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NIHR Health Protection Research Unit in Healthcare Associated Infections and Antimicrobial Resistance at Imperial College London

Prevent and control infections caused by multidrug resistant organisms in the community: lessons from England

Nina Zhu, PhD MPH MSc

Population Health and Policy Theme Research Lead
NIHR HPRU in Healthcare Associated Infections and Antimicrobial Resistance at Imperial College London

[@SupraChemina](#) 

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Overview

- Me, and UK NIHR Health Protection Research Unit
- AMR and infection prevention: from international and national imperatives to local implementation
- A decade of learning from implementation in the English context: what has worked? where next?
- COVID-19: positive and negative

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About me

- Bioengineering
- Epidemiology
- Health systems and policy
- Health economics

- Applied data linkage
- Simulation and modelling
- Policy and intervention evaluation, including unintended consequences

- HCAI surveillance, including hospital-onset COVID-19 infection (HOCl)
- Prescribing and antimicrobial stewardship

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About NIHR HPRU in HCAI and AMR



UK Health Security Agency



Dr Matthew Ellington



Imperial College London



Professor Alison Holmes

Priority Pathogens

Precision Prescribing

Practice, Design & Engineering

Population Health & Policy








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Population Health and Policy Theme

UKHSA strategy	Current work	Knowledge gaps
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Contained and controlled</p> <p>The UK's 20-year vision for antimicrobial resistance</p> <p><small>Published 26 January 2019</small></p> </div> <p><small>English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) Report 2020 to 2021</small></p> <p><small>Policy paper: PHE infectious diseases strategy</small></p> <p><small>The Public Health England strategy outlines our work to combat infectious diseases and sets out the strategic priorities for the 5-year period 2020 to 2025.</small></p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Primary care prescribing and evaluation of national AMS interventions</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Infection and AMR in the community</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">HCAI (including HOCl) surveillance</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">SSI surveillance, risk prediction and economic burden</div> <div style="border: 1px solid black; padding: 5px;">Strategic planning for AMR and pandemic response</div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Emergence and transmission of infection and AMR</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Risks and at-risk population</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Analysis of contextual environment</div> <div style="border: 1px solid black; padding: 5px;">Clinical and economic impact of interventions, including potential unintended consequences</div>

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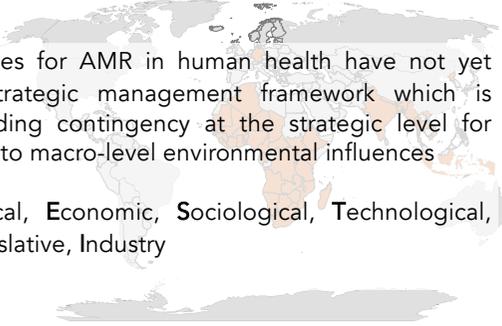
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Assessing contextual factors influencing the implementation of the National Action Plan: the PESTELI framework



- Situation analyses for AMR in human health have not yet employed a strategic management framework which is critical for building contingency at the strategic level for agile responses to macro-level environmental influences
- PESTELI: Political, Economic, Sociological, Technological, Ecological, Legislative, Industry**

Ahmad, Zhu et al. 2015, BMJ GH

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Existing country-level situation analyses (GARP reports)

Year	Country	Information source	Demographics	Politic context	Economic context	Health systems setting	Disease burden		Antibiotic use		Drug regulation and supply chain	Other
							Human	Animal	Human	Animal		
2010	Vietnam	Documentary review			✓	✓	✓	✓	✓	✓	✓	
2011	India	Literature review			✓		✓	✓	✓	✓	✓	Interventions to be considered
2011	Kenya	Documentary review		✓			✓	✓	✓	✓	✓	
2011	South Africa	Documentary review			✓	✓	✓	✓	✓	✓	✓	
2014	Nepal	Literature review	✓				✓	✓	✓	✓	✓	
2015	Mozambique	Literature review, expert opinion			✓	✓	✓	✓	✓	✓	✓	
2015	Tanzania	Documentary review		✓			✓	✓	✓	✓	✓	
2015	Uganda	Literature review, interviews	✓				✓	✓	✓	✓	✓	
2017	Zimbabwe	Literature review, interviews			✓	✓	✓	✓	✓	✓	✓	AMR in agriculture
2018	Bangladesh	Documentary review, literature review			✓	✓	✓	✓	✓	✓	✓	Surveillance, requirements in establishing antimicrobial stewardship (AMS) (human resources, education, investment)
2018	Pakistan	Literature review, interviews		✓	✓		✓	✓	✓	✓	✓	Drug accessibility, AMS and interventions

Ahmad, Zhu et al. 2015, BMJ GH

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PESTELI

- Political
- Legislative

Framework for assessing governance – comparing antimicrobial resistance to national health system arrangements

