Antimicrobial Mindfulness

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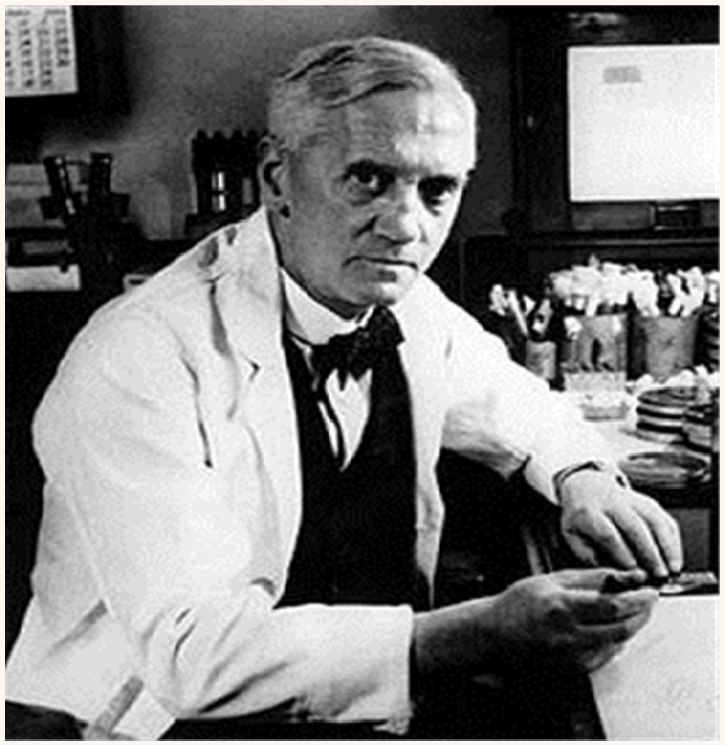
Objectives

- Provide an overview on antimicrobial stewardship programs (ASP)
- Describe the role of antimicrobial stewardship and infection prevention in limiting antimicrobial resistance
- Discuss future objectives of stewardship especially in the presence of an increasing influx of multidrug resistant (MDR) organisms

Birth of Antimicrobial Stewardship

"Microbes are educated to resist penicillin and a host of penicillin-fast organisms is bred out…

In such cases, the thoughtless person playing with penicillin is morally responsible for the death of the man who finally succumbs to infection with the penicillin-resistant organism. I hope this evil can be averted."



Fleming A. New York Times. 26 June 1945:21.

Goals of Antimicrobial Stewardship

- Improve patient outcomes
- Optimize selection, dose and duration of Rx
- Reduce adverse drug events including secondary infection (e.g., *C. difficile* infection)
- Limit emergence of antimicrobial resistance
- Reduce length of stay
- Reduce health care expenditures
- **How best can we achieve these goals?**

MacDougall CM and Polk RE. Clin Microbiol Rev. 2005; 18(4):638-56.
Dellit TH et. al. Clin Infect Dis. 2007; 44:159-177.

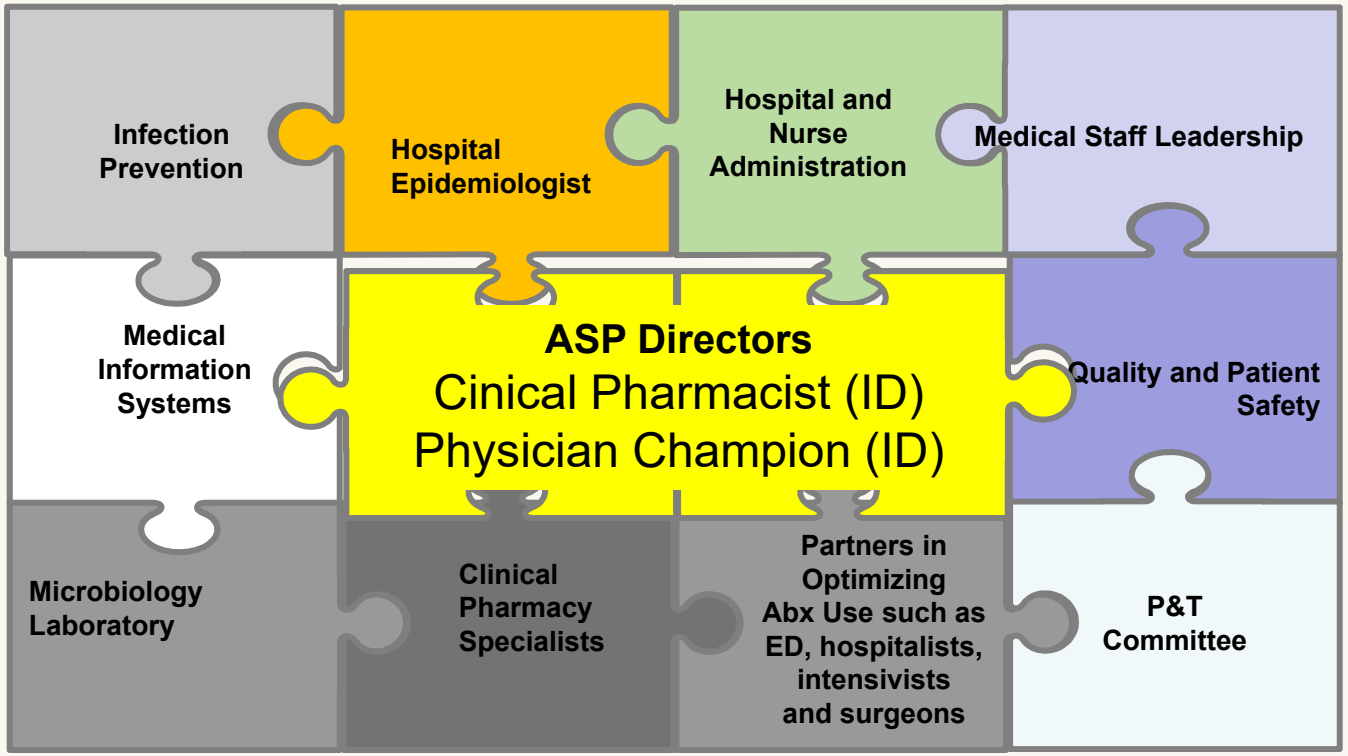
Initial IDSA/SHEA Antimicrobial Stewardship Guidelines

- A multidisciplinary ASP team should include an **ID physician and pharmacist** and other key stakeholders as determined by the institution
- Two core strategies were recommended
  - Prospective audit with intervention and feedback
  - Formulary restriction and preauthorization
- Other recommended strategies
  - Education
  - Order sets, guidelines and clinical pathways
  - De-escalation, dose optimization, IV to PO conversion

IDSA=Infectious Diseases Society of America
SHEA=Society for Healthcare Epidemiology of America

