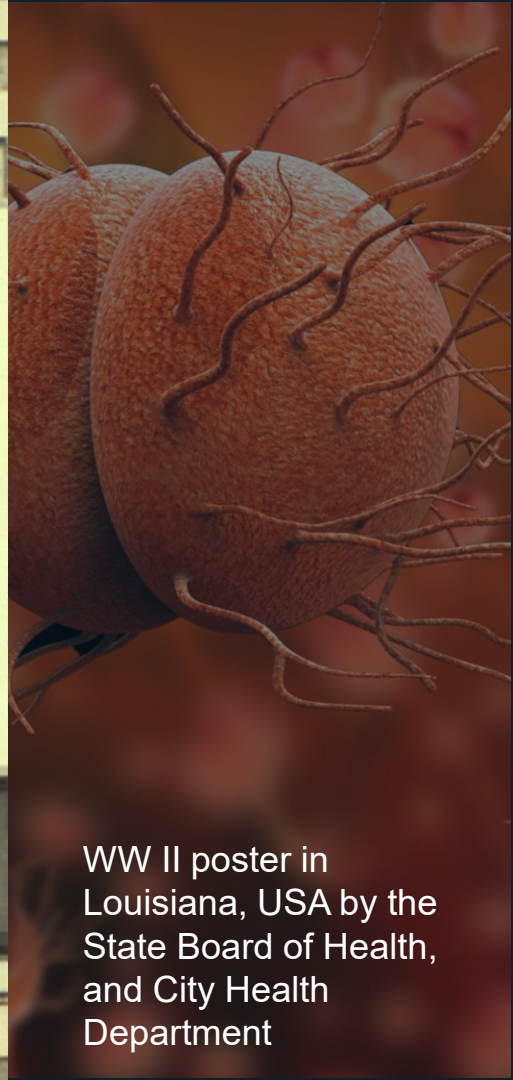
Sublicense agreement

T.B.D .

Commercial & distributor sublicense(s)

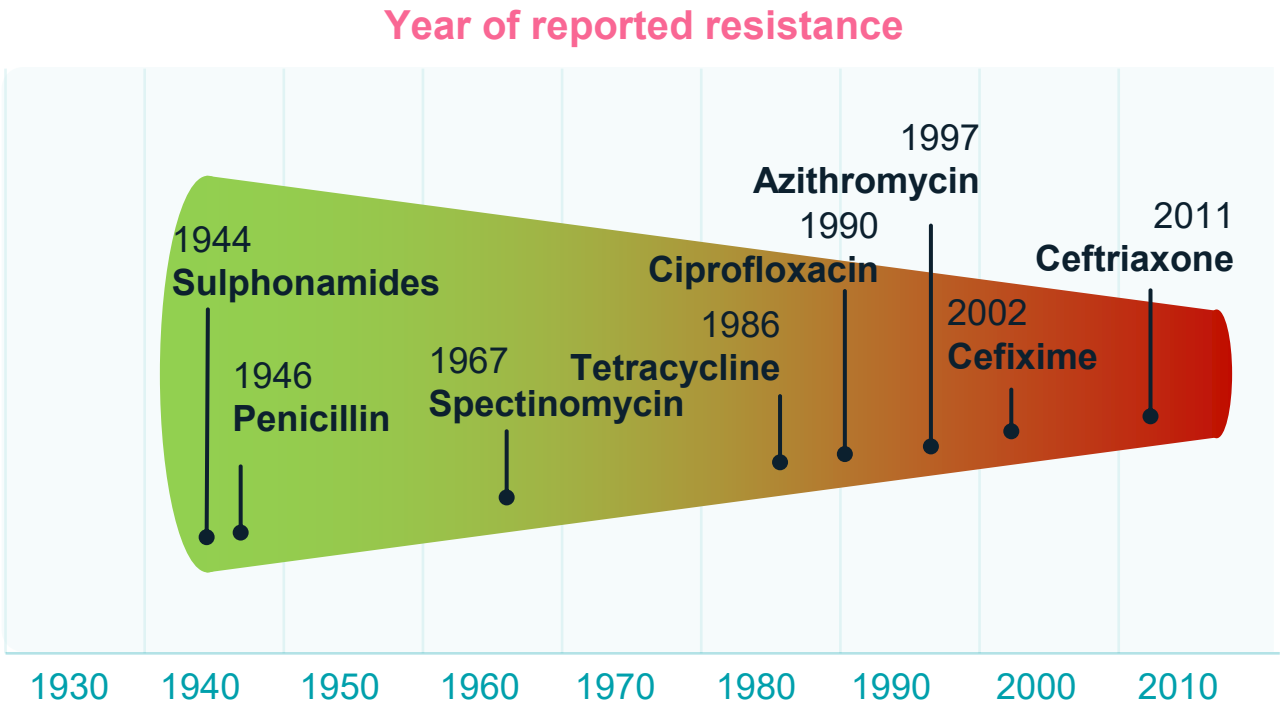
Supply

Appropriate access in up to 135 countries



WW II poster in Louisiana, USA by the State Board of Health, and City Health Department

