Evolution and Future of Antimicrobial Stewardship

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DISCLOSURES

- Consultant/Advisory Boards:
  - ThermoFisher [Biomarker for infection];
  - Shionogi (Scientific Advisory Council);
  - Merck (pneumococcal vaccine)
  - Paratek (Antimicrobial)
- Member of DSMB:
  - Eagle Pharmaceuticals (severe community-acquired pneumonia [CAP] study)
  - NefroHealth/Clinical Trial Services (Renal transplant study)
- UpToDate: Author, Section Editor
  - Respiratory Infections – including immunizations
- *Infectious Diseases in Clinical Practice*: Editor-in-Chief

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Objectives

- Describe the history of antimicrobial stewardship (AS)
- Review the development of the principles and core elements of AS
- Explain relationship of diagnostic testing and AS
- Describe the value of artificial intelligence on AS in the future

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Antimicrobial Resistance: Public Health Crisis

- The discovery of potent antimicrobial agents was one of the greatest contributions to medicine in the 20th century.
- Now THREATENED due to resistance

World Health Organization

- Antibiotic resistance: a threat to global health security
  -May 2013

PAST

Question slide

Who of the following was first to warn of the problem of drug/antimicrobial resistance?

a. Joseph Lister (1827-1912)
b. Paul Ehrlich (1832-1915)
c. Alexander Fleming (1881-1955)
d. Robert Koch (1843-1910)

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Prophetic Words

Drug resistance follows the drug like a faithful shadow."

— Paul Erhlich, 1854-1915 (Lancet 1913)

"There is the danger that the ignorant man may easily under dose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant."

— Alexander Fleming Nobel Prize lecture, Dec 11, 1945

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The Misuse of Antimicrobics
(from Symposium on Efficacy of New Drugs)

Soon after penicillin became available, 15 years ago, its eventual misuse, commercialization and possible untoward effects were foreseen. Official regulation was proposed to prevent absurd inclusion of penicillin in chewing gum, lotions, cough drops and the like. At present, an estimated 90 per cent of the use of antimicrobics is unnecessary. Besides the wastage from indiscriminate or misapplied use of any antimicrobic, harm may accrue in the forms listed:

Sensitization	Emergence of drug-resistant microbes
Reactions of hypersensitization	Discomfort of therapy
Toxicity	Unnecessary expense
Bacterial acquisition of resistance	Disappointment

Reiman HA. Med Clinics NA 1961; v4: 849-856

The Misuse of Antimicrobics

Causes of Misuse:

- Treatment of Trivial Infections (e.g., cold sore throat…..)
- Unnecessary Prophylaxis (e.g., prevention of 2nd bacterial infection during viral URI)
- Treatment of disease uninfluenced by antimicrobics (e.g., lupus)
- Overdosage/underdosage ("In the early 1940's, 40,000 units of penicillin/day lobar pneumonia")
- Unnecessary Combinations
- Demand of patient and family ("Physicians themselves are offenders of self-medication. Some are know to carry antimicrobics in their pocket for a quick dose if a sniffle or cough appears")
- Advertising

Reiman HA. Med Clinics NA 1961; v4: 849-856

The Misuse of Antimicrobics

"**The proper use of antimicrobics can be attained by comprehension of their place, value and proper dosage in amount and time**. Empiric is justified if properly controlled. The Hippocratic injunction "first do no harm" or **the question "Is this drug really necessary?"** are pertinent. **Much needless expense, untoward effect, harm and disappointment can be prevented by better judgment in the use of antimicrobics…"**

Reiman HA. Med Clinics NA 1961; v4: 849-856

Alliance for the Prudent Use of Antibiotics

- In 1981, clinician-scientist Stuart B. Levy founded the Alliance for the Prudent Use of Antibiotics at Tufts University, advocating globally for cautious antibiotic usage.
- The Alliance for the Prudent Use of Antibiotics evolved into a significant educational and advocacy body, later merging with the International Society of Antimicrobial Chemotherapy in 2019.

Guidelines for Improving the Use of Antimicrobial Agents in Hospitals: A Statement by the Infectious Diseases Society of America

The IDSA recommends that each hospital establish and provide the necessary financial and administrative support for a multidisciplinary team concerned with optimum usage of antimicrobial agents.

- Infectious Disease Physician
- Infection Control Practitioner
- Clinical Microbiologist
- Clinical Pharmacist

Function: Selection of antimicrobial agents; Educational programs; Methods to improve antimicrobial usage:

- Antibiotic order forms; Automatic stop orders; Limited susceptibility reporting; Audits of use

Marr JJ et al. J Infect Dis. 1988; 157: 869-875

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“Antimicrobial Stewardship”

- The term ‘antimicrobial stewardship’ attributed to John E. McGowan, Jr. and Dale N. Gerding in 1996 referring to the concept of responsible custodianship of antimicrobials as a shared, finite resource and in response to the concern of increasing antimicrobial resistance.
- The principle of Antimicrobial Stewardship (AMS) establishes the optimal selection, dosing, and duration of therapy for the best clinical outcome with consideration regarding the impact on resistance.

Owens R, Ambrose PG. Diag Microb Infect Dis. 2007

Society for Healthcare Epidemiology of America and Infectious Diseases Society of America Joint Committee on the Prevention of Antimicrobial Resistance: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals

David M. Shlaes, Dale N. Gerding, Joseph F. John, Jr., William A. Craig, Donald L. Bornstein, Robert A. Duncan, Mark R. Eckman, William E. Farrer, William H. Greene, Victor Lorian, Stuart Levy, John E. McGowan, Jr., Sindy M. Paul, Joel Ruskin, Fred C. Tenover, and Chatrchai Watanakunakorn

From Wyeth-Ayerst Research (Dr. Shlaes), Pearl River, New York; Veterans' Affairs Lakeside Medical Center (Dr. Gerding), Chicago, Illinois; UMDNJ-Robert Wood Johnson Medical School (Dr. John), New Brunswick, New Jersey; William S. Middleton Memorial Veterans' Hospital (Dr. Craig), Madison, Wisconsin; SUNY Health Science Center (Dr. Bornstein), Syracuse, New York; Lahey Clinic (Dr. Duncan), Burlington, Massachusetts; Duluth Clinic Limited (Dr. Eckman), Duluth,

Antimicrobial resistance results in increased morbidity, mortality, and costs of health care. Prevention of the emergence of resistance and the dissemination of resistant microorganisms will reduce these adverse effects and their attendant costs. Appropriate antimicrobial stewardship that includes optimal selection, dose, and duration of treatment, as well as control of antibiotic use, will prevent or slow the emergence of resistance among microorganisms. A comprehensively applied infection control program will interdict the dissemination of resistant strains.

Clinical Infectious Diseases 1997;25:584–99

BAD BUGS, NO DRUGS

2004: IDSA sent a white paper to Capital Hill stressing the rapidly growing public health crisis in the emergence of bacteria that were resistant to many, if not all, antibiotics that typically had activity against them.