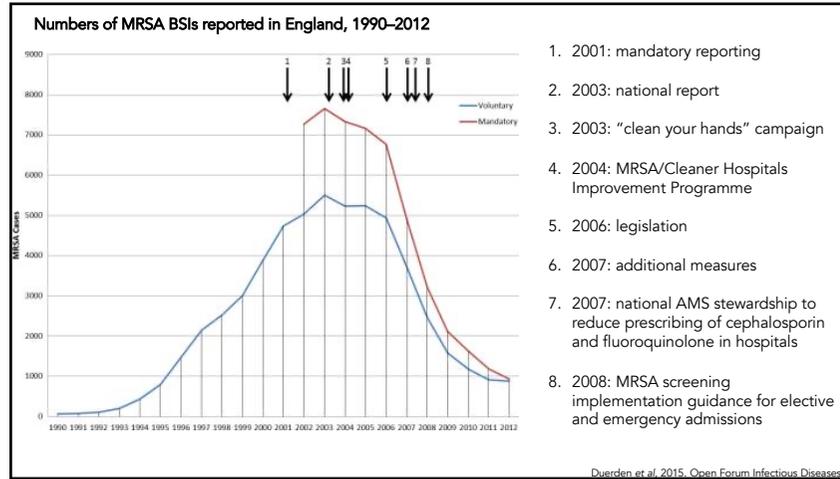
Governance model	
	Who is involved & what is the role?
How priorities are set for improving actions and standards?	What is the evidence base for decision-making
	What are the main strengths
How is performance monitored?	What are the main weaknesses?
	By whom?
How is accountability for performance ensured?	How? What are the main strengths and weaknesses?
	How are the accountability mechanisms in place linked to the health system's broader governance structures?
To what extent are the three components aligned?	Are the mechanisms effective?

"Comparison of governance approaches for the control of antimicrobial resistance: Analysis of three European countries". Birgand et al. (2018), ARIC. "A governance framework for development and assessment of national action plans on antimicrobial resistance". Anderson et al. (2019), LID.

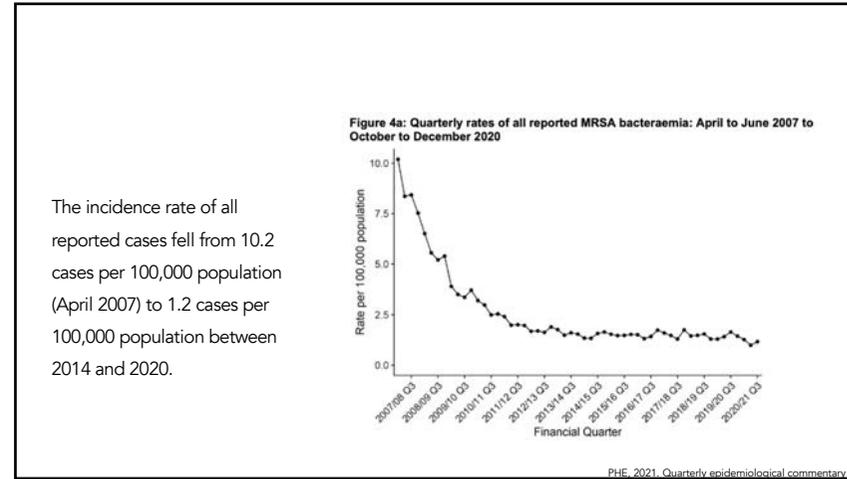
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Infection control has been high on the political agenda and on the agenda of the NHS in England since 2000.

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2000
UK AMR NAP: surveillance + AMS + IPC

Committee of Public Accounts: 1) the NHS did not have a grip on the extant of HCAI and 2) a root and branch shift towards prevention was needed at all levels and that a philosophy that prevention is everybody's business not just the specialists.

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2001
Introduction of mandatory reporting in England of MRSA BSI
 All cases of bacteraemia caused by *S. aureus*

- The proportion of cases due to MRSA
- No of MRSA per 1,000 patient-days
- Data made publically available

2003
 National report targeting 7 key areas for improvement: active surveillance and investigation, infection risks associated with medical devices, reservoirs of infection, standards of hygiene in clinical practice, prudent use of antimicrobials, management and organisation, and research and development

"Clean your hands" campaign: required alcohol hand gel at all points of patient contact

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2004
Setting of target reductions for all NHS hospitals
 The original national target of a 50% reduction in MRSA BSI in hospitals in England by 2008;

2006
Legislation was introduced, which implemented a statutory Code of Practice on HCAI that applied to all NHS healthcare providers; with additional measures introduced in 2007 (quarterly reporting on HCAs to hospital Boards, a legal requirement for hospital Chief Executives to report MRSA BSIs centrally)

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2008
The Health and Social Care Act 2008: Code of Practice on the prevention and control of infections and related guidance

- set out the code of practice for IPC, which applies to registered providers of all healthcare and adult social care in England
- set out 10 criteria for the inspection body - Care Quality Commission (CQC) - to judge the performance of a registered provider

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Code of practice for MRSA infections include:

- **National mandatory reporting:** MSSA and MRSA bacteraemia; Gram-negative bacteraemia; *Clostridioides difficile* infection (including independent sector hospitals)
- **Institution policy:** screening upon admission; suppression regimens for colonised patients; isolation; transfer; antibiotic prophylaxis for surgery; post infection review for patients with bacteraemia

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2011
England's Chief Medical Officer (CMO) Annual Report on Infectious Diseases and AMR

- 17 recommendations are made as part of the report, including:
 - a call for antimicrobial resistance to be put on the national risk register
 - better surveillance of data across the NHS and worldwide
 - better hygiene measures should be used when treating the next generation of HCAs (building on the success of MRSA BSI reduction since 2003)



Former CMO Professor
 Dame Sally Davies

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2013

Prevention and control of infection in care homes

- set out the code of practice for IPC, which applies to registered providers of all healthcare and adult social care in England
- set out 10 criteria for the inspection body - Care Quality Commission (CQC) - to judge the performance of a registered provider

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UK's 20-year vision: 2020-2024

Contained and controlled
The UK's 20-year vision for antimicrobial resistance
Published 20 January 2019

- **A lower burden of infection**, better treatment of resistant infections, and minimised transmission in communities, the NHS, farms, the environment and all other settings.
- **Optimal use of antimicrobials and good stewardship across all sectors**, including access to safe and effective medicines that have been manufactured responsibly for all who need them; achieving and maintaining usage levels by sector as good as the best countries in the world where comparable data are available.
- **New diagnostics, therapies, vaccines and interventions** in use, and a full antimicrobial resistance research and development pipeline for antimicrobials, alternatives, diagnostics, vaccines and infection prevention across all sectors; with access to new and old technologies for all.

