Review of current computerized clinical surveillance decision support to improve antimicrobial stewardship efforts

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BACKGROUND

- Antimicrobial resistance has long been identified as a serious threat in healthcare
- In Sep. 2014, Executive Office of the President has released a report on combating antibiotic resistance: by the end of 2017, the Centers of Medicare & Medicaid Services (CMS) mandate hospitals, long term care facilities and nursing homes to develop and implement robust antimicrobial stewardship program (ASP) that adhere to best practices
- The 2007 IDSA guideline for developing an institutional program to enhance antimicrobial stewardship recommends the use of a clinical decision support system (CDSS) tool to improve antimicrobial treatment decisions and the use of computer-based surveillance to facilitate good stewardship *(Level of evidence: B-II)*.

PURPOSE

- Evaluate the current literature for the impact of clinical surveillance decision support (CDSS) software to antimicrobial stewardship programs
- Assess the effectiveness of CDSS software in improving outcomes in antimicrobial stewardship programs

METHODS

Study Period:

- Studies published in the last 10 years between January 1, 2004 and January 1, 2014

Database Search:

- Three databases were searched: Medline, EMBASE, International Pharmaceutical Abstracts (IPA)

Key Words Searched:

- Anti-infective or antibacterial or antimicrobial or antibiotic
- Stewardship or management
- Computerized or electronic health records or electronic medical records
- Decision making or computer assisted or decision support
- Clinical surveillance

Inclusion & Exclusion Criteria:

- Inclusion:
  - Evaluative studies of ASP with the use of CDSS
  - Inpatient acute care
  - Adult patients ≥ 18 years of age
- Exclusion:
  - English only
  - Review of literature or expert's opinions

Data Extraction:

- Conducted independently by 2 investigators: titles, abstracts and full-text of publications identified were reviewed for inclusion
- Review articles describing the relevant topic of interest were scanned for any additional referenced publications
- 339 articles were identified via literature searched, 33 articles were reviewed in full-text, 16 articles were included. Primary reason for article exclusion was irrelevance to topic of interest