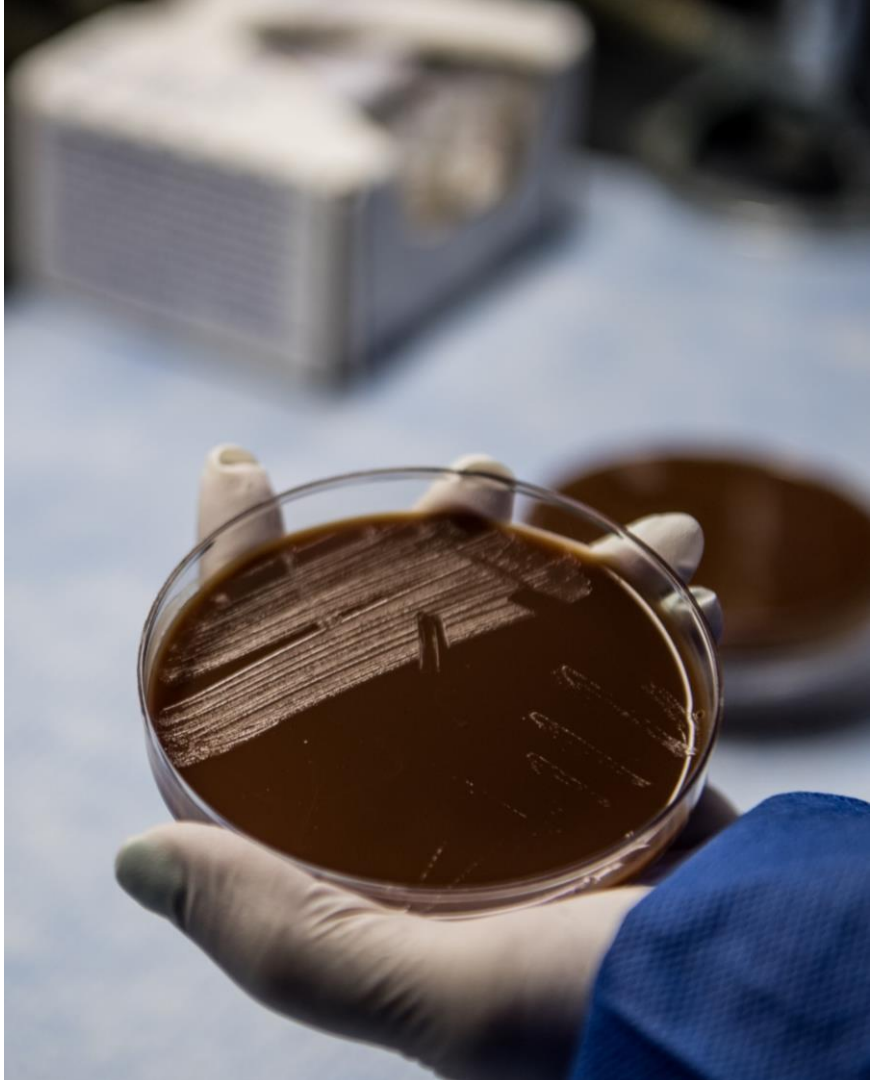
Development of resistance in *N. gonorrhoeae*



Over the past 80 years, the *Neisseria gonorrhoeae* bacterium has developed defenses against all classes of antibiotic medicines.

Zoliflodacin drug development project

- Investigational oral first-in-class antibiotic being developed for the treatment of uncomplicated gonorrhoea infection by GARDP & Innoviva Specialty Therapeutics
- GARDP enrolled nearly 1000 patients in 16 sites across 5 countries
- New Drug Application under priority review by the US FDA: **Decision expected by 15 December 2025**
- Following US FDA approval: Dr Reddy's to submit adapted registration dossier in South Africa and Thailand
- **€80 million:** GARDP's approximate costs to sponsor the phase 3 trial and carry out other critical activities to complete the development of zoliflodacin, as well as support initial regulatory submission and registration



Global observational study of neonatal sepsis

In 2020, GARDP and its partners completed enrolment for one of the world's largest neonatal sepsis observational studies to inform the development of antibiotic treatments and regimens for neonatal sepsis.