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Birgand et al. *Antimicrobial Resistance and Infection Control* (2018) 7:28
https://doi.org/10.1186/s12876-018-0321-5

Antimicrobial Resistance and Infection Control

REVIEW Open Access

Comparison of governance approaches for the control of antimicrobial resistance: Analysis of three European countries

Gabriel Birgand¹, Enrique Castro-Sánchez², Sonja Hansen³, Petra Gastmeier⁴, Jean-Christophe Lucet^{1,5,6}, Ewan Ferlie⁷, Alison Holmes⁸ and Raheelah Ahmad^{9*}



Dr Raheelah Ahmad

- Non-mandatory recommendations
- Primarily persuasive interventions
- Process-based incentives
- Voluntary surveillance

Birgand et al. 2018, ARIC.

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Available online at www.journalofhospitalinfection.com

Journal of Hospital Infection

Journal homepage: www.elsevier.com/locate/jhin

Comparison of national strategies to reduce methicillin-resistant *Staphylococcus aureus* infections in Japan and England

S. Mizuno^{1,2}, M. Iwami^{3,4}, S. Kurisawa⁵, N. Naylor⁶, K. Yamashita⁷, Y. Kyriatis⁸, G. Meads⁹, J.A. Otter¹⁰, A.H. Holmes¹¹, Y. Imanaka¹², R. Ahmad¹³

¹Department of Healthcare Economics and Quality Management, Aichi University, Japan
²Division of Infectious Diseases, Imperial College London, London, UK
³Health Health Protection Research Unit in Healthcare Associated Infection and Antimicrobial Resistance, Imperial College London, Manchester Campus, London, UK
⁴Health Service Research & Management Division, School of Health Sciences, City University of London, London, UK
⁵Health and Wellbeing Research Group, University of Winchester, Winchester, UK
⁶Imperial College Healthcare A&P Trust, Hammersmith Hospital, London, UK
⁷Health Group, Management Department, Imperial College Business School, London, UK



Dr Raheelah Ahmad

England versus Japan

England has focused on national mandatory and structural interventions, supported by a combination of outcomes-based incentives and punitive mechanisms, and multi-disciplinary IPC hospital teams.

Japan has focused on (non-mandatory) recommendations and primarily persuasive interventions, supported by process-based incentives, with voluntary surveillance.

Mizuno et al. 2018, JHI

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What to you want to change?

Guidelines – practice gap **across** organisations in England

Percentage of staff complying with hand hygiene policy

Percentage of frontline health care workers vaccinated with the seasonal influenza vaccine in NHS hospitals

PHE, 2016.

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What to you want to change?

Guidelines – practice gap **within one** organisations in England

- Documentation of antibiotic stop/review date (surgery): 25%
- Documentation of antibiotic indication (medicine and surgery) : 17%
- Adherence to local policy or microbiology/infectious disease team recommendation: 84%

Charani et al. (2017). JAC.

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What do we know from IPC implementation in England?

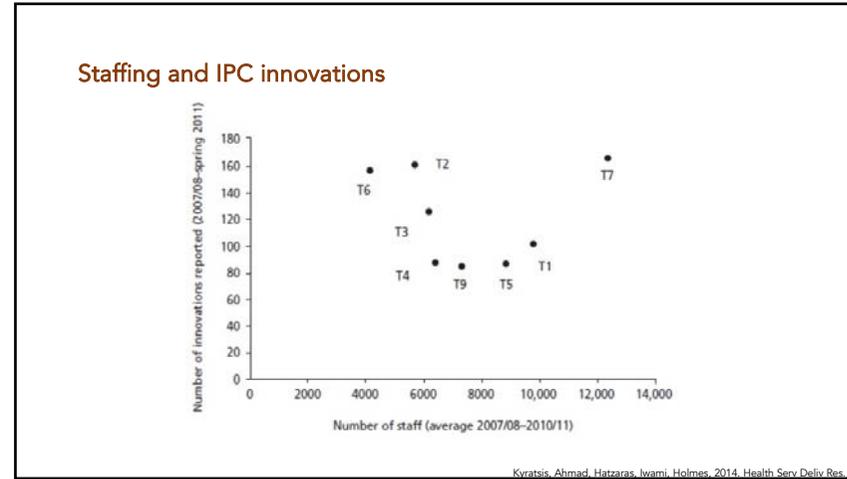
- Organisational slack is necessary
- A positive organisational culture is more relevant than organisational form
- Innovation adoption is sustained when involvement is wider (than IPC)
- Public knowledge mobilisation can be a powerful (positive) force