IDSA. Bad Bugs, No Drugs, July 2004

Present

Question:

According to the IDSA/SHEA Antimicrobial Stewardship Guidelines of 2007, A comprehensive evidence-based stewardship program should include which of the following

a. Be Independent of Hospital Administration
b. Include an infectious diseases physician and a clinical pharmacist with ID training as core members
c. Avoidance of extra compensation for AS activities
d. Have cost reduction as the primary purpose

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Antimicrobial Stewardship:

Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship

Timothy H. Dellit,[1] Robert C. Owens,[2] John E. McGowan, Jr.,[3] Dale N. Gerding,[4] Robert A. Weinstein,[5] John P. Burke,[6] W. Charles Huskins,[7] David L. Paterson,[8] Neil O. Fishman,[9] Christopher F. Carpenter,[10] P. J. Brennan,[9] Marianne Billeter,[11] and Thomas M. Hooton[12]

Definition

"An ongoing effort…to optimize antimicrobial use in order to **improve patient outcomes**, and reduce adverse sequelae of antimicrobial use (including antimicrobial **resistance**, **C difficile**)...Effective antimicrobial stewardship programs can be financially self-supporting and improve patient care"

Dellit T, et al. *Clin Infect Dis.* 2007;44:159-177.

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Definition

"An ongoing effort…to optimize antimicrobial use in order to **improve patient outcomes**, and reduce adverse sequelae of antimicrobial use (including antimicrobial **resistance**, **C difficile**)...Effective antimicrobial stewardship programs can be financially self-supporting and improve patient care"

1. Core members of a multidisciplinary antimicrobial stewardship team include an infectious diseases physician and a clinical pharmacist with infectious diseases training

Dellit T, et al. *Clin Infect Dis.* 2007;44:159-177.

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Strategies for Improving Antimicrobial Use and the Role of Antimicrobial Stewardship Programs

Thomas M. File Jr,[1,2] Joseph S. Solomkin,[3] and Sara E. Cosgrove[4]

ASPs can act as a central hub for all antimicrobial use and should, as per the IDSA stewardship guidelines, play a role in educational initiatives, infection control strategies, and interdepartmental and interdisciplinary communication and collaboration.

Clin Inf Dis. 2011. 53(S1):S15–S22

Summa Started Comprehensive ASP-2010

Tamara L. Trienski, PharmD and Thomas M. File, Jr. MD

Summa Health System, Akron, OH

Conclusions

Our ASP has been well received with a high rate of accepted recommendations and positive feedback. This is attributed to be a result of pre-implementation education by the ASP to medical staff, as well as positive, real-time educational interaction by an Infectious Diseases Physician at the time of recommendation.

Our ASP has been associated with:

1. Decrease in Antimicrobial Utilization Rates.
2. Decrease in Antimicrobial Resistance Rates.
3. Cost Savings associated with Antimicrobial Expenditures.

Clinical Infectious Diseases

IDSA GUIDELINE

Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America

Tamar F. Barlam,[1,a] Sara E. Cosgrove,[2,a] Lilian M. Abbo,[3] Conan MacDougall,[4] Audrey N. Schuetz,[5] Edward J. Septimus,[6] Arjun Srinivasan,[7] Timothy H. Dellit,[8] Yngve T. Falck-Ytter,[9] Neil O. Fishman,[10] Cindy W. Hamilton,[11] Timothy C. Jenkins,[12] Pamela A. Lipsett,[13] Preeti N. Malani,[14] Larissa S. May,[15] Gregory J. Moran,[16] Melinda M. Neuhauser,[17] Jason G. Newland,[18] Christopher A. Ohl,[19] Matthew H. Samore,[20] Susan K. Seo,[21] and Kavita K. Trivedi[22]

I. DOES THE USE OF PREAUTHORIZATION AND.OR PROSPECTIVE AUDIT AND FEEDBACK INTERVENTIONS BY ASPS IMPROVE ANTIBIOTIC UTILIZATION AND PATIENT OUTCOMES?
II. Is Didactic Education a Useful Antibiotic Stewardship Intervention for Reducing Inappropriate Antibiotic Use?
III. Should ASPs Develop and Implement Facility-Specific Clinical Practice Guidelines for Common Infectious Disease Syndromes to Improve Antibiotic Utilization and Patient Outcomes?

Clin Infect Dis 2016

Antimicrobial Stewardship Center of Excellence (CoE)

- The IDSA CoE program recognizes institutions that have created stewardship programs led by infectious diseases physicians and ID-trained pharmacists that are of the highest quality
  - 194 hospitals have received the designation since the program's launch in 2017
  - SUMMA-one of first 4 recognized
  - **Have observed reduction: Doses/days of ABX; LOS; Readmission rates; Mortality ICU; Resistance; Cost**

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National Action Plan for Combating Antibiotic-Resistant Bacteria

GOALS

- **Slow the emergence of resistant bacteria** and prevent the spread of resistant infections
- **Strengthen national one-health** surveillance efforts to combat resistance
- **Advance development and use of rapid and innovative diagnostic tests** for identification and characterization of resistant bacteria
- Accelerate basic and applied research and **development for new antibiotics, other therapeutics, and vaccines**
- **Improve international collaboration** and capacities for antibiotic-resistance prevention, surveillance, control and antibiotic research and development

National Action Plan for Combating Antibiotic-Resistant Bacteria. March 2015. Available: https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibotic-resistant_bacteria.pdf. Accessed 8-21-2015

CDC Core Elements of ASP

Table 2. Centers for Disease Control and Prevention Core Elements of an Effective Antimicrobial Stewardship Program

Leadership commitment: adequate personnel, financial, and information technology resources are available
Accountability: a single leader is responsible for program outcomes
Drug expertise: ASP-dedicated pharmacists are responsible for assisting with the implementation of ASP goals and initiatives
Action: recommendations are implemented that are supported by scientific evidence and endorsed by professional societies
Monitoring: antimicrobial prescribing and local resistance patterns are tracked
Feedback: data on antimicrobial use and resistance are reported to physicians and nonphysician prescribers
Education: physicians and nonphysician prescribers receive education regarding rational antimicrobial prescribing and local resistance patterns