RESULTS

FIGURE 1. Literature Search

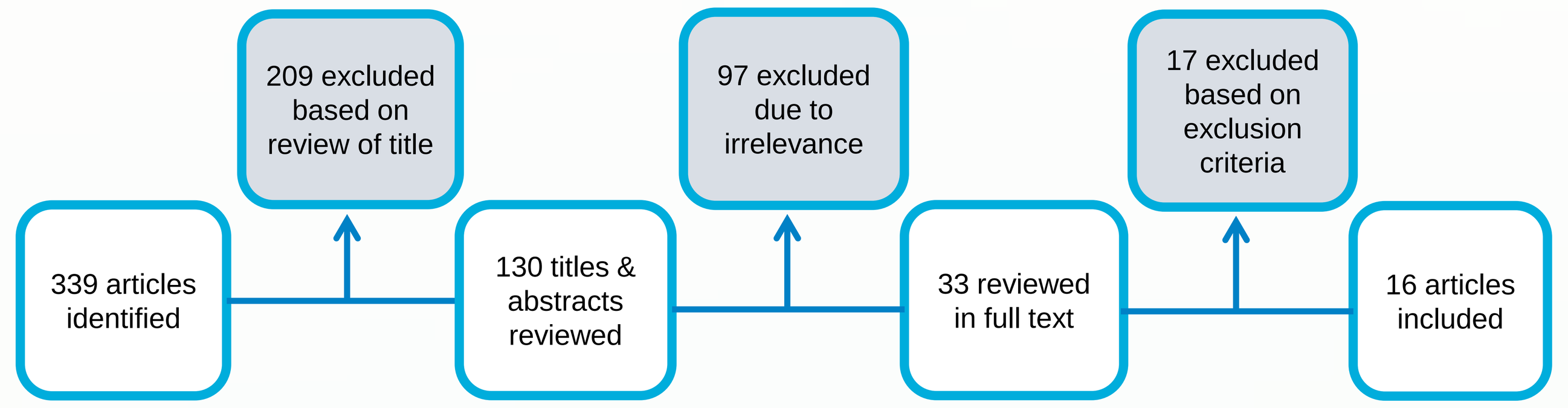


FIGURE 2. Summary of Outcomes

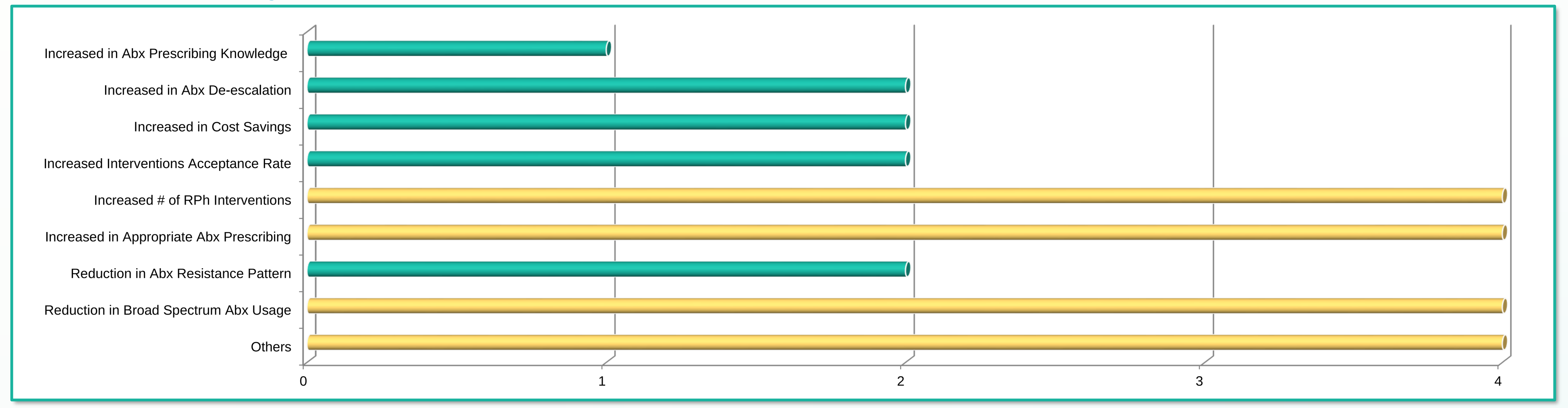
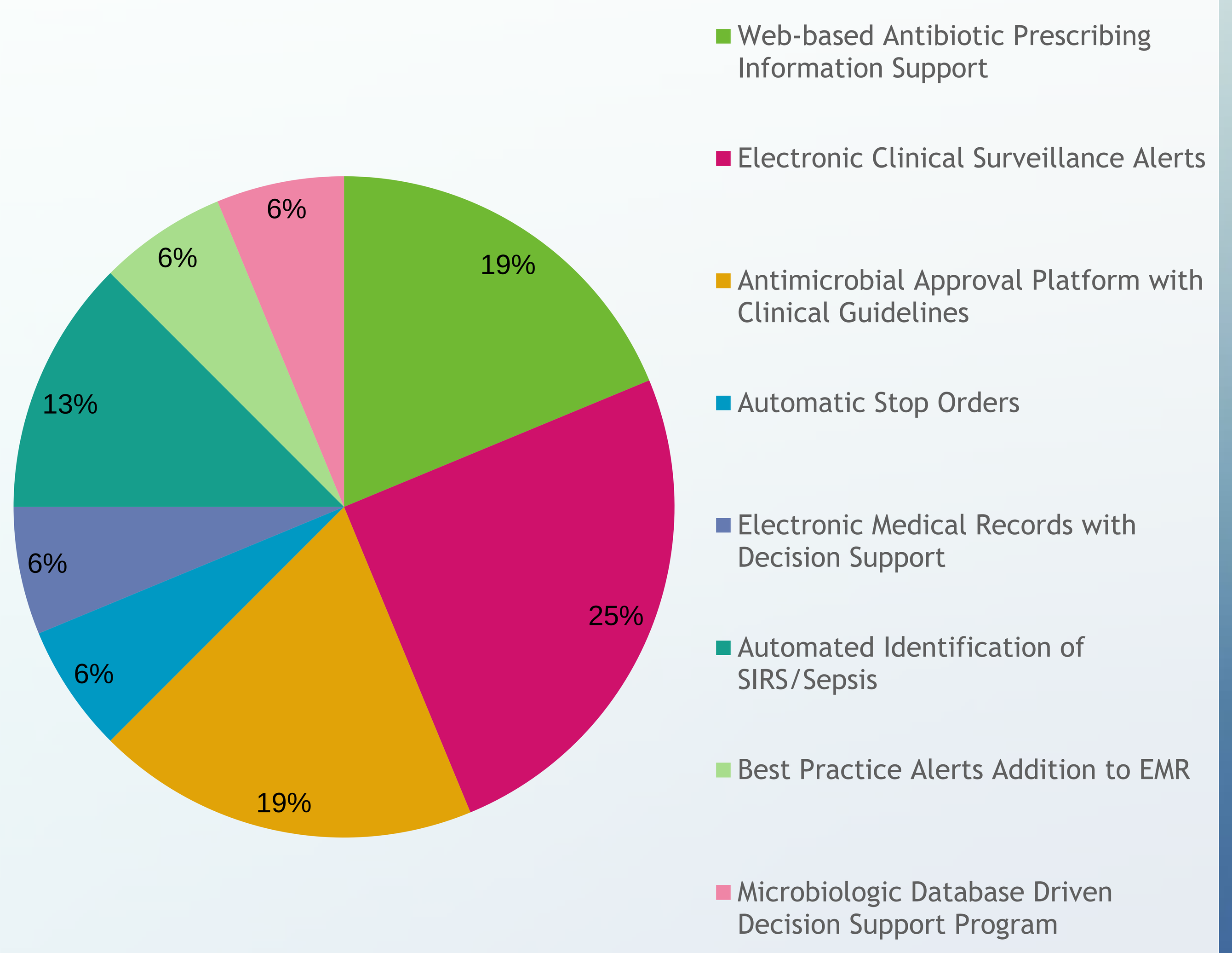