Study sites

More than 3,200 newborns recruited in 19 hospital across 11 countries:

Bangladesh	India	Thailand
Brazil	Italy	Vietnam
China	Kenya	Uganda
Greece	South Africa	

Some key partners:

- Penta
- The MRC Clinical Trials Unit at University College London
- City St George's, University of London
- University of Antwerp

Russell NJ, et al. Patterns of antibiotic use, pathogens, and prediction of mortality in hospitalized neonates and young infants with sepsis: A global neonatal sepsis observational cohort study (NeoOBS). PLOS Medicine. 2023;20. doi:10.1371/journal.pmed.1004179

Clinical Development – NeoSep1 clinical trial

Part 2

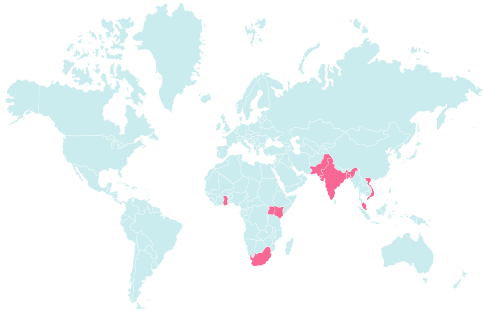
8 regimens to be tested:

- 3 new combinations:
  - fosfomycin + amikacin
  - fosfomycin + flomoxef
  - flomoxef + amikacin
- 5 additional regimens:
  - WHO-recommended and/or commonly used regimens

Enrolment: approx. 3,000 neonates

Outcome measure:

- Efficacy, Clinical status at day-28, safety



To take place in at least 15 sites in 9 countries:

Ghana
Kenya
South Africa
Uganda
Bangladesh
India
Malaysia (TBC)
Pakistan
Vietnam

Clinical Development – NeoSep1 clinical trial

Expected outcomes

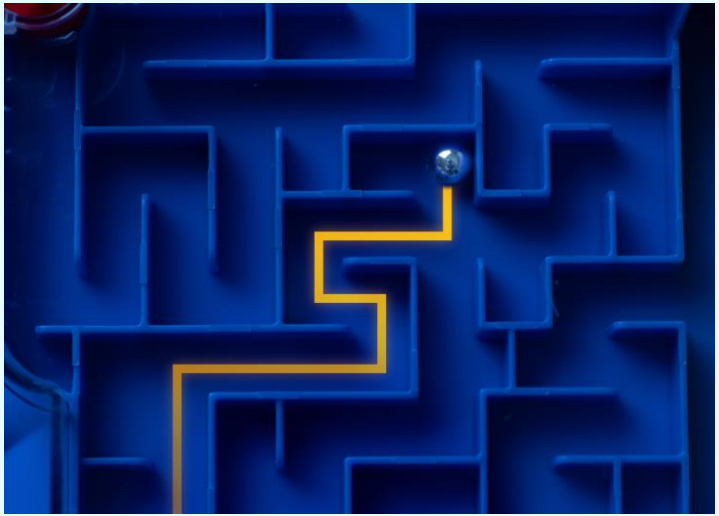
- **New treatment options:** The trial may identify one new regimen (or more) to treat neonatal sepsis
- **Ranking of treatment options:** Recommended, existing and commonly used neonatal sepsis treatment regiments will be ranks according to effectiveness, safety and cost, depending on patient characteristics / clinical setting
- **Trial design:** The PRACTical study design uses a meta-analytic approach to summarize evidence for multiple treatment regimens from one large trial instead of multiple small studies

Given the number of different options, choosing **one of the best** treatments out of the multiple available options **for this patient** is more important than identifying "**the best**" treatment. The findings will also help identify and avoid **the worst** regimen for the specific patient.

GARDP's strategy 2027-2031: Adapting to the changing global health landscape

GARDP’s strategy 2027-2031

- GARDP is preparing an updated strategy for its next strategic phase, including:
  - Updated disease area strategy
  - Expanded portfolio
  - Strong framework for defining our role in product development and access
  - Evolved theory of change to understand and evaluate impact
  - Operational growth projections
- Stakeholder consultations in 2026
- Publication by 2027



Seeking your input

- How can GARDP contribute to your efforts to counter AMR?

What do you need from us?

What would you like to see in GARDP's new strategy?

Ministry of Foreign Affairs

Federal Ministry of Research, Technology and Space

Ministry of Health, Welfare and Sport

With funding from the

Federal Ministry for Economic Cooperation and Development

through KFW

厚生労働省
Ministry of Health, Labour and Welfare

Co-funded by the European Union

Global Health EDCTP3

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

REPUBLIQUE ET CANTON DE GENEVE

Gates Foundation

Canada

UKaid from the British people

GAMRIF

RiGHT 국제보건기술연구기금

Gouvernement Princier
PRINCIPAUTÉ DE MONACO

GSK

wellcome

saMRC advancinglife

GARD P

Spearhead
Innovating against AMR

15:45-16:00

Closing remarks

Julia Bielicki, University Children's Hospital Basel (UKBB), **Saara Malkamäki**, University of Basel, **Christoph Nabholz**, Swiss Re

16:00-18:00

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Networking & Apéro

Funded by Innosuisse