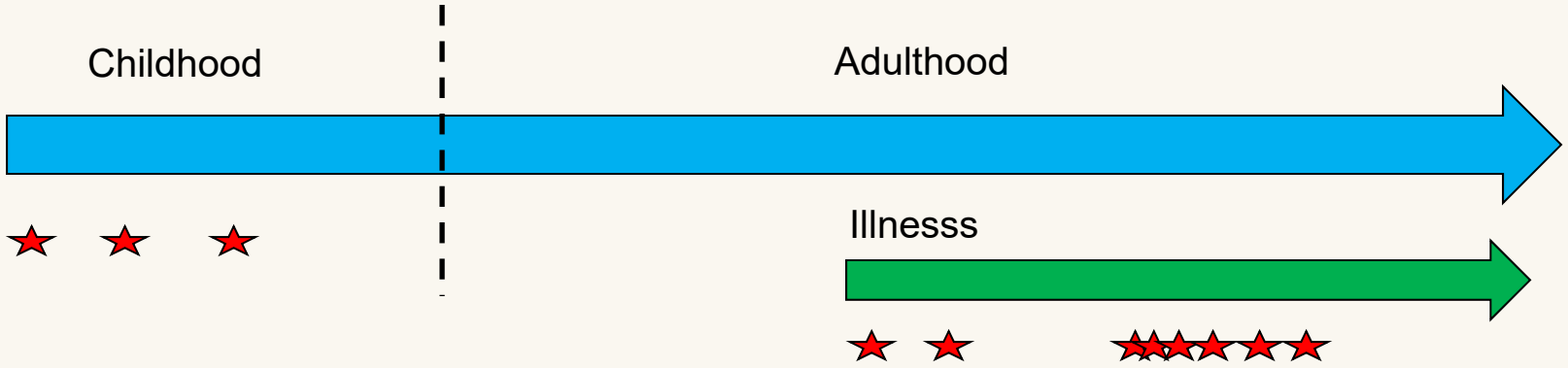
Clin Infect Dis 2007;44:159-177

Antimicrobial Stewardship Team



Clin Infect Dis 2007;44:159-177

Antibiotic Exposure is Along a Continuum

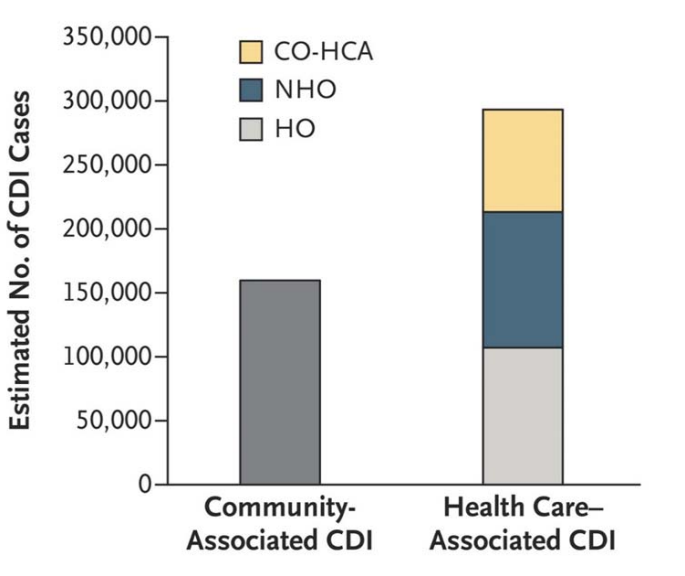


Antibiotic Days: think of the patient's total lifetime accumulation of antibiotics

ASP and Infection Prevention

- Work closely to review certain patient cases to identify where anti-infective agents could have been optimized
- Assist in identifying patients that may need the attention of an Infection Prevention Specialist
- Communicate anti-infective shortages
- Part of Infection Prevention meetings
- Example: C.difficile…

Estimated Annual U.S. Burden of *C. difficile*



Estimated U.S. Burden of CDI, According to the Location of Stool Collection and Inpatient Health Care Exposure, 2011.

CO-HCA: Community onset healthcare-associated
NHO: Nursing home onset
HO: Hospital onset

- **453,000 CDI cases[1]**
  - **293,000 healthcare-associated**
    - **107,000 hospital-onset**
    - **104,000 nursing home-onset**
    - **81,000 community-onset, healthcare-facility associated**
  - **160,000 community-associated**
    - **82% associated with outpatient healthcare exposure**

Overall, 94% of CDI cases related to healthcare

- **29,000 deaths**
- **$4.8 billion in excess healthcare costs[2]**

1. Lessa et al. N Engl J Med 2015; 372(9):825-834.
2. Dubberke et al. Clin Infect Dis 2012; 55:S88-92.

C. Difficile - Risk Factors

- Antibiotic exposure
  - Most important modifiable risk factor
- Hospitalization
  - ~ 2% colonized in general population but can be ~ 10x higher in hospitalized
- Advanced age
- Cancer chemotherapy
- GI surgery or procedures
- Gastric acid suppressive therapy (PPI use)

Cohen, et al *Infect Control Hosp Epidemiol* 31(5): 431-455, 2010

Human GI Microbiome

- Ecosystem of microbes in GI tract
- Most important mechanism against *C. difficile* disease
- Antibiotic exposure has a lasting impact on it
  - 85-90% of CDI occurs within 30 days of antibiotic use
  - CDI risk is 7-10x for following 3 months after antibiotics
- Concept of “collateral damage”

Chang et al. ICHE 2007;28(8):926-931.
Hensgens et al. J Antimicrob Chemother 2012;67(3):742-748.
Lessa et al. NEJM 2015;372(9):825-834.

Clinical Presentation

- Asymptomatic carriage
  - <2-5% healthy adults
  - 20% in patients in hospital for over a week
- Diarrhea without pseudomembranes
- Pseudomembranous colitis
  - Abd pain, leukocytosis, fever
- Fulminant colitis in ~3%
  - Risk of perforation, megacolon, or death

Control in Healthcare

- Spores shed in environment need to be managed
  - Isolation (contact) of patients – ideally in own room
  - Effective early treatment to limit shedding
  - Hand hygiene with soap and water
    - Spores not affected by antimicrobial hand gels – BIG ISSUE!!
  - Effective environmental cleaning
    - Cleansing with 1:10 hypochlorite solution or 10% bleach
  - Don't forget common use equipment and other objects

Antimicrobial Stewardship Role

- Judicious use of antimicrobials both in type and length
- At time of CDI diagnosis – re-evaluate need for non-CDI abx
- Assist in proper treatment of CDI
  - Realize ~15-25% relapse possible in following 2 months
- Possible restriction of some antimicrobial and PPI use
- In our facility, manage fecal microbiota transplantation

Formulary Restrictive Approach

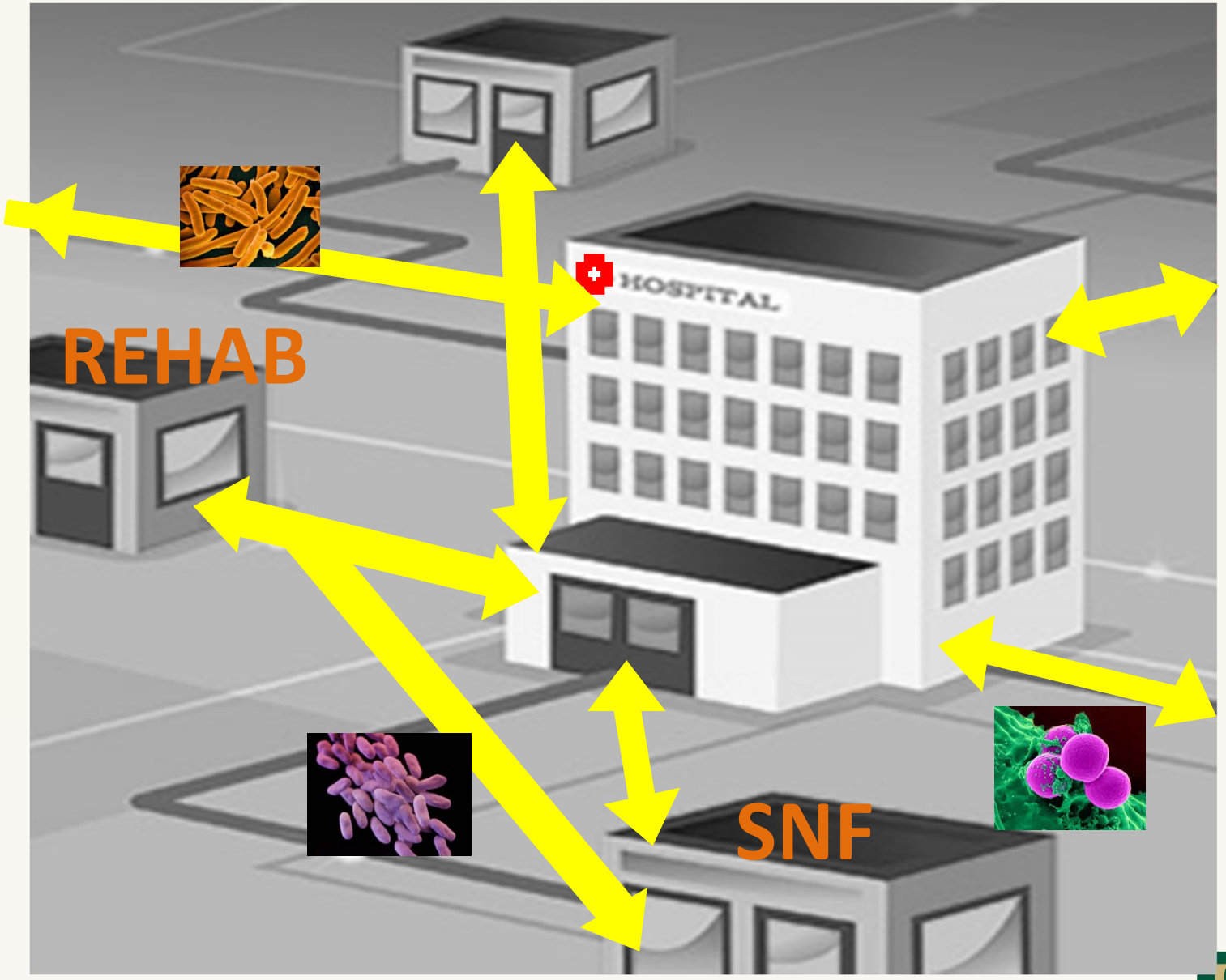
- Require approval by ID physician or pharmacist
- Found to be highly effective in preventing CDI, especially in the geriatric population
- Longer interventions and those involving 3rd generation cephalosporins and quinolones more effective

1. Feazel L, et al. *J Antimicrob Chemother* 2014 Jul;69(7):1748-54.
2. Aldeyab MA, et al. *J Antimicrob Chemother* 2012 Dec;67(12):2988-96.