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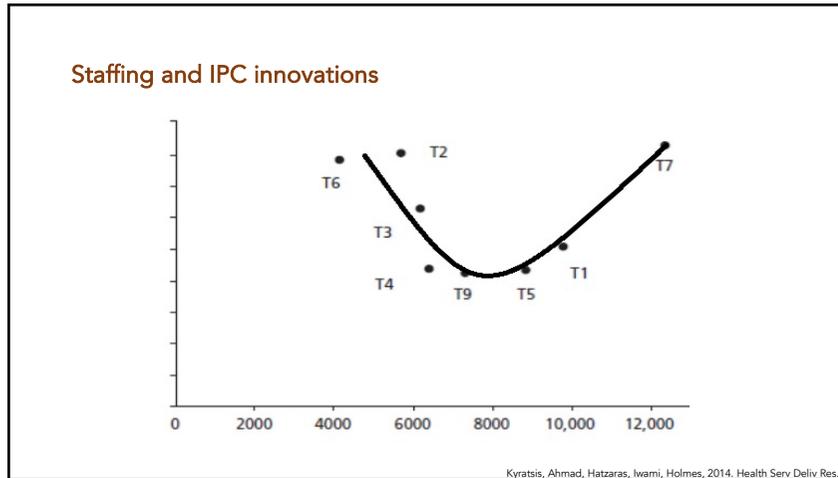
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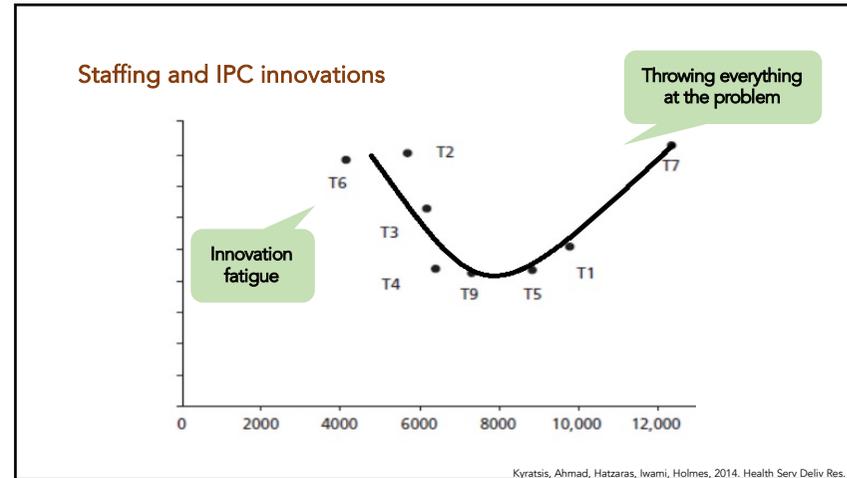
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Culture – organisational level

A multi-level neo-institutional analysis of infection prevention and control in English hospitals: coerced safety culture change?

Year	Regulative	Normative	Cultural-cognitive
2000	0	15	0
2001	0	15	0
2005	30	0	30
2006	50	30	15
2007	55	25	30
2008	45	25	25
2009	25	25	30

Kyratsis, Ahmad, Iwami, Castro-Sanchez, Atun, Holmes, 2019. Sociology of Health and Illness.

34

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- What you must do
- What you should do
- **What you would (always) do**

Kyratsis, Ahmad, Iwami, Castro-Sanchez, Atun, Holmes, 2019. Sociology of Health and Illness.

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How can we gauge organisational culture?

- Positive organisational culture by fostering good working relationships and communications across units and staff groups.
- Indicators: work satisfaction, emergency and crisis management, absenteeism, healthcare worker turnover

Zingg, Holmes et al., 2015. Lancet Infectious Diseases.

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How can we gauge organisational culture?

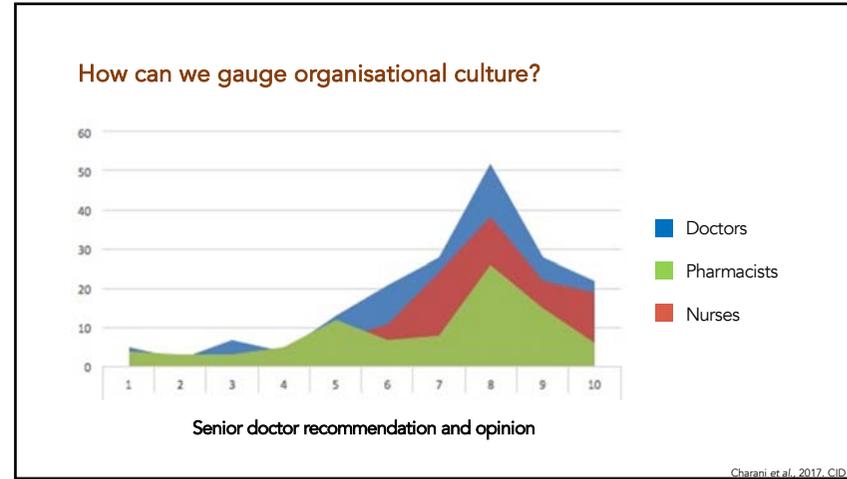
- Unwritten rules
- Hierarchy
- Team dynamics