Pollack LA, Srinivasan A. Clin Infect Dis. 2014; 59: S97-100

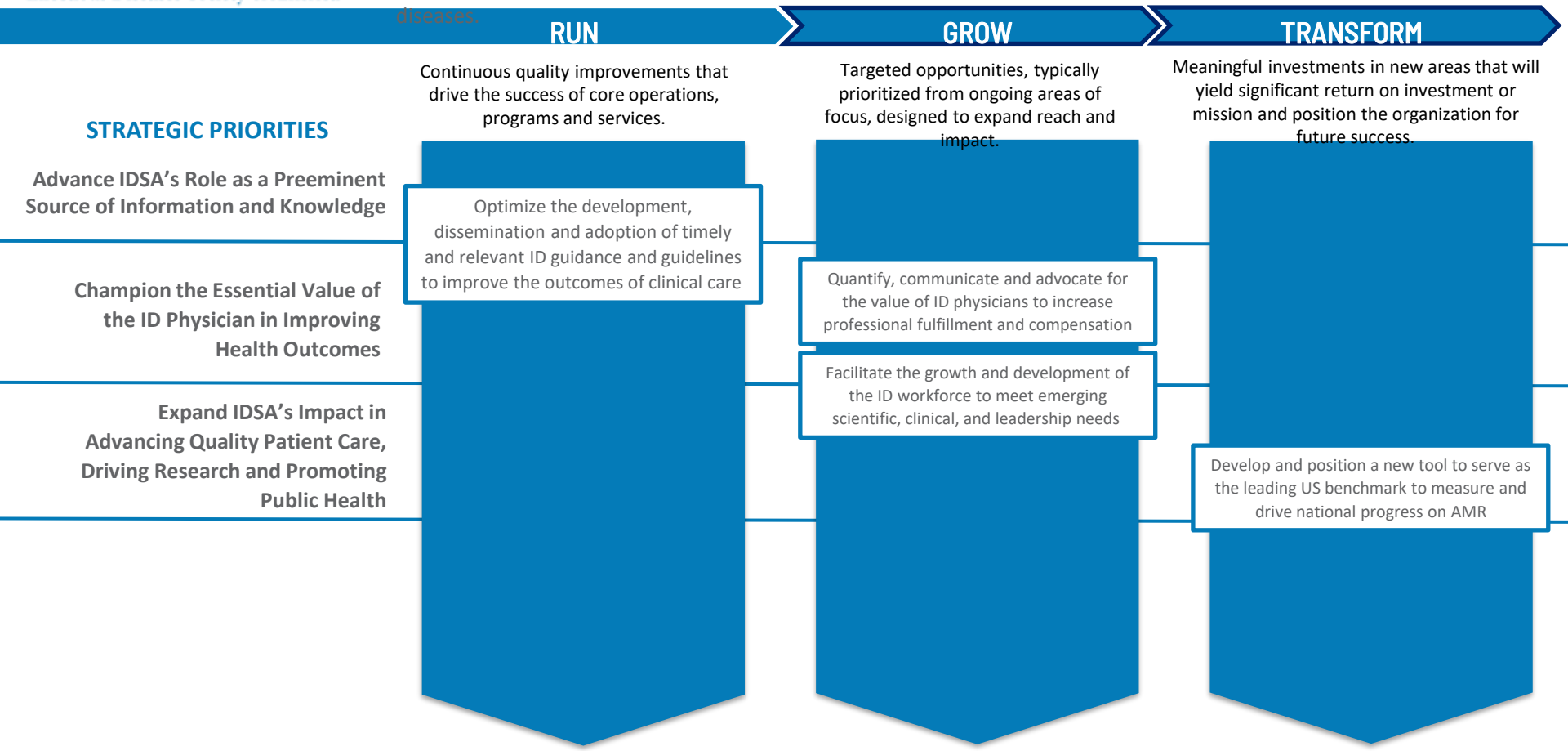
Joint Commission and CMS reinforce stewardship

- 2017: The Joint Commission recommended that all accredited hospitals establish active stewardship programs with clearly defined roles and protocols
- 2020: Centers for Medicare and Medicaid Services regulations mandated antimicrobial stewardship programs for all U.S. hospitals by March 2020
- However, the quality and effectiveness of these programs varied

IDSA
Infectious Diseases Society of America

MISSION STATEMENT | To improve the health of individuals, communities, and society by promoting excellence in **patient care**, **education**, **research**, **public health**, and **prevention** relating to infectious diseases.

VALUES | Leadership • Excellence • Diversity • Collaboration • Innovation



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Guidance for the Knowledge and Skills Required for Antimicrobial Stewardship Leaders

2014

Sara E. Cosgrove, MD, MS;[1] Elizabeth D. Hermsen, PharmD, MBA;[2] Michael J. Rybak, PharmD, MPH;[3] Thomas M. File Jr, MD;[4] Sarah K. Parker, MD;[5] Tamar F. Barlam, MD[6]

Antimicrobial stewardship programs are increasingly recognized as critical in optimizing the use of antimicrobials. Consequently, more physicians, pharmacists, and other healthcare providers are developing and implementing such programs in a variety of healthcare settings. The purpose of this guidance document is to outline the knowledge and skills that are needed to lead an antimicrobial stewardship program. It was developed by antimicrobial stewardship experts from organizations that are engaged in advancing the field of antimicrobial stewardship.

Infect Control Hosp Epidemiol 2014;35(12):1444-1451

TABLE 1. Knowledge and Skills for Implementation and Maintenance of an Antimicrobial Stewardship Program (ASP)

Category	Knowledge	Skills
General principles of antimicrobial stewardship		
	Understand the mission and goals of antimicrobial stewardship	State the mission and goals of antimicrobial stewardship
	Understand the linkage between antimicrobial use and resistance, selection of pathogenic organisms (eg, *Clostridium difficile*), and other adverse patient outcomes	Describe the relationship between antimicrobial use and resistance, selection of pathogenic organisms, and adverse patient outcomes
	Understand the roles and responsibilities of stakeholders in antimicrobial stewardship, including physician, pharmacist, infection preventionist, microbiologist, hospital administrators	List individuals and disciplines that should be involved in antimicrobial stewardship and explain rationale for inclusion

Antimicrobial Stewardship & Healthcare Epidemiology (2026), **6**, e130, 1–13
doi:10.1017/ash.2026.10344

Original Article

Guidance for the Knowledge and Skills required for Antimicrobial Stewardship Leaders: an update from the Society for Healthcare Epidemiology of America, Infectious Diseases Society of America, Pediatric Infectious Diseases Society, and the Society of Infectious Diseases Pharmacists

2026

Marisa Holubar MD, MS[1,2], Tanaya Bhowmick MD[3], Whitney R. Buckel PharmD[4], Sara E. Cosgrove MD, MS[5], Christopher Evans PharmD[6], Thomas M. File Jr. MD[7,8], Margaret Fitzpatrick MD, MS[9,10], Elizabeth Leung PharmD[11,12], Anurag N. Malani MD[13], Ana Rios MD[14], Jenna Preusker PharmD[15,16] and Priya Nori MD[17]

Table 1. Fundamental antimicrobial stewardship Knowledge and Skills—Clinical Infectious Diseases

Knowledge/skill		Acute Care[a]	Out-patient[a]	Long-term care[a]	Basic (B)	Intermediate (I)	Advanced (A)
Antimicrobials	Mechanisms of action and spectrum of activity	B, I, A	B, I	B, I	Understand differences in mechanisms of action and spectrum of activity of *commonly used* antimicrobials.	Understand differences in mechanisms of action and spectrum of activity *within* drug classes. Educate frontline prescribers about mechanisms of action and spectrum of activity of *common* antimicrobials.	Educate frontline prescribers about mechanisms of action and spectrum of activity of *less* common antimicrobials (eg those used to treat extensively drug-resistant infections).
	Antimicrobial resistance	B, I, A	B	B, I	Recognize *common* resistance profiles based on local epidemiology for antimicrobial / organism combinations and distinguish	Recognize *less common* resistance profiles based on local epidemiology and design recommendations to optimize treatment	Recognize viral and fungal resistance profiles, especially in special populations.

FUTURE

Trying to predict the future is a discouraging and a hazardous occupation.

