DUKE ANTIMICROBIAL STEWARDSHIP OUTREACH NETWORK (DASON)

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Navigating the CDC's Antibiotic Resistance Patient Safety Atlas

Recently, the CDC created and debuted its Antibiotic Resistance Patient Safety Atlas (AR Atlas). The Atlas' goal is to make data on drug-resistant pathogens occurring in healthcare associated infections (HAI) universally and quickly available to the public, including the public health community, physicians, and industry. This month's newsletter will discuss the data presented in the Atlas, benefits and limitations of the Atlas, and the Atlas' role in informing DICON/DASON member hospitals about national and regional antibiotic resistance.

What is the new CDC AR Atlas?

The AR Atlas is an interactive tool that contains data on 31 bug-drug resistance profiles ("phenotypes") and 3 HAI events (CLABSI, CAUTI, and SSI). Atlas users select the phenotype of interest (e.g., MRSA) and HAI of interest (i.e., SSI) to view temporal and geographic trends at the state, regional, or national level. Previously, NHSN published data on pathogen resistance infrequently and only reported aggregate data for the entire NHSN network [1, 2]. In contrast, the AR Atlas is updated annually in December. Thus, the Atlas provides an improved user experience, the ability to hone in to certain geographic regions in the US, and improved access to more updated resistance data contained in our national HAI surveillance system.

What data does the AR Atlas contain?

The AR Atlas currently contains data reported by US acute care hospitals to the NHSN for CLABSI, CAUTI, and SSI from 2011-2014. All facilities reporting one or more HAI to NHSN are included in the Atlas. The majority of CLABSI and CAUTI data are from ICUs since NHSN did not require whole-house HAI reporting until 2015. This means that resistance estimates for CLABSI and CAUTI can only be interpreted in the context of ICU populations at the current time. All superficial, deep, and organ space SSI that had one or more pathogen(s) identified are included in the Atlas data.

What is the main AR Atlas outcome?

The main outcome is percent resistance, calculated as the number of resistant isolates divided by the total number of isolates for a particular pathogen. The AR Atlas contains 31 resistance profiles, or pathogen-drug resistance combinations. The AR Atlas does not report estimates for percent resistance if: 1) a state did not provide any data, or 2) there were 20 or less observations available for analysis.

Percent resistance = (number of resistant pathogens/ number of total pathogens) x 100

The percent resistance is **not** a measure of frequency of disease in the hospitalized population. For example, national percent resistance for MRSA is 43.4%. This means that from 2011-2014,

43.4% of the *Staphylococcus aureus* reported from patients with HAIs due to *S. aureus* were resistant to methicillin. It does **not** tell us about how common MRSA is as an HAI pathogen or how common MRSA HAIs are among hospitalized patients. Thus, temporal resistance trends must be interpreted in conjunction with HAI trend data.

The AR Atlas's percent resistance should not be directly compared to hospital-specific antibiogram numbers produced by local microbiology labs. First, users should realize that antibiograms report percent susceptible as recommended by CLSI [3]. This is the **inverse** of percent resistant that is reported in the AR Atlas. Second, facility antibiograms calculate percent susceptible estimates from microbiologic specimens that may include a broad range of patients: outpatients, emergency departments, inpatient wards (medical and surgical), and intensive care units. The AR Atlas contains only pathogens identified from patients with a defined CAUTI, SSI, and CLABSI from acute care hospitals. Resistance is expected to be higher in patients with HAI who, by definition, have healthcare exposures. Thus, do not feel reassured if a facility antibiogram estimate appears less worrisome than estimates in the AR Atlas.

What are the benefits and limitations of the AR atlas?

Benefits of AR Atlas	**Limitations of AR Atlas**
• Provides evidence that drug-resistance is a problem and supportive data for advocating for infection prevention and antimicrobial stewardship efforts. • Provides access to national, regional, and state level data on AR to use in independent investigations and generating hypotheses. • Provides more recent data than periodic publications from CDC. • Provides an improved user experience and more advanced graphics. • Provides a query function to evaluate temporal or geographical trends of antimicrobial resistance.	• The percent resistance in the Atlas does not correlate with the overall frequency of antibiotic-resistant infections in hospitals. It reflects resistance among patients with HAI due to the selected pathogens. • The percent resistance metric does not reflect the effect of prevention efforts as well as incidence metrics calculated among all patients at risk. • The estimates of percent resistance are based on reported HAI data which predominately reflects ICU populations for CLABSI and CAUTI. • As with all nationally reported data, CAUTI, CLABSI, and SSI events may not be validated. Validation practices vary among reporting institutions. • Antimicrobial susceptibility data come from labs that are "expected" to use CLSI standards for antimicrobial susceptibility testing; however, use of CLSI standards may vary among institutions. • The Atlas currently does not stratify by hospital type. This highlights the difficulty in obtaining resistance estimates specific to small and medium sized community hospitals. • The temporal trends only include four years of data. This limits the ability to detect larger or longer temporal trends.