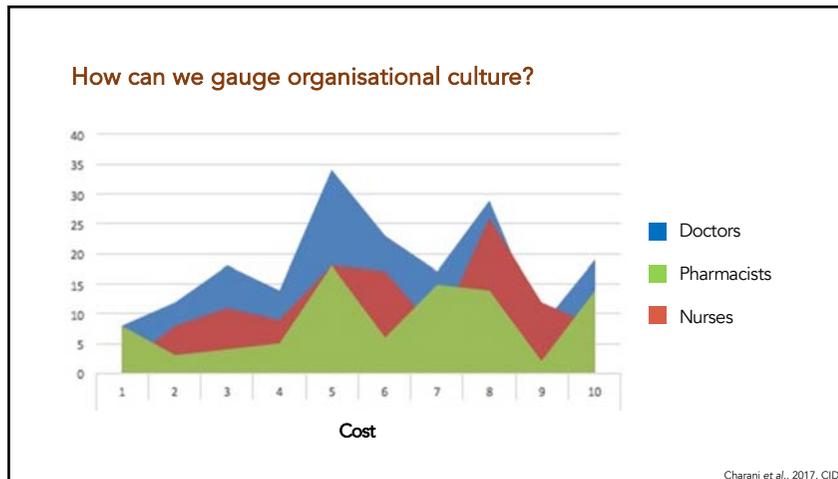
Dr Esmita Charani

"Antibiotic stewardship programmes – what's missing?". Charani et al. (2010). JAC.
 "Behaviour change strategies to influence antibiotic prescribing in acute care: a systematic review". Charani et al. (2011). CID.
 "Understanding the Determinants of Antimicrobial Prescribing within hospitals: The role of 'Prescribing Etiquette'". Charani et al. (2013). CID.

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How can we gauge organisational culture?



"The ability for individual staff to passively resist something is far greater than the position and power of any individual within the organisation. So if we want to introduce something new and if it isn't really understood and accepted at the ground level, people will just make the right noises and not act, absolutely embrace it and do it. A lot of it is about hearts and minds."

Executive team member

Holmes et al., 2016. The Health Foundation

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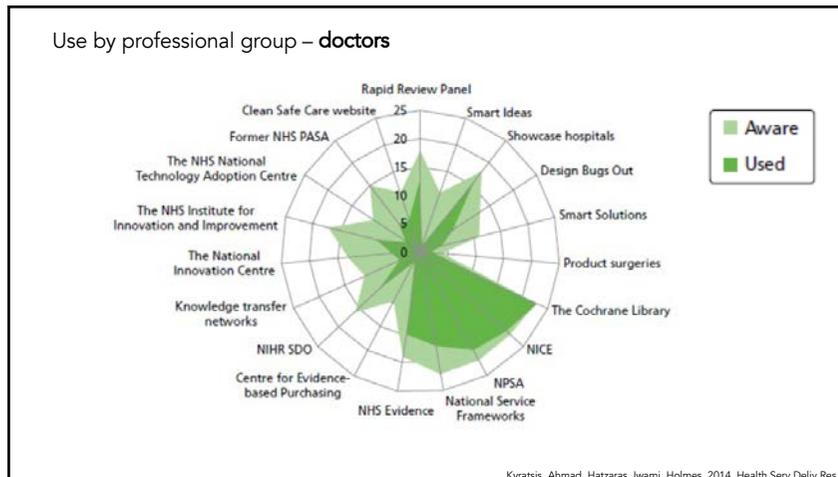
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Who to involve? When?

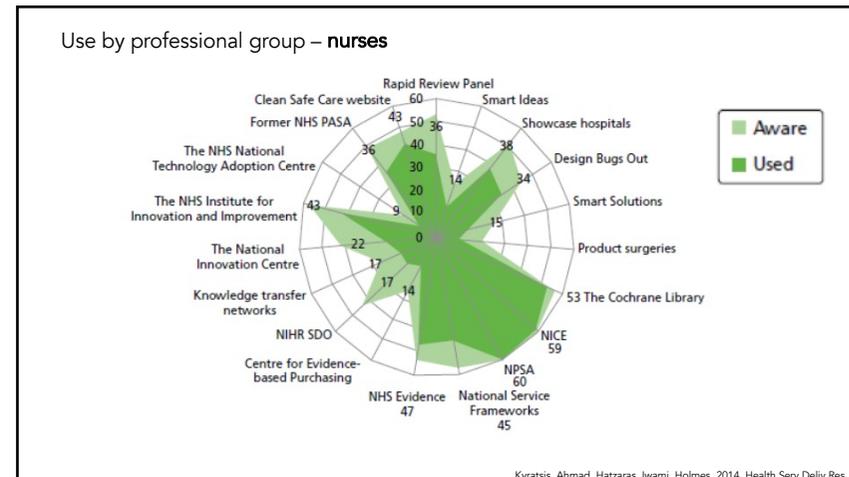
The diagram illustrates the relationship between implementation stages and involvement levels. A horizontal bar at the top is divided into four stages: Initiation, Decision Making, Implementation planning, and Implementation execution. Below this, three concentric circles represent levels of involvement: the innermost circle is the 'IPC team', the middle circle is 'Wider hospital', and the outermost circle is 'External to hospital'. The circles are shaded in increasing intensity from the innermost to the outermost.