Stewardship Effects of MDROs

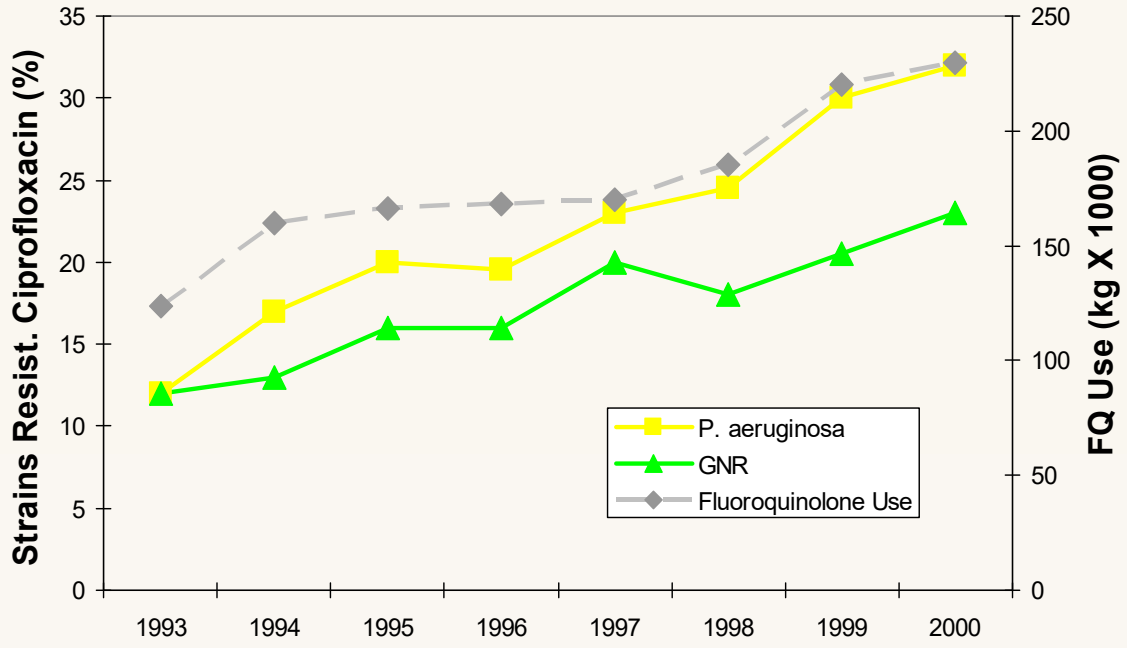
- We know that antimicrobial use increases antimicrobial resistance over time
- However more difficult to demonstrate that stewardship has profound affect on resistance rates
  - Studies have numerous variables, numerous targets (ie. many MDROs), and not standardized & of limited duration
  - Populations are in constant flux

Goff DA , File TM. *Inf Dis Clin N Am* 2016;30: 539-551.
Wagner B et al. *Infect Control Hosp Epidemiol* 2014;35: 1209-28,


HOSPITAL
REHAB
SNF

Fluoroquinolone Use and Resistance among Gram-Negative Isolates, 1993-2000

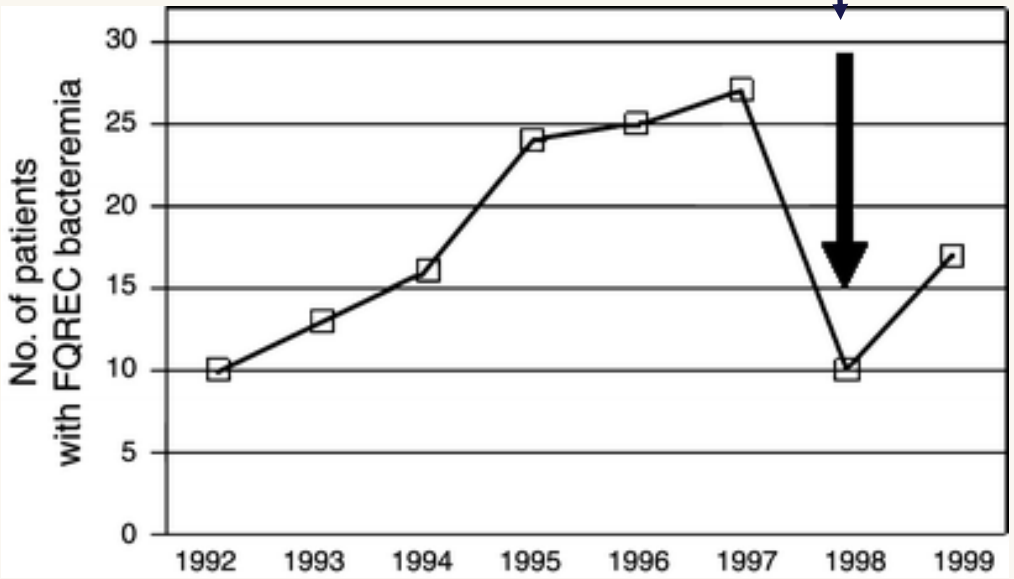
National ICU Surveillance Study



Neuhauser, et al. *JAMA* 2003; 289:885

Antimicrobial Use and Resistance Example in Oncology

Discontinuation of fluoroquinolone prophylaxis for 6 months



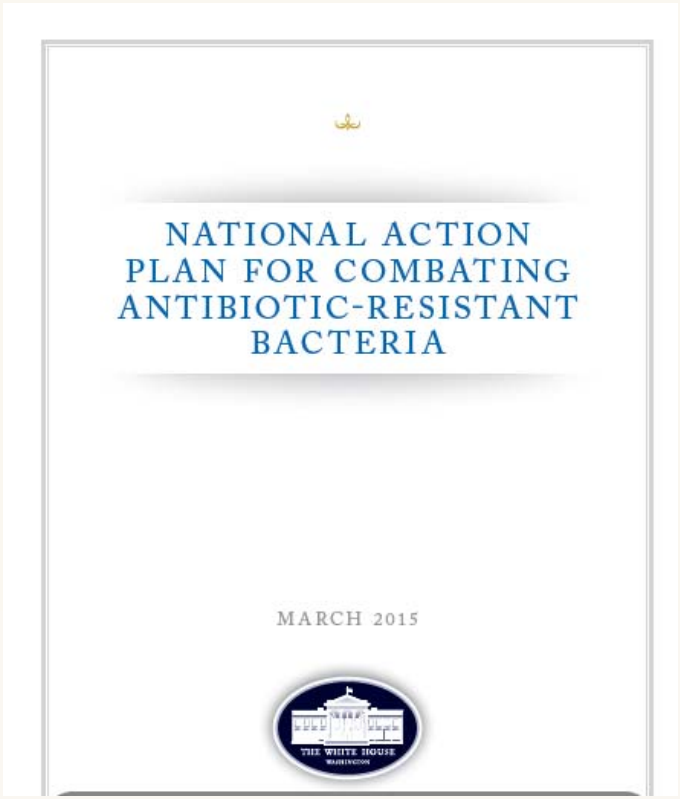
FQREC=fluoroquinolone- resistant *E. coli*