Arthur C Clarke 1964 (Science fiction writer; co-wrote 2001: a Space Odyssey)

Future

- Innovations
  - Technological advances
  - Rapid diagnostic testing
  - Newer approaches to mitigation of Infectious Diseases (vaccines, novel antimicrobials targeting different sites of microbes-e.g., virulence factors)
- Expanding to all Areas (outpatients, LTCF, Environment, Agriculture, Dentists, Veterinarians, (‘One Health’,)
- Legislative influences (GAIN, Pasteur, DISARM acts)

Future

- Artificial Intelligence/Machine Learning

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Future

Question

According to recent reports, which of the following is most accurate concerning the impact of Artificial Intelligence on Antimicrobial Stewardship

a. Has the potential to improve antimicrobial prescribing

b. Will be easily implemented

c. Will be quickly adopted by healthcare professionals

d. Will be able to readily interpret changes in pathogen genetics

Deaths Due to Drug-resistant Bacteria Predicted to Skyrocket

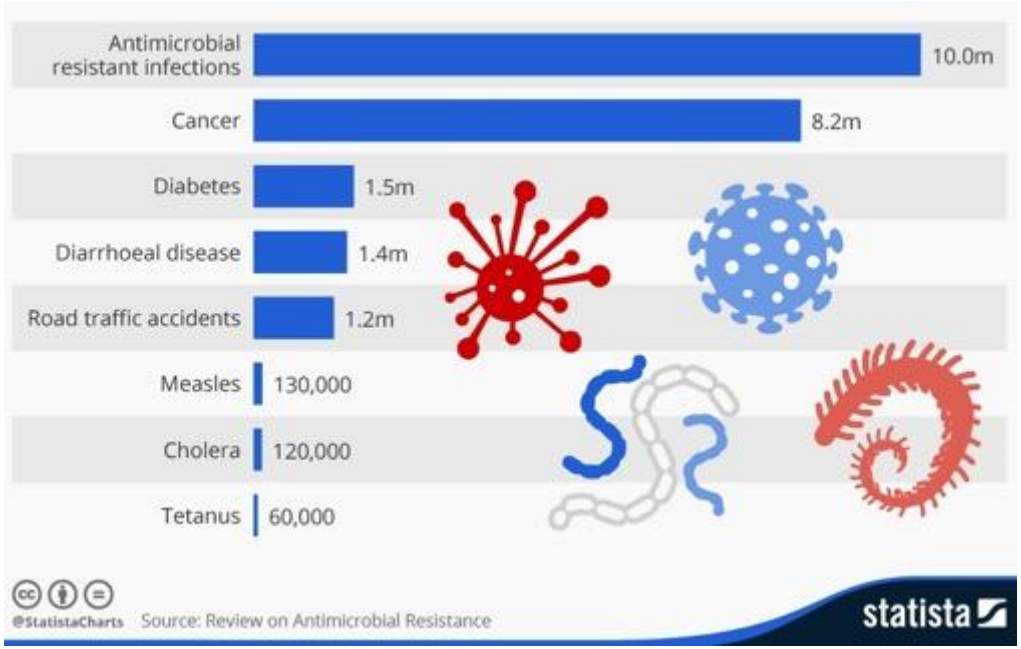
- Each year in the United States, ≈2 million people have resistant bacterial infections; 23,000 people die as a direct result[1], and the problem is getting worse[2,3]

Predictions for 2050

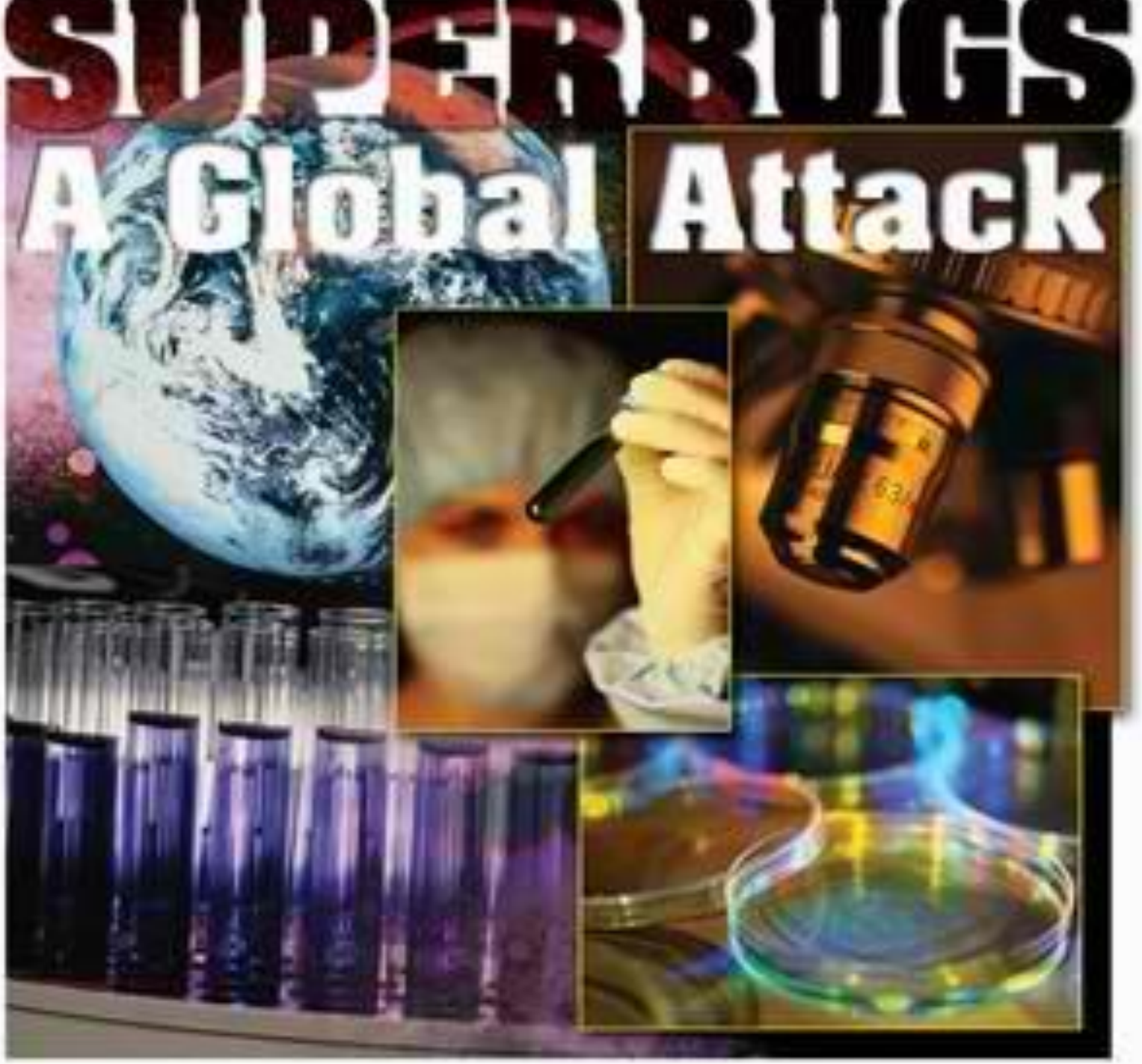
- **10 million deaths** due to resistant infections (up from 700,000 in 2013)[3]
- Costs will be **≈$100 trillion[3]**