Ahmad et al., 2012, JHI

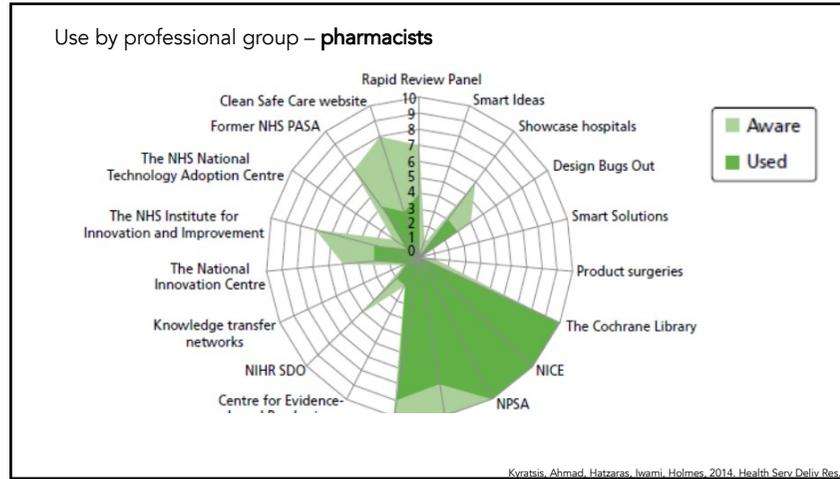
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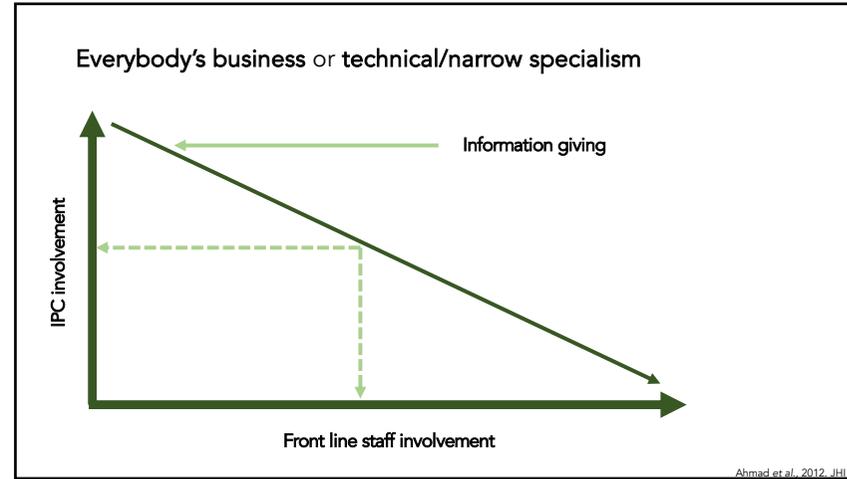
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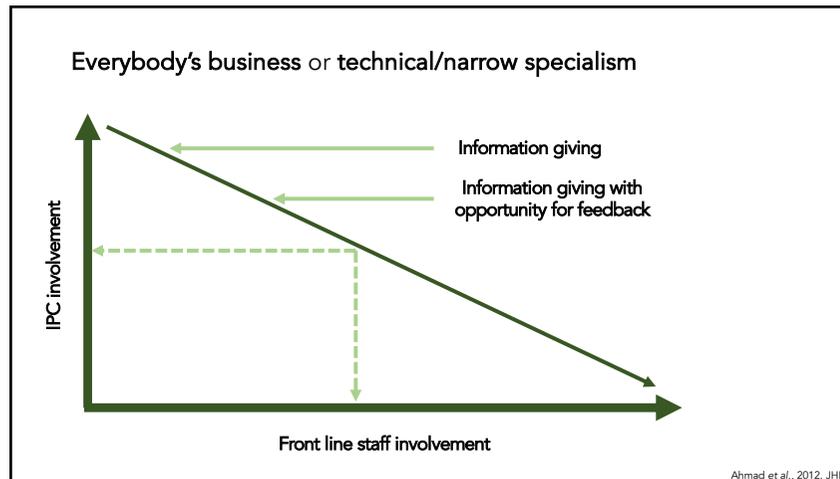
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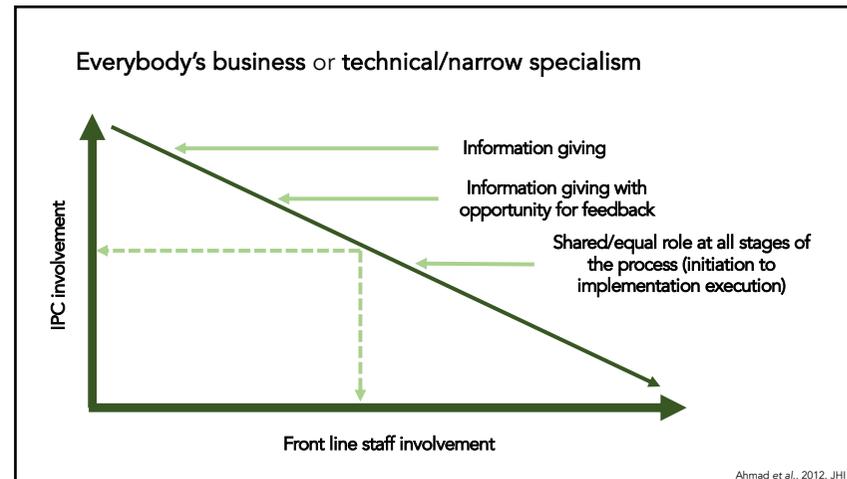
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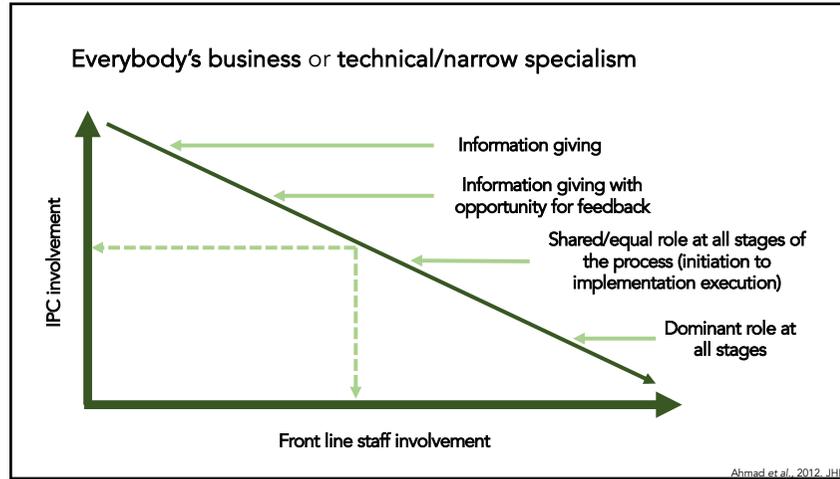
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Principles of behaviour change – what, how, and who?