Kern WV. *Eur J Clin Microbiol Infect Dis* 2005;24:111-8

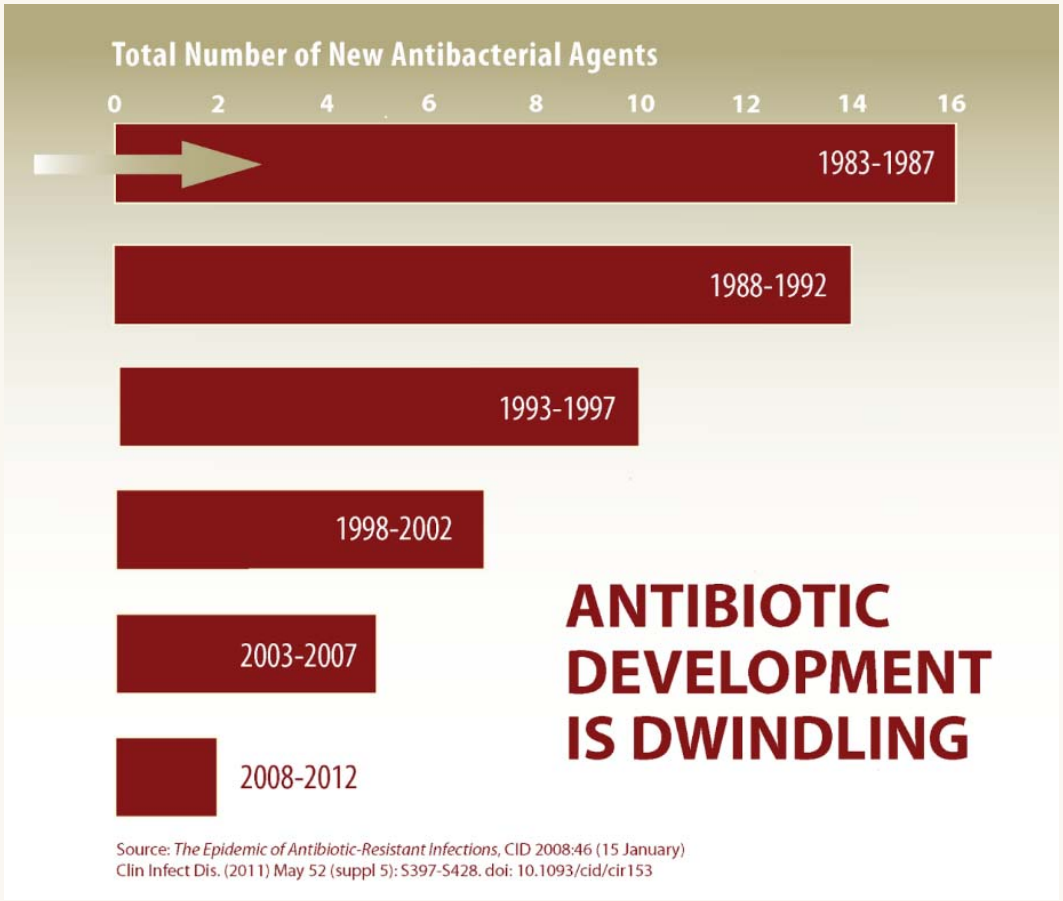
- First national snapshot of burdens and threat on this issue in U.S.
- The use of antibiotics is the single most important factor leading to antibiotic resistance
- Up to 50% of all antibiotics prescribed are not needed or are not optimally effective as prescribed
- Each year 2 million people acquire drug resistant bacteria directly resulting in an estimated 23,000 deaths

CDC. Threat Report 2013. http://www.cdc.gov/drugresistance/threat-report-2013/

White House June 2015 Forum



Antibiotic Development: Dry Pipeline



What we do clinically

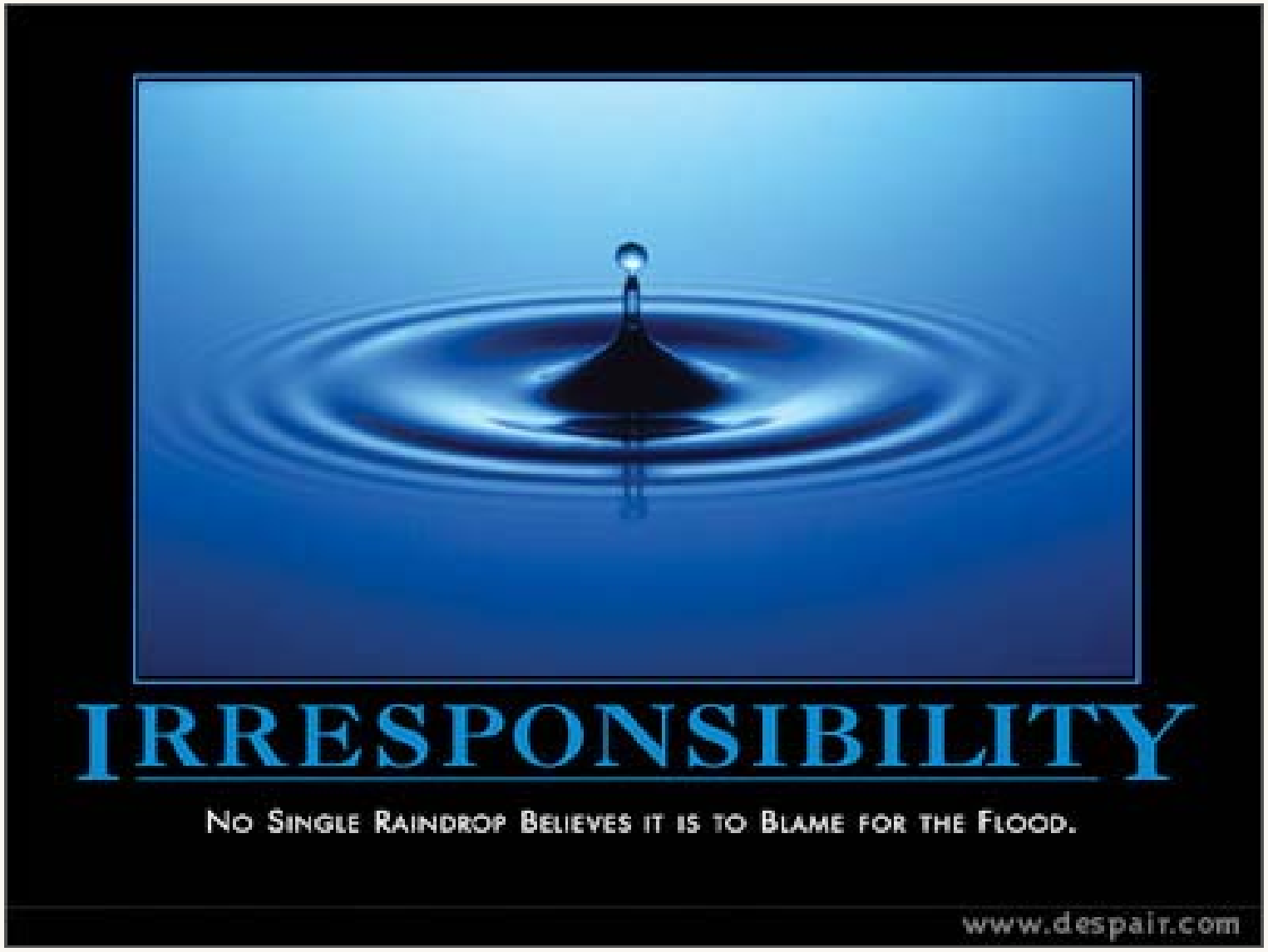
Broad empiric coverage $\propto$ $\frac{\text{Risk of Complications}}{\text{Certainty of Diagnosis}}$

Note that this is a dynamic process and should always be re-evaluated.

Challenges of Prescribing Antibiotics in Nursing Homes and SNFs

- How do prescribers make decisions about abx order?
  - Rely on others assessments; 67% ordered over phone
- Limited documentation of assessments
  - 43% of NH initiated antibiotic courses had no documentation of infection in medical record
- Data/ Labs – difficulty obtaining and interpreting to inform
- Other pressures – families, patient and other staff influence