Death From Drug-Resistant Infections Set to Skyrocket

Deaths from antimicrobial-resistant infections and other causes in 2050

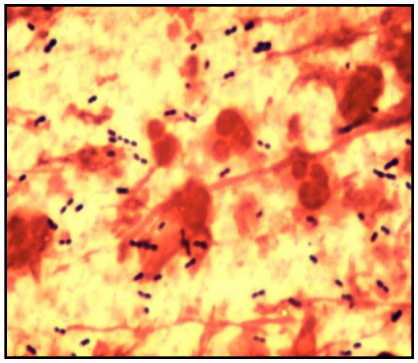


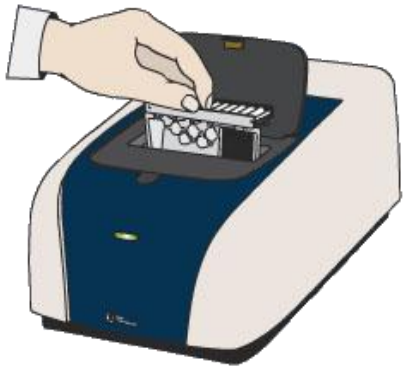
1. Centers for Disease Control and Prevention. Antibiotic/Antibiotic Resistance. http://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf/. Accessed September 14, 2015. 2 Beck J. *The Atlantic*. June 27, 2015. http://www.theatlantic.com/health/archive/ 2015/06/how-to-stop-prevent-antibiotic-resistance-resistant-bacteria/397058/. Accessed September 14, 2015. 3. McCarthy N**.** Deaths from drug-resistant Infections set to skyrocket. January 5, 2015. http://www.statista.com/chart/3095/drug-resistant-infections/. Accessed September 14, 2015.


SUPERBUGS
A Global Attack

Advances of Diagnostic Tests for Etiology of Infectious Diseases

- Standard culture methods (blood, sputum)
  - Low yield, time to results
- Gram stain, urinary antigen testing
  - *S pneumoniae*, *Legionella* spp
- **Newer molecular tests (PCR, NGS)**
  - **Potential for more rapid diagnosis, greater sensitivity**
  - **Allows for pathogen-directed therapy**
- **Biomarkers**
  - **Procalcitonin**
  - **Others (adrenomedullin, dTREM-1, Presepsin)**
  - **Host expression panels (Septicyte, IntelliSep, Triverity)**





PCR, polymerase chain reaction; NGS, Next Generation Sequencing

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CHEST Commentary

Rapid Diagnostic Testing for Community-Acquired Pneumonia

Can Innovative Technology for Clinical Microbiology Be Exploited?

Victor L. Yu, MD; and Janet E. Stout, PhD

- Two nonsynchronous events have affected management of CAP
  - Spiraling empiricism
    - Broad spectrum antimicrobial therapy with deemphasis of microbiology
      - Just treat for everything
      - Consequence of Increase Resistance; Adverse Effects
    - "Golden era" of clinical microbiology
      - Non culture-based (e.g., Urinary Antigen, Molecular tests, Metagenomics)
      - Rapid ID of pathogen
      - Offers more specific therapy

(Chest 2009; 136: 1618)

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Use of Multiplex PCR and Antimicrobial Stewardship Intervention to Optimize Antimicrobial Therapy in Pneumonia Patients at a Community Teaching Hospital

• Paula A. Politis, PharmD, BCPS, BCIDP, FIDSA; Matthew R. England, PhD, D(ABMM); Thomas M. File, Jr. MD, MSc, MACP, FIDSA, FCCP Summa Health System – Akron Campus, Akron, OH

	Total Patients (n = 91)
ICU location, no. (%)	52 (57%)
Positive culture with ≥ 1 organism, no. (%)	35 (38%)
Positive PN with ≥ 1 organism, no. (%)	75 (82%)
ASP recommendation for more appropriate antimicrobials, no.	66 (73%)
	Positive culture (n = 35)
Same organism identified on PN, no. (%)	34 (97%)
	Negative culture* (n = 56)
Positive PN with ≥ 1 organism, no. (%)	42 (75%)

Conclusions

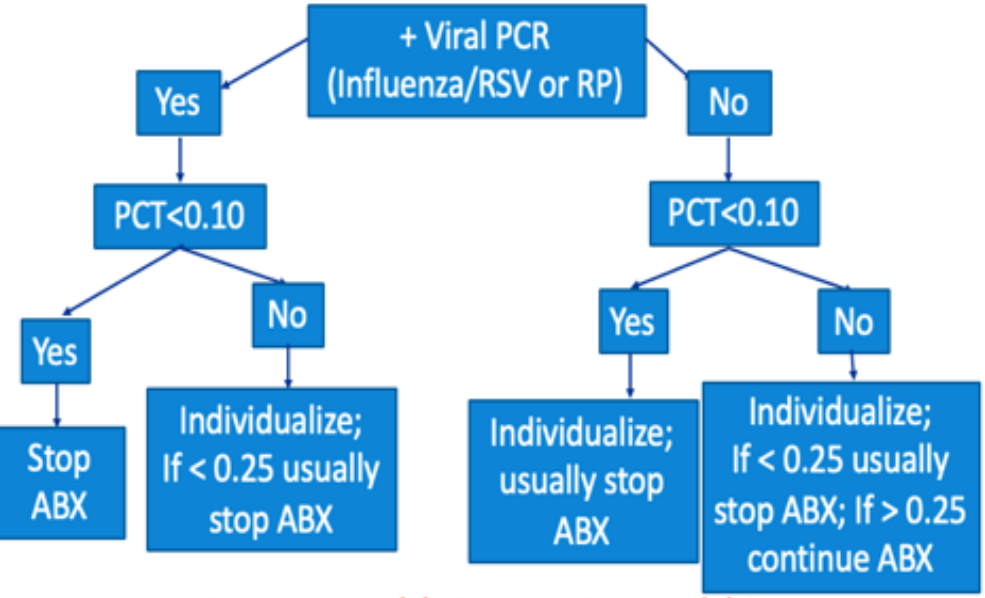
- **PN significantly identified more likely pathogens than standard culture methods and correlated well when standard cultures were positive**
- The PN significantly enhanced the detection of potential pathogens in patients with CAP and HAP.
- When paired with ASP recommendations, the PN optimized antibiotic utilization and enhanced antimicrobial stewardship efforts.

Politis et al. IDWeek 2024

Early Discontinuation of Antibacterials is Safe for Patients with Community-Acquired Pneumonia (CAP) Who Have a Positive Viral Test, Negative Tests for Bacteria, and Low Procalcitonin

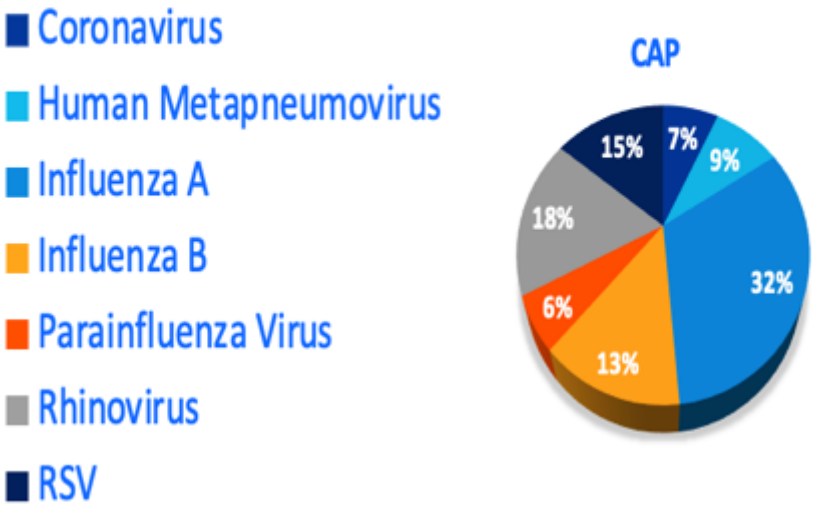
Paula A. Politis, PharmD, BCPS; George Kallstrom, PhD; Michael J. Tan, MD, FACP, FIDSA; Thomas M. File Jr., MD, MSc, MACP, FIDSA, FCCP
Summa Health System – Akron Campus, Akron, OH