To promote prudent use of antimicrobials in primary care in England

- A mixed approach
- Monitoring and feedback
- Letter from the Chief Medical Officer
- Quality premium (incentive)
- Addition of primary care prescribing information open access to all providers

PHE, 2018, ESPAUR

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Principles of behaviour change – what, how, and who?

Quality Premium – indicators

#	Indicator Name	Weighting
1	Early Cancer Diagnosis	17%
2	GP Access and Experience	17%
3	Continuing Healthcare	17%
4	Mental Health	17%
5	Bloodstream Infections	17%
6	RightCare*	15%

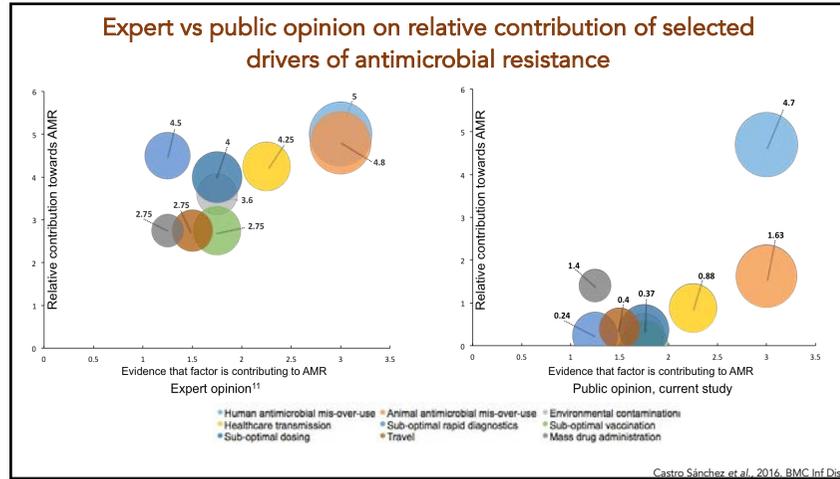
NHS England

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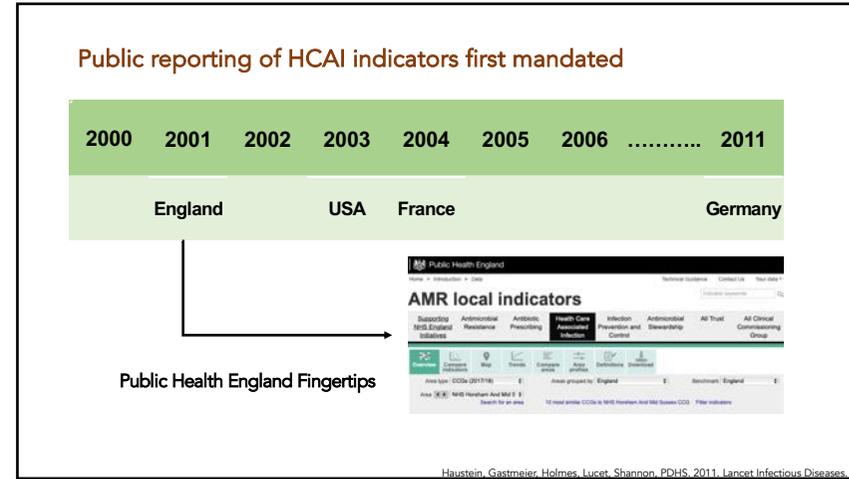
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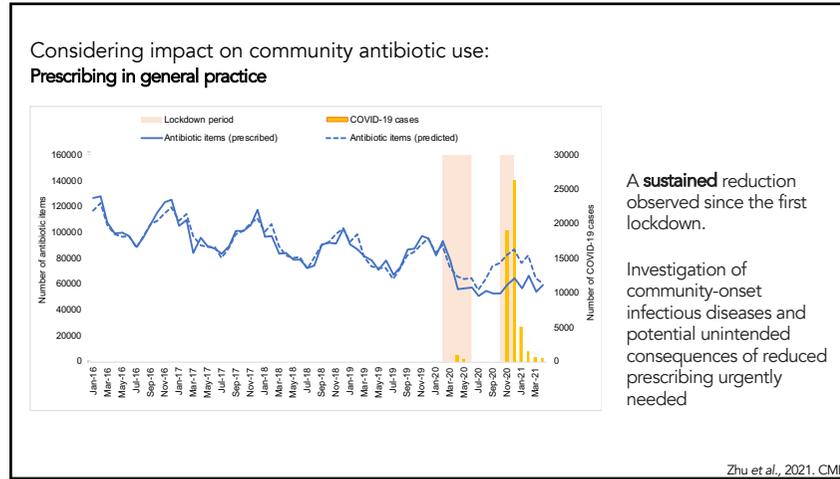
Antimicrobial use, drug-resistant infections and COVID-19

Timothy M. Rawson, Damien Ming, Raheelah Ahmad, Luke S. P. Moore & Alison H. Holmes