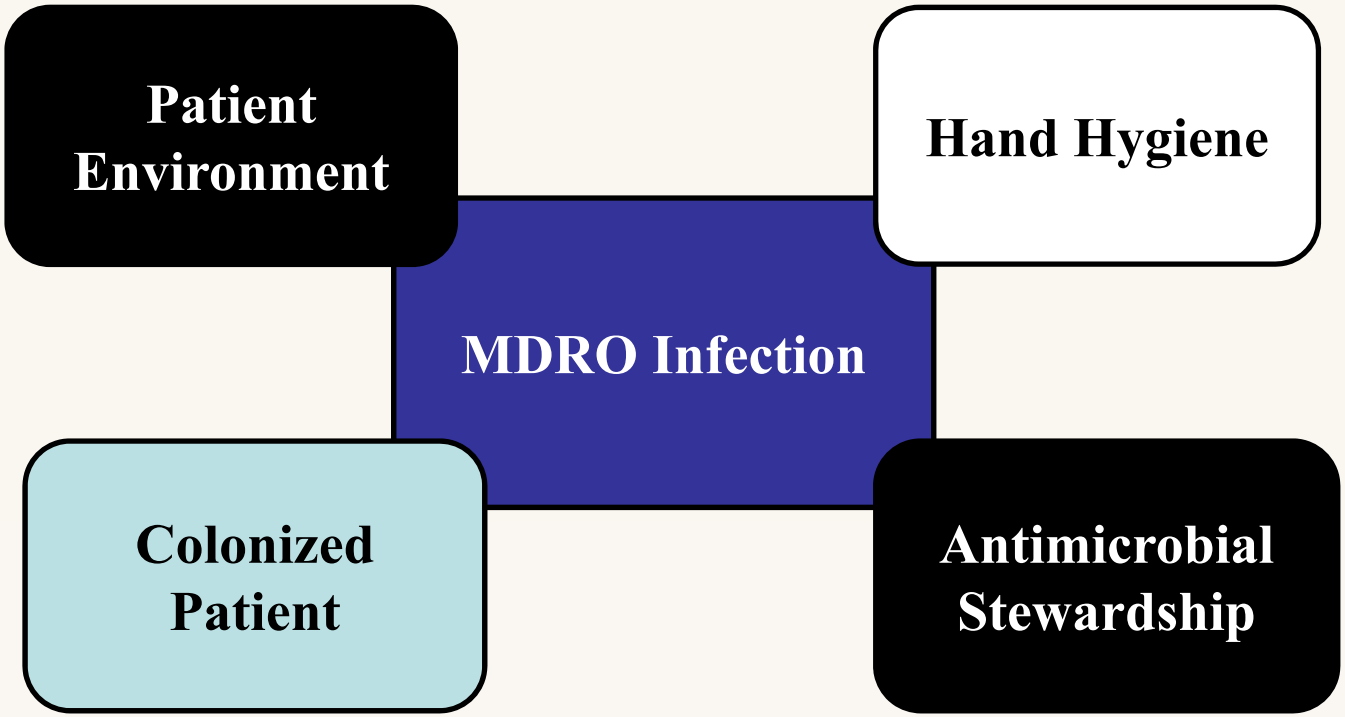
Richards. *J Am Med Dir Assoc* 2001;6(2):109-12.


IRRESPONSIBILITY
No Single Raindrop Believes it is to Blame for the Flood.
www.despair.com

Areas of High Yield to Reduce Resistance

- Asymptomatic bacteriuria and respiratory tract disease
- Do not culture open draining wounds – tells us what is colonized and tempts treatment
- Altered mental status not all due to infection – assess!
- Shorter courses reduce resistance and found still effective – urine, lungs, etc.

Factors that affect MDRO's



Elements for Success

- Individualizing ASP to our institution's needs
- Effective communication
- Providing positive feedback to pharmacy and medical staff members
- Respecting those who want to practice autonomy in their respective area
  - Balance restrictive approach to autonomy of prescriber

ASP and Microbiology

- Antibiogram development and resistance trends
- Assist in evaluating certain patients to ensure optimal therapy
- Developing selective reporting of drugs in susceptibility panels
- Microbiology part of Antimicrobial Subcommittee
- Evaluating rapid diagnostics and how its use can impact patient care – culture independent pathogen detection
  - MALDI-TOF

Tools for ASP

- Rapid Diagnostics
  - Blood Culture Identification (BCID) Panel
    - 27 Targets
  - Respiratory Panel
    - 20 Targets
  - Gastrointestinal Panel
    - 21 Targets
  - CNS Panel
  - Pneumonia / LRTI Panel
    - pending
- Increasing number of panels available commercially

Two Approaches for Rapid Pathogen Detection in Blood

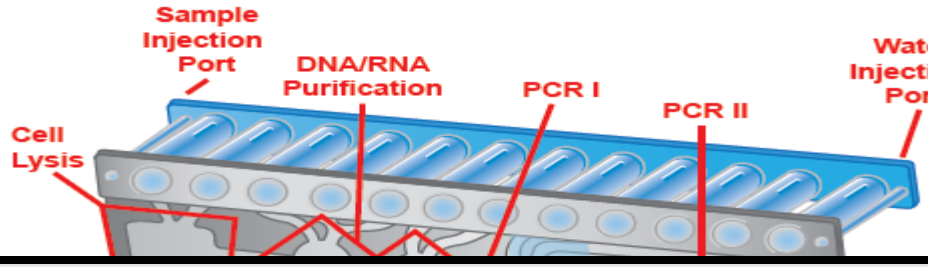
- Rapid identification and resistance detection in positive blood culture bottles – several kits available now or near future
- Rapid direct detection of pathogens directly from blood samples – no culture step – only 1 kit FDA cleared with at least 2 others in development

Rapid ID/Resistance from Positive BC Bottle – kits available / in development

- Luminex Verigene – GP and GN panels
- Biofire BCID – just one covering GP/GN
- iCubate GP (GN in trials now)
- Genmark – GP/GN/Fungus – CE cleared should be in trials soon in US
- Accelerate Pheno – uses FISH to ID pathogen and direct monitoring of growth to detect resistance

FilmArray Blood Culture Identification (BCID) Panel

The FilmArray Pouch and Analysis Report

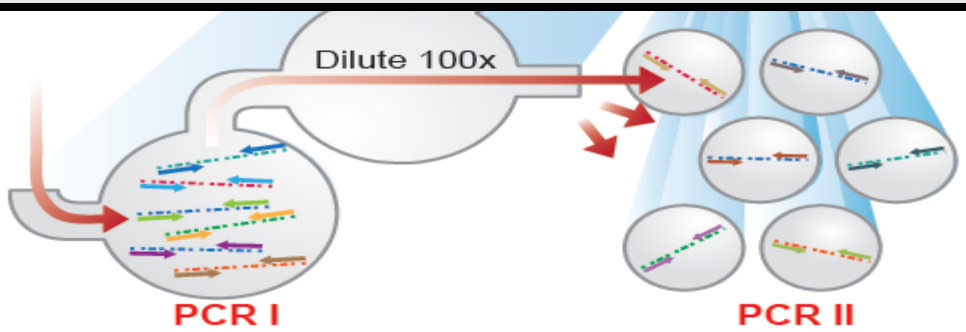


Simple: Two minutes of hands-on time

Easy: No precise measuring or pipetting required

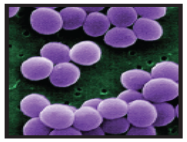
Fast: Turnaround time of about 1 hour

Comprehensive: 27 target BCID panel



Setting up the

FilmArray Blood Culture Identification (BCID) Panel

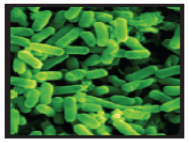


Gram + Bacteria

Enterococcus
Listeria monocytogenes

Staphylococcus
Staphylococcus aureus

Streptococcus
Streptococcus agalactiae
Streptococcus pyogenes
Streptococcus pneumoniae



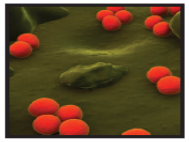
Gram – Bacteria

Acinetobacter baumannii
Haemophilus influenzae
Neisseria meningitidis
Pseudomonas aeruginosa

Enterobacteriaceae
Enterobacter cloacae complex
Escherichia coli
Klebsiella oxytoca
Klebsiella pneumoniae
Proteus
Serratia marcescens

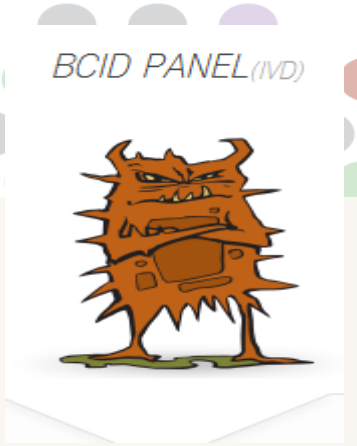
Yeast

Candida albicans
Candida glabrata
Candida krusei
Candida parapsilosis
Candida tropicalis



Antibiotic Resistance

mecA - methicillin resistant
vanA/B - vancomycin resistant
KPC - carbapenem resistant



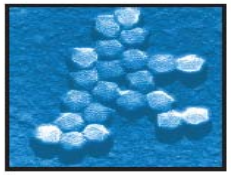
BIOFIRE DIAGNOSTICS, INC.