What region-specific conclusions have DICON physicians made from viewing the atlas?

<u>Methicillin Resistant Staphylococcus Aureus (MRSA) in Surgical Site Infections:</u>

The AR Atlas shows that MRSA accounts for approximately 52% of SSI due to *Staphylococcus aureus* isolates in the South Atlantic region, and that from 2011-2014, percent resistance of MRSA was generally stable (49.7% resistant in 2011, 95% CI (45.6-53.8); 53% in 2012 (49.7-56.1); 53.7% in 2013 (50.5-56.8); 50.2% in 2014 (47.1-53.2)). At the same time, numerous publications have concluded that the incidence of invasive MRSA infections is decreasing [4-6]. Our own analysis of DICON SSI data from2008-2012 [7] found that rates of SSI due to MRSA declined by over 30% during this time period (adjusted prevalence rate ratio 0.69 (0.54–0.89)) whereas the proportion of resistance remained relatively stable at approximately 50%, consistent with the Atlas data. This example highlights the importance of understanding the difference between trends in percent resistance and trends in infection rates. Both metrics provide useful but different information.

Carbapenem Resistant Enterobacteriaceae (CRE):

The AR Atlas trend of CRE in the South Atlantic region shows an overall stable percent resistance from 2011-2014 (3.2% resistant in 2011, 95% CI (2.4-4.1); 2.3% in 2012 (1.8, 2.7); 2.8% in 2013 (2.2-3.2); 2.6% in 2014 (2.1, 3.1)).

DICON investigators recently reviewed prospective CRE isolates in the DICON database from January 2008-December 2012. The purpose of this study was to describe the incidence of CRE in DICON hospitals and to examine the effect of lower carbapenem breakpoints that CLSI introduced in 2010 [8]. During 2008-2012, the rate of CRE detection increased from 0.26 cases/100,000 patient-days to 1.4 cases/100,000 patient-days (incidence rate ratio (IRR), 5.3 (1.22-22.7)). After adjusting for clustering of CRE by hospital, this increase in incidence remained statistically significant. The 5 DICON hospitals that adopted 2010 CLSI breakpoints had higher rates of CRE detection when (1) compared to themselves prior to implementation of new breakpoint and (2) compared to hospitals that did not adopt the new breakpoints. After controlling for this detection difference amongst hospitals, the authors concluded that increasing CRE trend is related to both changes in testing and increasing endemicity.

This example again highlights potential limitations of the AR Atlas. Comparing Atlas CRE data to DICON CRE data is exceedingly difficult as no metrics are available for direct comparison. Furthermore, data are included as reported by contributing hospitals without any validation of methods.

How can DICON and DASON help me navigate the information in the new AR Atlas?

The AR Atlas augments, but does not supplant, the need for both internal tracking of local incidence rates of resistant organisms and for comparative data from DICON and DASON. As highlighted above, AR Atlas outcomes are difficult to compare to recent DICON literature and benchmarks because different metrics are used. We believe measures of incidence among the larger healthcare population at risk are better suited for estimating the effect of infection prevention and stewardship programs. A decrease in the number of patients infected with an MDRO in all patients at risk (and not the proportion of isolates resistant) is often the goal of intervention; this goal may not be reflected in the percent resistance metric reported in the Atlas. Moreover, DICON/DASON data are confirmed and validated at the local level with standardized data collection and reporting infrastructure among member hospitals, allowing for meaningful comparisons among member facilities. We remain committed to helping interpret data, such as that in the AR Atlas, and to identifying trends and creating practical, specific recommendations applicable to member hospitals.

Take Home Points:

- Users can obtain national, regional, or state estimates of antibiotic resistance in HAIs through the NHSN AR Atlas.
- The AR Atlas is currently limited to SSI, CLABSI, and CAUTI aggregate measures of pathogen resistance and a four-year time period (2011-2014).
- The quality of the AR Atlas data varies among facilities, may not be validated, and generally includes pathogens causing healthcare associated infections that are highly influenced by ICU patients. Therefore, we advise against broad generalization of the estimates outside of this limited population.
- Percent resistance metrics do not represent the frequency of resistant infections in the hospitalized population at risk, but rather how often resistant pathogens are seen among patients with HAIs due to that selected pathogen.
- Temporal trends for the percent resistance metric may not match trends in incidence of resistant pathogens seen in other published literature.
- The percent resistance metrics are more likely to change slowly in response to prevention efforts. For estimating the effect of prevention efforts, resistant infection incidence over the population at risk for infection remains the preferred metric.

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