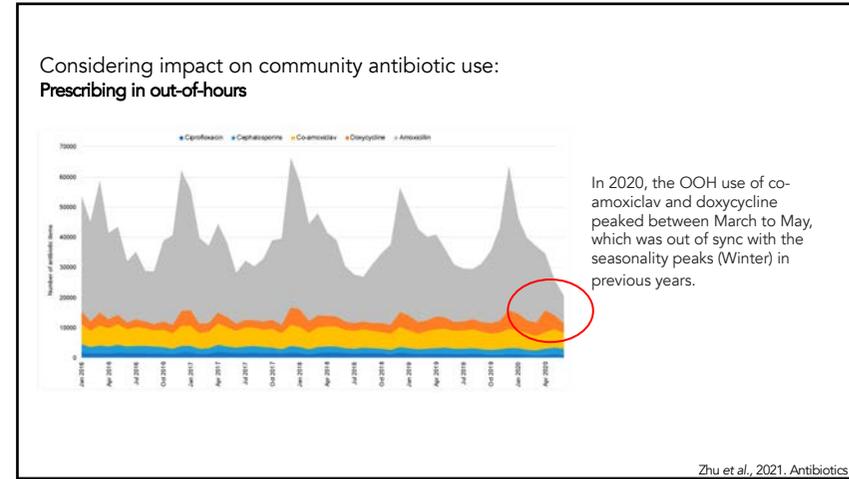
Nature Reviews Microbiology (2020) | Cite this article

- The impact of COVID-19 on antimicrobial use and AMR is complex, nuanced, and context specific (e.g. critical care, secondary care, and community medicine, low vs high resource settings)
- There has been large data on bacterial and fungal co-infections and secondary infections in hospitalised COVID-19 patients

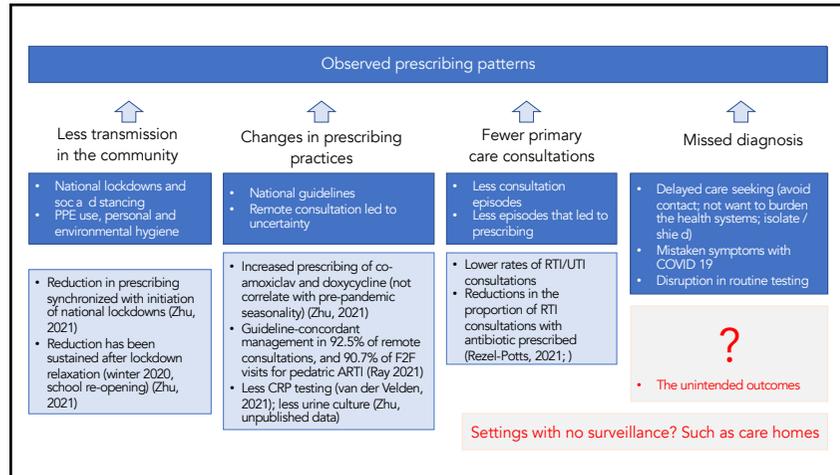
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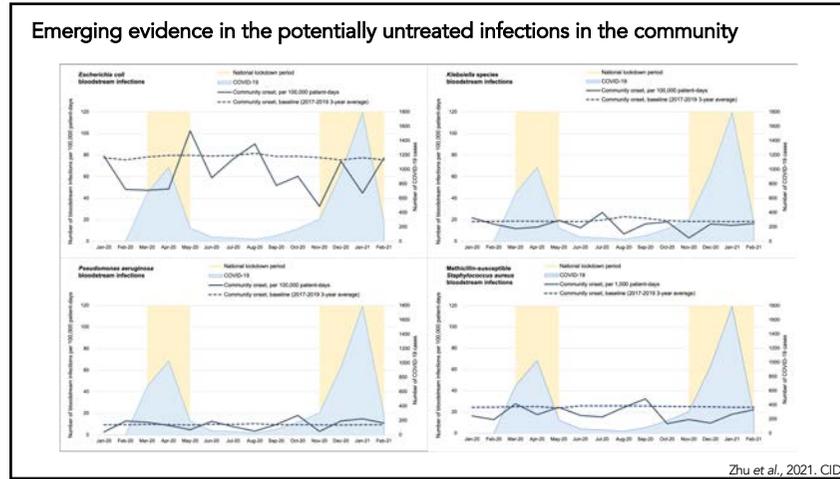
50 1971 2021
BRITISH SOCIETY FOR ANTIMICROBIAL CHEMOTHERAPY

Who we are - What we do - Journals - Events

Plummeting number of UTI diagnoses since the advent of COVID brings huge uncertainty to the management of serious infections in vulnerable patients

- Less presentation to primary care
- Higher diagnostic uncertainty
- Potentially worsened outcomes

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In summary

- **AMR and infection prevention: from international and national imperatives to local implementation**
 - Understand the macro-level factors, especially for governance
 - Mandatory vs voluntary, restrictive vs persuasive

- **A decade of learning from implementation in the English context: what has worked? where next?**
 - Successful implementation of IPC within healthcare facilities required: organisational slack, positive culture, wider engagement, public knowledge mobilisation

- **COVID-19: positive and negative**
 - Emerging evidence showed mixed impact of the pandemic
 - Potential missed / delayed treatment of infections in the community, especially in settings with poor surveillance

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Acknowledgements

Prof Alison Holmes
 Prof Paul Aylin
 Dr Raheelah Ahmad
 Dr Timothy Rawson
 Dr Esmita Charani
 Dr Enrique Castro-Sánchez
 Dr Gabriel Birgand
 Dr Jonathan Otter
 Dr James Price

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Imperial College London

Imperial College Healthcare **NHS**
NHS Trust

World Health Organization

NIHR Health Protection Research Unit for HCAI and AMR
 Centre for Antimicrobial Optimisation (CAMO)
 Imperial College London
 Imperial College Healthcare NHS Trust.

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