Evaluation of FilmArray BCID

- 206 blood culture bottles analyzed
  - 153/167 (91.6%) identified monomicrobial growth
    - 13/167 (7.8%) microorganisms not covered in panel
  - 6/167 (3.6%) FilmArray detected an additional microorganism compared to blood culture
  - 3/206 (1.5%) FilmArray was invalid
- Results were reproducible

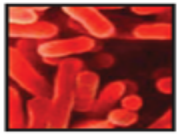
Altun et al, Clinical Evaluation of the FilmArray BCID in Identification of Bacteria and Yeasts from Positive Blood Culture Bottles, JCM, 2013

1 Test. 20 Respiratory Pathogens. All in about an hour.



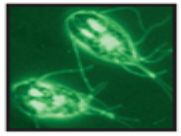
Viruses

- Adenovirus
- Coronavirus HKU1
- Coronavirus NL63
- Coronavirus 229E
- Coronavirus OC43
- Human
- Human Rhinovirus/ Enterovirus
- Influenza A
- Influenza A/H1
- Influenza A/H1-2009
- Influenza A/H3
- Influenza B
- Parainfluenza 1
- Parainfluenza 2
- Parainfluenza 3
- Parainfluenza 4
- Respiratory



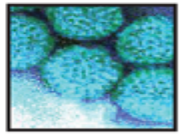
Bacteria

Campylobacter (jejuni, coli and upsaliensis)
Clostridium difficile (toxin A/B)
Plesiomonas shigelloides
Salmonella
Yersinia enterocolitica
Vibrio (parahaemolyticus, vulnificus and cholerae)
Vibrio cholerae
Diarrheagenic E. coli/Shigella
Enteroaggregative *E. coli* (EAEC)
Enteropathogenic *E. coli* (EPEC)
Enterotoxigenic *E. coli* (ETEC) *lt/st*
Shiga-like toxin-producing *E. coli* (STEC) *stx1/stx2*
E. coli O157
Shigella/Enteroinvasive *E. coli* (EIEC)



Parasites

Cryptosporidium
Cyclospora cayetanensis
Entamoeba histolytica
Giardia lamblia



Viruses

Adenovirus F 40/41
Astrovirus
Norovirus GI/GII
Rotavirus A
Sapovirus (I, II, IV and V)

FilmArray™ Gastrointestinal Panel

Shortcomings of PCR Panels

- Lack of culture
  - There is a lack of sensitivity data
    - Thus an inability to assess for resistance other than mecA, VRE, KPC
  - Only gives information ‘Yes, I am here’
  - Still need to do “old style” microbiology for bacteria

Rapid Diagnostics: Mass Spectrometry

- Matrix-assisted laser desorption/ ionization time of flight mass spectrometry (MALDI-TOF-MS)
  - Identification is based on protein fingerprints
    - There is no culture so there is no added information available about sensitivity to drugs
    - Additional prep steps for yeasts compared to bacteria that are time consuming
    - Need stewardship to interpret the results and potentially de-escalate therapy as in all rapid diagnostics

Alam et al, Comparative evaluation of 1,3 β-d-glucan, mannan and anti-mannan antibodies and Candida species-specific snPCR in pts with candidemia, BMC ID, 2007

Evaluating ASPs

- Measuring the efficacy of an ASP is where a lot of programs struggle
- Limited literature on evaluating ASPs
- Financial
  - Opportunity to improve
  - Need to account for all costs
- Microbiological
  - Resistance trends can be measured
- Clinical outcomes

Expert Rev Anti Infect Ther 2016; 14(6): 569-575

Joint Commission Standards

- The hospital's antimicrobial stewardship program uses organization-approved multidisciplinary protocols
  - Examples: fecal microbiota transplant protocol, *C. difficile* guidelines
- The hospital collects, analyzes, and reports data on its antimicrobial stewardship program
  - Feedback on resistance patterns and developing strategies to counter resistance
- The hospital takes action on improvement opportunities identified in its antimicrobial stewardship program
- In effect January 1st, 2017

https://www.jointcommission.org/topics/hai_antimicrobial_stewardship.aspx

CMS Guidelines

- The hospital has written policies and procedures whose purpose is to improve antibiotic use (antibiotic stewardship)
- The hospital has designated a leader (e.g., physician, pharmacist, etc.) responsible for program outcomes of antibiotic stewardship activities at the hospital
- The hospital's antibiotic stewardship policy and procedures requires practitioners to document in the medical record or during order entry an indication for all antibiotics, in addition to other required elements such as dose and duration

https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-15-12-Attachment-1.pdf

CMS Guidelines

- The hospital has a formal procedure for all practitioners to review the appropriateness of any antibiotics prescribed after 48 hours from the initial orders (e.g., antibiotic time out)
- The hospital monitors antibiotic use (consumption) at the unit and/or hospital level
- Adding antimicrobial stewardship standards for acute care and critical access
- May be going into effect June 2019 but under review

https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-15-12-Attachment-1.pdf

How to change our approach to Stewardship?

- Engrain it early → start during medical school
  - World Health Organization (WHO) states that stewardship is an 'integral part of antimicrobial resistance containment activities'
- Antibiotics are prescribed by many persons
  - Junior residents more so than senior residents
  - General physicians, Surgeons, OB-GYN
    - Only a small percentage of the whole is prescribed by Infectious Diseases

Medical Students' Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers? L. Abbo et al., CID, June 2013

Table 1. Medical Students' Perceptions and Attitudes About Antimicrobial Prescribing and Resistance—Percentage Who Agree/ Strongly Agree With Each Statement

Perceptions and Attitudes	All n = 311	School A n = 120	School B n = 66	School C n = 125	*P* Value[a]
Inappropriate use of antimicrobials can harm patients	97%	95%	100%	98%	.148[b]
Inappropriate use of antimicrobials causes antimicrobial resistance	97%	94%	100%	98%	.071[b]
Prescribing broad-spectrum antimicrobials when equally effective narrower spectrum antimicrobials are available increases antimicrobial resistance	95%	94%	100%	93%	.092
Better use of antimicrobials will reduce problems with antimicrobial-resistant organisms	94%	93%	99%	94%	.23
Antimicrobials are overused nationally	94%	91%	99%	94%	.109
Strong knowledge of antimicrobials is important in my medical career	92%	88%	94%	94%	.175
I would like more education on the appropriate use of antimicrobials	90%	92%	89%	88%	.637
Poor infection control practices by healthcare professionals cause spread of antimicrobial resistance	83%	85%	82%	82%	.749
I would like more education on antimicrobial resistance	79%	80%	77%	78%	.902
Appropriate use of antimicrobials can cause antimicrobial resistance	70%	63%	64%	79%	.012
Antimicrobials are overused at the hospitals where I have rotated	65%	70%	62%	62%	.334
New antimicrobials will be developed in the future that will keep up with the problem of "resistance"	20%	22%	15%	21%	.541
Antimicrobial resistance is not a significant problem at the hospitals where I have rotated	3%	4%	2%	2%	.623[b]
Antimicrobial resistance is not a significant problem nationally	2%	3%	0%	2%	.271[b]

[a] χ^2 test.
[b] Fisher exact test.

Medical Students' Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers? L. Abbo et al., CID, June 2013

GRAM POSITIVE	No. Isolates *	PENICILLIN	AMPICILLIN	OXACILLIN	CEFTRIAXONE	CEFOTAXIME	IMIPENEM	MEROPENEM	GENTAMICIN	CLINDAMYCIN	CLINDAMYCIN INDUCE	ERYTHROMYCIN	CIPROFLOXACIN	LEVOFLOXACIN	LINEZOLID	SYNERCID	VANCOMYCIN	DAPTOMYCIN**	RIFAMPIN	TETRACYCLINE	TIGECYCLINE	TRIMETH/SULFA
Bacillus	30	20		30		34				57							100					
Corynebacterium	11	18		50		75				17							100					
Coryne. striatum	116	3		9		34				8							100					
Vanc Sens Ent. faecalis	277		99												100		100					
Vanc Res Ent. faecalis	23		100												100		0	100				
Vanc Sens Ent. faecium	33		42												100		100					
Vanc Res. Ent. faecium	71		0												100		0	93				
Beta Hem Strep A	19	100	100							76	81	74		100			100					
Beta Hem Strep B	141	100	100							50	86	35		99			100					
Staph. aureus MSSA	586	25		100					99	91	79	56			100	100	100	100	100	93	100	95
Staph. aureus MRSA	1050	0		0					93	64	88	9			100	100	100	98	98	93	100	77
Staph. epidermidis MSSE	169	20		100					91	80	96	47			100	100	100	80	97	86	100	70
Staph. epidermidis MRSE	443	0		0					59	40	88	17			100	100	100	100	90	84	100	30
Staph. lugdunensis	34	35		85					100	82	96	79			100	100	100	100	100	88	100	100
Str. pneumo	30	50			95	84	44	50		87		53		100			100		100	73		60
Strep. anginosus	71	99	73		100	100				82		69	76				100					

*Organisms with <100 isolates tested may not have statistically valid results. **Colistin and Daptomycin only tested on request. Number of isolates is low.