Figure 4: Use of Procalcitonin with + Viral PCR



Summa Health System Stewardship

Figure 3: Viruses Isolated



- 68 cases viral pneumonia: **Mean antibiotic duration was 2.6 days for patients with CAP in comparison to standard of care duration for CAP (5-7 days)**
- 30 day mortality and 30 day readmission rate similar for all cause pneumonia at our institution
- **Conclusion: Discontinuing antibiotic is safe if a viral etiology is identified without evidence of bacterial co-infection (low procalcitonin) and results in less antibiotic usage**

Rapid Pneumonia Panel Improves Early Antibiotic Optimization

- National, multicenter retrospective study, ICU, VA hospitals
- 11,746 patients, including 4523 from hospitals implementing multiplex pneumonia panel; 7223 matched controls
- Findings
  - **Panel significantly associated with de-escalation (aRR, 1.23; 95% CI, 1.02-1.50) and early appropriate therapy**.
  - Overall **mortality similar but was relatively lower among culture-positive patients**
  - Improvements were **most evident in hospitals with greater ASP capacity**

Britt NS et al. Clin Infect Dis. 2026; published online June 12

OPEN

Next-Generation Sequencing in Periprosthetic Joint Infections

Clinicians' Guide to Its Diagnostic Role

Ravina Kullar, PharmD, Craig D. Tipton, PhD,† Thomas File, MD,‡ Alisina Shahi, MD, PhD,§ Jason C. Sniffen, DO,|| and Ellie J.C. Goldstein, MD¶*

TABLE 1. Microbiological NGS Approaches Commercially Available for Infectious Disease and Used in PJI

Method	Companion Diagnostics	Sample Type Accepted	Outcome Driven Findings*	Provider	References
Amplicon sequencing (bacterial and fungal)	qPCR and biomarker† panels	Multiple body fluids, tissues, swabs, and pooled samples in orthopedics; paraffin embedded tissue	Improve chronic wound healing rate, reduce postoperative infection following lithotripsy, reduce urinary tract infection symptoms, and diversify the usage of antibiotics	MicroGen DX	14,28,30,32,35
Amplicon sequencing (bacterial, fungal, or parasitic)	qPCR	Multiple body fluids, tissues, and swabs; paraffin embedded tissue		U. Washington	36
Amplicon sequencing (bacterial and fungal)	qPCR	Multiple body fluids, tissues, and swabs	Clinical management changes (eg, antibiotic de-escalation)	Mayo Clinic	37
Metagenomic sequencing		Blood (plasma)		Karius	38–41

*Outcome-driven findings defined as cohort studies such as randomized controlled trials and retrospective studies comparing treatment guided by an NGS LDT versus a standard of care.

†Biomarker panels available for qualifying specimen types such synovial fluid and urine.

Effect of Introducing Procalcitonin on Antimicrobial Therapy Duration in Patients With Sepsis and/or Pneumonia in the Intensive Care Unit

Annals of Pharmacotherapy
1–7

DOI: 10.1177/1060028014520957
aop.sagepub.com
SAGE

Bryan M. Bishop, PharmD[1], John J. Bon, PharmD[1], Tamara L. Trienski, PharmD[1], Timothy R. Pasquale, PharmD[1], Bradley R. Martin, MD[1], and Thomas M. File Jr, MD[1]

- Observational, historical control to assess impact of PCT in ICU; Education of staff prior to introduction
- 50 patients with PCT at initial suspicion of infection and 48 hrs
  - 50 Control pts--same time frame, diagnosis, gendr, age, APACHE II
- Active ASP in place
- Findings:
  - **Duration of ABX decreased by 3.3 days (p=0.0238)**
  - **Duration in hospital decreased by 4.3 days (p=0.029)**
  - **Readmission to hospital decreased by 16% (p=0.055)**
  - **Mortality 2% vs 4% (p=0.5)**

Implementation of a Procalcitonin Assay Requires Appropriate Stewardship to Result in Improved Antimicrobial Use

Tamara L. Trienski, PharmD and Thomas M. File, Jr, MD, MS

An antimicrobial stewardship team that reviews rapid diagnostic testing results and provides feedback to providers can help clinicians understand and act upon these results. Without this oversight, there may be little change in behavior of practitioners. Procalcitonin does not replace clinical judgment but can be a valuable tool regarding the duration of ABX in bacterial infections, including sepsis. [Infect Dis Clin Pract. 2014]

Use of Procalcitonin as a Tool to Enhance Antimicrobial Stewardship

Paula A. Politis[1,2] and Thomas M. File Jr[3,4]

[1]Department of Pharmacy, Summa Health, Akron, Ohio, USA ; [2]College of Pharmacy, Northeast Ohio Medical University, Rootstown, Ohio, USA; [3]Division of Infectious Disease, Summa Health, Akron, Ohio, USA; and [4]Department of Internal Medicine, Infectious Diseases Section, Northeast Ohio Medical University, Rootstown, Ohio, USA

When implementing PCT-guided protocols, ASPs should emphasize that biomarker-guided therapy works best when integrated with clinical assessment and established diagnostic criteria, rather than replacing clinical judgment or being used in isolation from microbiological methods. [Clin Inf Dis. 2026]

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ASM | Journal of Clinical Microbiology

Health system implementation of clinical decision support to optimize respiratory pathogen profile utilization