Nosocomial, Non Urinary

GRAM POSITIVE	No. Isolates	PENICILLIN	AMPICILLIN	OXACILLIN	CEFTRIAXONE	CEFOTAXIME	IMIPENEM	MEROPENEM	GENTAMICIN	CLINDAMYCIN	CLINDA INDUCED	ERYTHROMYCIN	LEVOFLOXACIN	LINEZOLID	SYNERCID	VANCOMYCIN	DAPTOMYCIN**	RIFAMPIN	TETRACYCLINE	TIGECYCLINE	TRIMETH/SULFA
Bacillus	40	18		25		15				60						100					
Corynebacterium	53	11		36		88				19						100					
Coryne. striatum	47	2		11		45				2						100					
Vanc Sens Ent. faecalis	89		100											100		100					
Vanc Res Ent. faecalis	8		100											100		0	100				
Vanc Sens Ent. faecium	2		50											100		100					
Vanc Res Ent. faecium	19		0											100		0	100				
Beta Hem Strep Gp A	38	100	100							88	83	84	100			100					
Beta Hem Strep Gp B	296	100	100							65	89	45	99			100					
Staph. aureus MSSA	433	29		100					98	85	80	53		100	100	100	83	98	93	100	94
Staph. aureus MRSA	1085	0		0					95	64	82	10		100	100	100	93	98	92	100	77
Staph. epidermidis MSSE	142	25		100					100	83	87	49		100	100	100	100	98	89	100	78
Staph. epidermidis MRSE	178	0		0					79	46	85	16		100	99	100	78	96	74	100	37
Staph. lugdunensis	17	29		76					100	94	94	82		100	100	100		100	88	100	100
Strep. pneumoniae	31	55			95	95	68	100		83		50	100			100		100	73		70

*Organisms with <100 isolates tested may not have statistically valid results. **Colistin and Daptomycin only tested on request. Number of isolates is low.

Community Acquired, Non Urinary

Antibiotic resources our medical students are using …

"Respondents who referred to physicians or pharmacists and those who utilized IDSA guidelines, had statistically significantly higher knowledge scores compared to students who did not use those resources."

Table 3. Resources Used for Learning About Antimicrobial Prescribing and An times Use Source), and Mean Knowledge Score for Respondents Who Used th Those Resources

		School						
	All	A	B					
Resources	n = 305	n = 117	n = 64	n = 124	*P* Value[a]	Score n = 298	± SD	*P* Value[b]
UpToDate	90%	89%	89%	92%	.690	51%	0.180	.998
iPhone or smartphone application	83%	91%	67%	85%	<.0001	52%	0.178	.798
Hospital pharmacists	80%	70%	81%	90%	.001	52%	0.183	.052
Non–infectious diseases physicians	80%	77%	78%	84%	.369	52%	0.180	.057
Infectious diseases specialists	72%	71%	78%	70%	.481	53%	0.179	.003
Medical journals	55%	56%	63%	50%	.258	51%	0.170	.952
Peers (other students)	54%	52%	53%	57%	.708	52%	0.177	.653
Sanford guide	49%	40%	20%	72%	<.001	52%	0.189	.295
Infectious Diseases Society of America guidelines	29%	28%	41%	24%	.061	55%	0.199	.013
Other guidelines by professional organizations	48%	35%	53%	57%	.002	53%	0.173	.131
Textbooks or study guides	46%	53%	38%	43%	.096	51%	0.170	.860
Wikipedia	41%	56%	38%	29%	<.0001	49%	0.166	.035
Pharmaceutical representatives	3%	6%	3%	1%	.053[c]	49%	0.175	.628

Abbreviation: SD, standard deviation.
[a] χ^2 test.
[b] Kruskal-Wallis test.
[c] Fisher exact test.

Medical Students' Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers? L. Abbo et al., CID, June 2013

Antibiotic resources our medical students are using …

Table 3. Resources Used for Learning About Antimicrobial Prescribing and Antimicrobial Resistance (Percentage Who Often or Sometimes Use Source), and Mean Knowledge Score for Respondents Who Used the Resources Compared to Respondents Who Do Not Use Those Resources

		School						
	All	A	B	C		All Mean Knowledge		
Resources	n = 305	n = 117	n = 64	n = 124	*P* Value[a]	Score n = 298	± SD	*P* Value[b]
UpToDate	90%	89%	89%	92%	.690	51%	0.180	.998
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Sanford guide	49%	40%	20					
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Pharmaceutical representatives	3%	6%	3%	1%	.053[c]	49%	0.175	.628

Abbreviation: SD, standard deviation.
[a] χ^2 test.
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[c] Fisher exact test.

"Students who reported using sources such as Wikipedia overall had lower knowledge scores."

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As a whole, how do we do rate with our antibiotic choices?

- Treatment indication of antibiotics, choice of antibiotic or duration of therapy is incorrect in up to _____ percentage of cases.

As a whole, how do we do rate with our antibiotic choices?

- Treatment indication of antibiotics, choice of antibiotic or duration of therapy is incorrect in up to _50%_ percentage of cases.

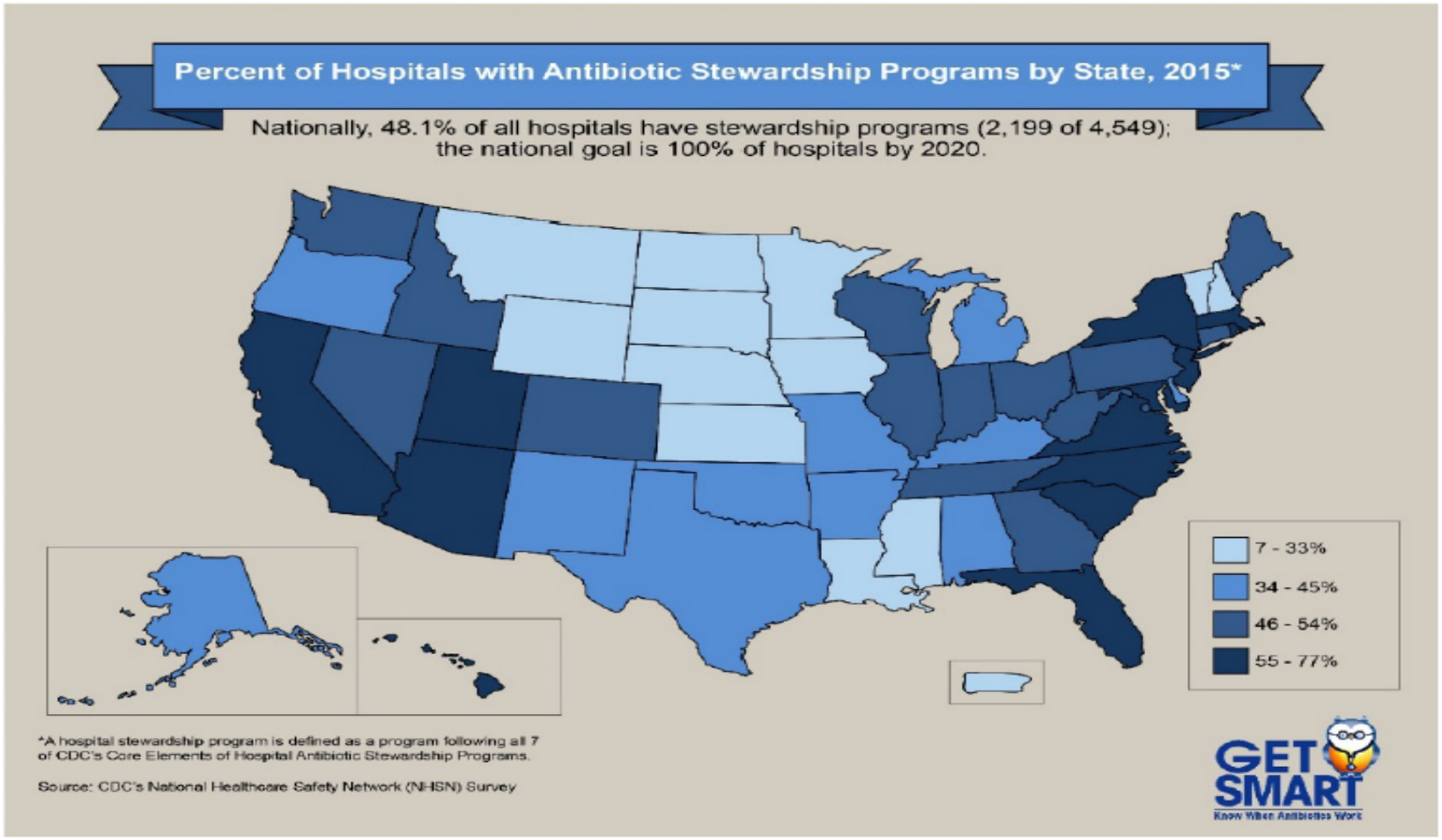
What is the primary purpose of Antimicrobial Stewardship?