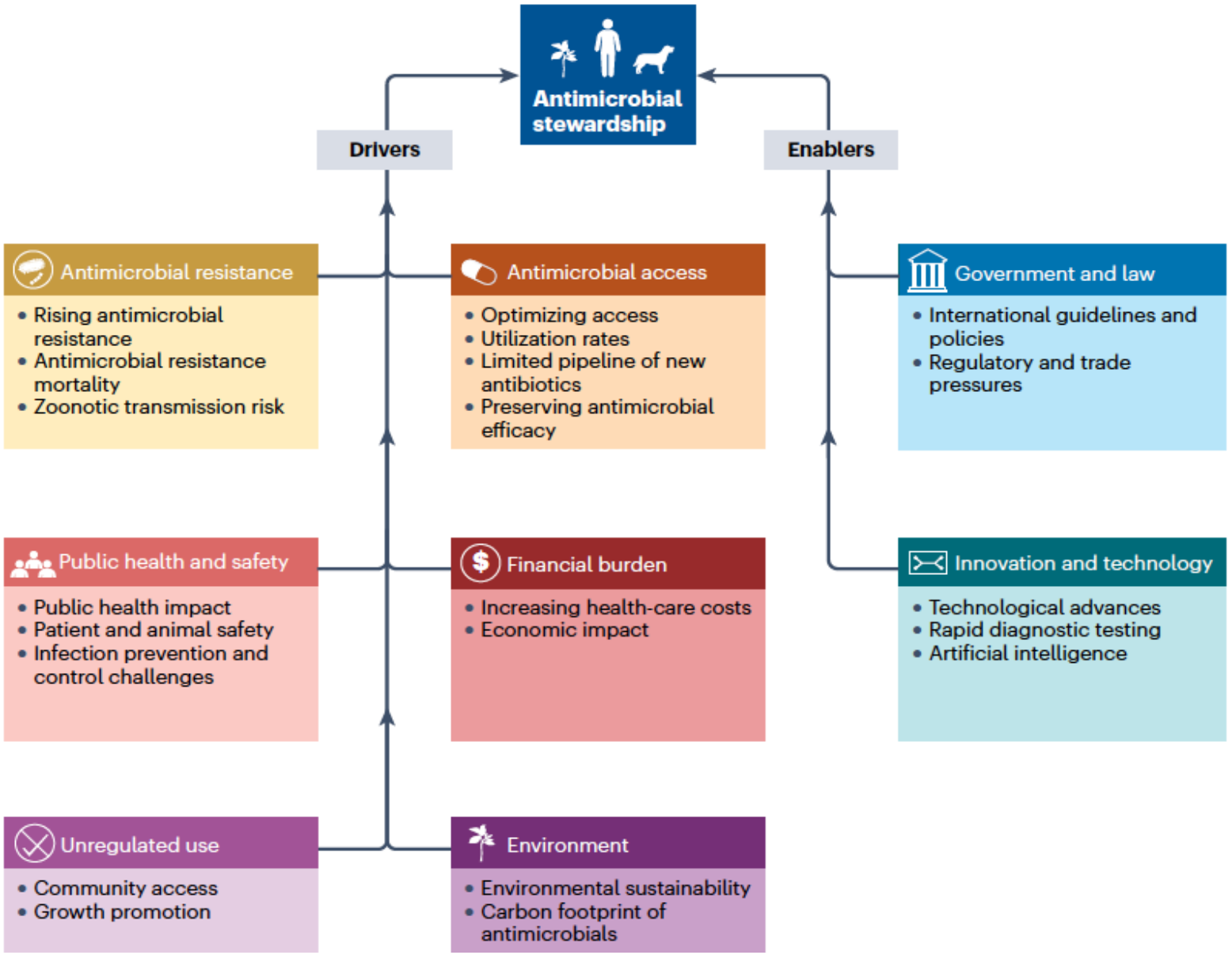
Erika M. Flores,[1,2] Yun Li,[3,4,5] Jenna T. Reece,[1] Mika Epps,[6] Onyeka Nwankwo,[6] Judith O'Donnell,[6] Laurel Glaser,[1] Kyle G. Rodino[1]

- "Diagnostic stewardship ensures that multiplex molecular assays are used to deliver the right test, for the right patient, at the right time. Through coordinated input from interdisciplinary teams across the diagnostic pathway, stewardship enhances test selection, resource utilization, and interpretation of complex syndromic panels"

- "Overall, the **introduction of the clinical decision support successfully reduced the overutilization of large respiratory pathogen syndromic panels** by encouraging the use of a seasonal respiratory viral panel when clinically appropriate."

J Clin Microb July 2026

AS from a One Health Perspective



James R et al. Nature reviews microbiolgy. 2026; 24: 146-162

Importance* of Antimicrobial Stewardship in Evidence-based Guidelines

Infectious Diseases Society of America (IDSA) Position Statement: Why IDSA Did Not Endorse the Community-Acquired Pneumonia Guidelines 2025 Update [1]

Michael Klompas,[1,2] Majdi Al-Hasan,[3,4] Mayar Al Mohajer,[5,6] Robert Colgrove,[7,8] Shira Doron,[9] Thomas File,[10,11] Natasha N. Pettit,[12] Michael Pulia,[13] and Sharon Weissman[3,4]

Balance Versus Bias: Correcting Misinformation About the 2025 American Thoracic Society Community-Acquired Pneumonia Guidelines [2]

We caution **IDSA that their over prioritization of stewardship**, view of pneumonia as a simple condition, and lack of appreciation of uncertainty in the etiologies of pneumonia may suit their short-term goals but will ultimately erode trust, reduce their effectiveness, and impede the shared goal of improving antibiotic use and public health

- *Controversy?
- 1. Clin Infect Dis. 2026; 82: 622-624; 2. Clin Infect Dis. 2026; 83: e219-e220

Question:

For a patient with community-acquired pneumonia, the identification of a virus based on a molecular test has what impact on use of antibacterial agents?

a. It is associated with less use of antibacterial agents

b. It has no effect on use of antibacterial agents since co-infection with a bacteria must be assumed

c. It increases the cost of care

d. It leads to prolongation of hospital stay

CAP with + Virus: ATS vs IDSA

Prescribing empiric antibiotics

Characteristic	ATS	IDSA
1. Outpatient without comorbidity	+	+
2. Outpatient with comorbidity	+	-
3. Inpatient, non severe	+	-
4. Inpatient severe	+	+

- ATS: Concern for co-infection; no evidence that it is safe to withhold antibiotics for patients with viral pneumonia[1]
- IDSA: ABX warranted for some but not all patients in 2 or 3; "clinicians have the capacity to weigh and balance these considerations when determining whether empiric antibiotics are warranted or not"[2]
- **In our experience, when a virus is identified and paired with PCT, along with other factors that lower the likelihood of bacterial co-infection (e,g,, WBC, absence consolidation on imaging), ASP intervention has supported the safe withholding or shortened duration of empiric antibiotics in patients[3-6]**
- Recent observational studies suggest lack of benefit of antibiotics in most patients[.7,8]

1. Jones B et al. AJRCCM July 2025; 2. Klompas M et al. CID Jan 2026; 3. Politis P et alCID, April 2026;4. Politis P et al. OFID 2022; 5. Politis P et al. OFID 2018; 6. Politis et al. OFID 2019 ; 7. Beibelberg B et al. CID 2026; 8. Karlsen KL et al. OFID 2025

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Artificial intelligence-driven approaches in antibiotic stewardship programs and optimizing prescription practices: A systematic Review

- Assessment of 24 studies
- "**Machine learning and AI enhance antimicrobial stewardship by optimizing empirical antibiotic selection, predicting resistance, and dosing, all of which have the potential to reduce mortality**"
- "When used on patients from different regions, systems trained on data from epidemiologically regions usually fail."

Hanrandi H et al. Artificial Intelligence in Med 2025; 162: 103089

The impact of artificial intelligence on the prescribing, selection, resistance, and stewardship of antimicrobials: A scoping review

- 70 sources reviewed; 16 studies included
- **AI improves accuracy of therapy selection, reduces inappropriate prescriptions, aids in clinical decision-making**
- **Barriers: Integration challenges, incorporating AI in real-world clinical settings.**
  - **Concern of the quality and availability of updated data**
  - **Biases in models**
  - **Hesitancy of implementation by HCP due to lack of familiarity**
  - **Integration into EMR**
  - **Rapid genetic and resistance changes of pathogens**

Al Nazrouei N et al BMC Infect Dis. 2026; 26: 222

Artificial intelligence in antimicrobial stewardship: a systematic review and meta-analysis of predictive performance and diagnostic accuracy

- Assessed 3458 studies; Included 80 studies
- AI and machine learning tools could lead to more **precise antimicrobial prescribing, reduce antimicrobial resistance, and better resource utilization**
- **Concern of generalizability**-many studies lacked standardization in methodologies and validation approaches, potentially limiting their applicability in diverse clinical settings.
  - the complexity and interpretability of some ML models pose challenges to their adoption in practice, as they may not be easily understood or trusted by clinicians.

 Pennisi F et al. European J of Clin Microbiol Infect Disse. 2025; 44: 463-513

Summa Health

This Ohio health system tested an AI tool to predict sepsis. Here's how it went

Summa Health's experience highlights the challenges of AI adoption, especially at community health

- 2021: started alert system to flag patients who were likely to develop sepsis
  - "Generated so many flags-as many as 80,000/month-that they couldn't tell which were worth acting on"
- 2024-2025: Tested new AI algorithm as part of multi-center assessment
- **Challenges: Hurdles in**
  - **Culture**
  - **Medical practice**
  - **Resource availability**

Statnews July 6,2025

Summa Health

Artificial Intelligence
Potential in Infectious Diseases

*Munshi Moyenuddin, MD, PhD,**
Thomas M. File, Jr, MD, MSc†

(*Infect Dis Clin Pract* 2026;34:e1621)

- **AI is beginning to move from concept to clinical reality.**
- AI could address the growing threat of antimicrobial resistance, ranging from applications in resistance surveillance to the discovery of new antibiotics
- AI/ML models can potentially increase the likelihood of AMR enhancing antimicrobial stewardship.
- **Challenges and Limitations**
  - **Scarcity of high-quality, unbiased data sources**
  - **Limited understanding of development process in real-world settings**
  - **Trust of end-users**
  - **Requirement of sustained financial support, constant updating with of new evidence, literacy among users, adequate digital infrastructure, consideration of data privacy, governance, and regulatory issues**

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Artificial Intelligence

- Advances in AI have significant potential to connect the use of data to support real-time individualized treatment decisions
- Need more standardization of interpretability to address real-world validation and usage
- But coming QUICKLY

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HATCo, Summa Health announce collaborations to deliver AI initiatives

Patrick Williams
Akron Beacon Journal
USA TODAY NETWORK

When HATCo announced its plan to acquire Akron-based Summa Health and switch the hospital system to a for-profit model, it pledged to revolutionize the industry by harnessing artificial intelligence's greater potential.

With a bundle of partnerships announced Aug. 19, the company is now providing a closer look at what that approach will mean for patients, including more prompt diagnoses and access to tools that assist with checking symptoms and setting appointments.

Summa and HATCo (short for Health Assurance Transformation Company) say the new collaborations form the core of the health system's technology "stack," piled high with AI-driven initiatives.

Summa Health has announced its technology "stack" to fuel its AI transformation following its acquisition by Health Assurance Transformation Company last year.

AIDOC: Diagnostic AI

CLAROUM: Supply Chain AI

COMMURE: Administration AI

FABRIC: Consumer Access AI

HIPPOCRATIC AI: Voice AI

JUDI HEALTH: Claims and benefits AI

TRANCARENT: Consumer benefits AI

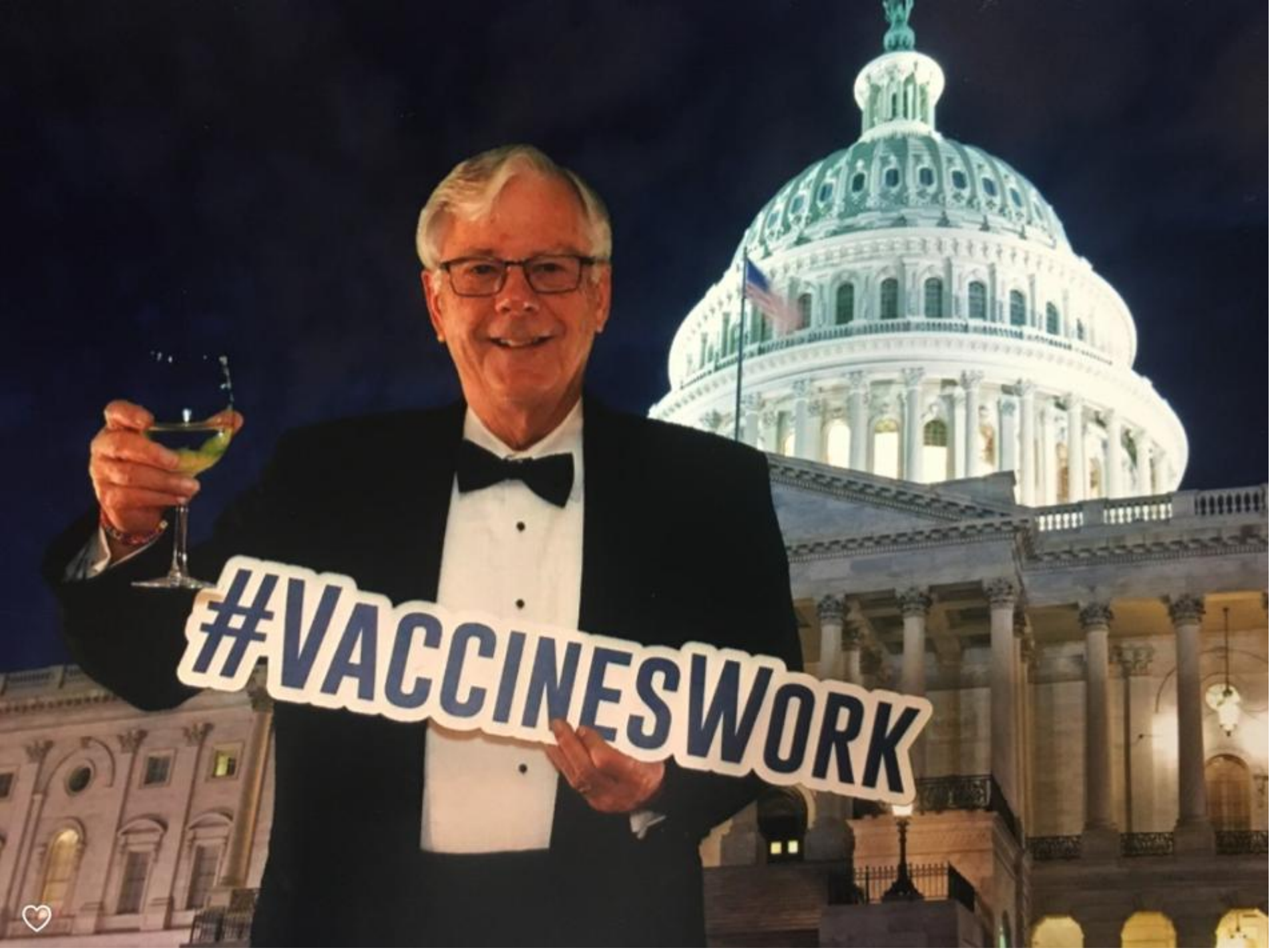
VERSE MEDICAL: Equipment AI

FUTURE

Trying to predict the future is a discouraging and a hazardous occupation. The only thing we cam be sure about the future is that it will be absolutely fantastic

Arthur C Clarke 1964 (Science fiction writer; co-wrote 2001: a Space Odyssey)

Summa Health


#VACCINESWORK