- A. Institutional adherence to regulatory standards, such as the Joint Commission
- B. Reduce drug costs
- C. Improve patient outcomes
- D. Managing critical antibiotic shortages

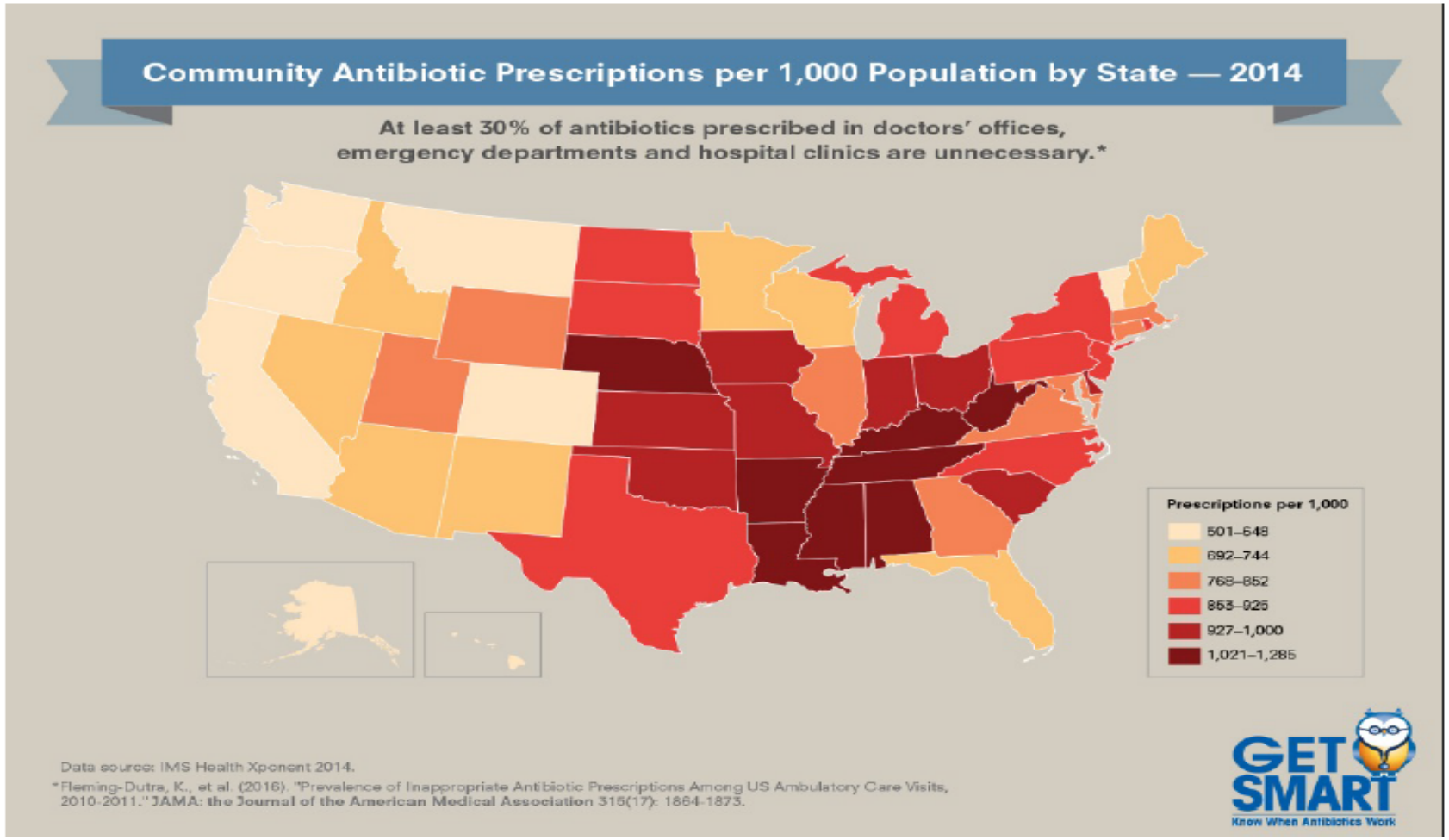
Which of the following are key components to an ASP program?

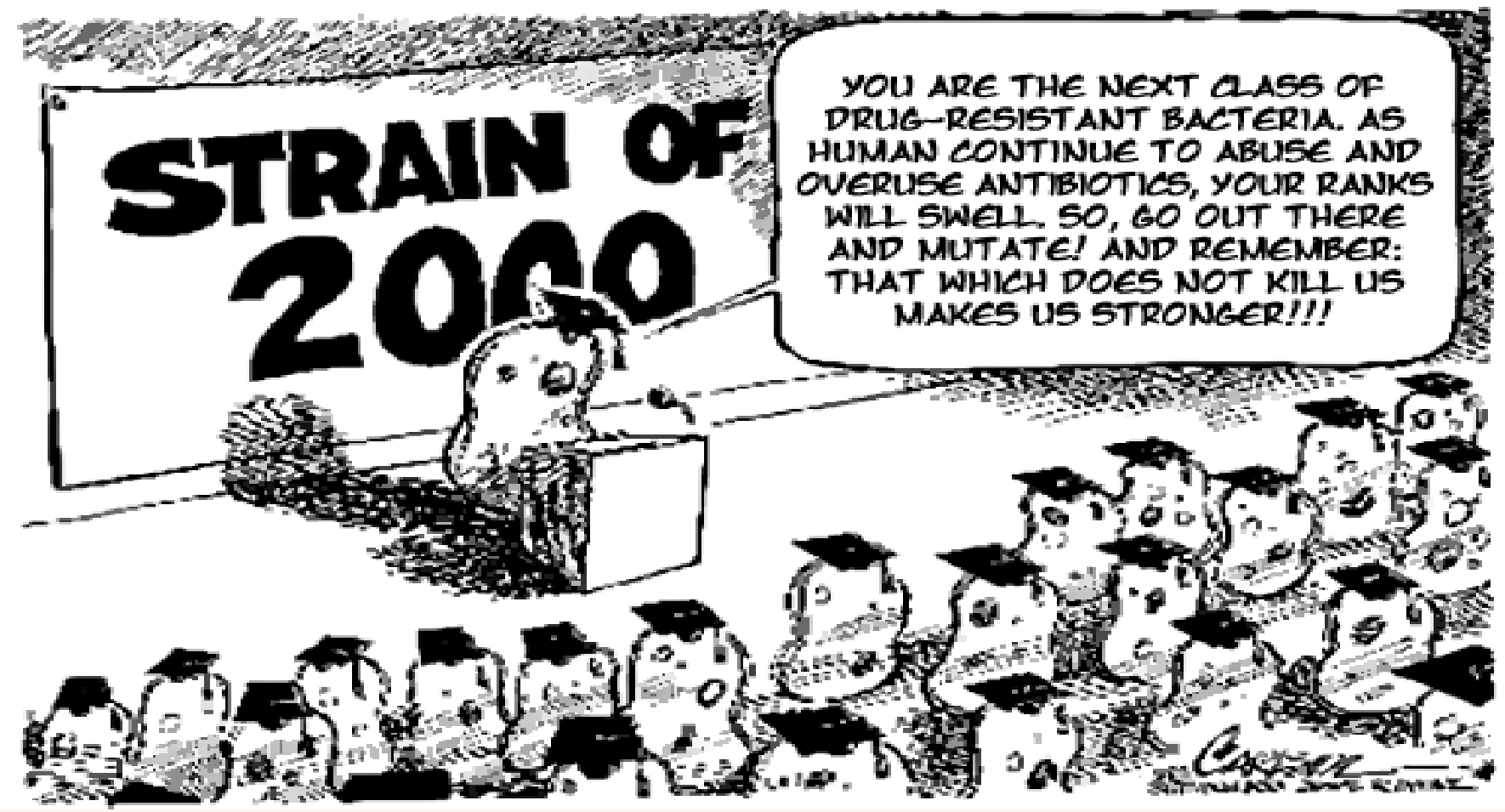
- A. Pre-authorization of restricted antibiotics
- B. Prospective audit and feedback
- C. Antibiotic cycling
- D. All of the above
- E. A and B

Antibiotic Stewardship Programs Map



Outpatient Antibiotic Prescriptions Map





https://www.google.com/search?q=remember+antimicrobial+stewardship


Questions ?