TABLE 1. Studies evaluating the use of clinical surveillance decision support tool for ASP

Reference, Country	Study Design	CDSS	Interventions	Outcomes
Bochicchio et al, 2006; US	Prospective randomized pilot	JHABX PDA during abx prescribing	12 ICU fellows in 1:1 ratio randomized to receive PDA for abx prescribing or paper guidelines. Subjects were given tests at baseline, 3 and 6 months on knowledge of infectious disease mgmt	PDA group demonstrated notable improvement in test scores
Buising et al, 2008; Australia	Retro/prospective pre-post	Computerized antimicrobial approval systems (cAAS)	5 years before and 2 years post implementation of cAAS data were analyzed. 28 restricted abx were selected. cAAS lists standard indications, specified duration of approval for each indication	DDD of CPN, VAN, CAR, FQ reduced but ES-PCN increased; Reduction in MRDOs
Buising et al, 2008; Australia	Retro/prospective pre-post	Web-based CDSS with CAP guideline	3 stage study: baseline, academic detailing and CDSS. Study conducted in ED to measure prescribing behavior comparing academic detailing to CDSS	Use of CDSS shows improvement in appropriateness of abx prescribing
Calloway et al, 2013; US	Quasi-experimental	Clinical surveillance decision support	2 year study period with 3 tier system alerts: critical, daily and additional alert review	105% increase in # of interventions; 96% increase of cost savings estimate per year
Chan et al, 2011; Taiwan	Retrospective pre-post	Hospital-wide computerized antimicrobial approval system (HCAAS)	6 years study period: a list of restricted abx were defined by ICC. HCAAS would prompt for ID physician review within 48 hours of restricted abx prescribing	DDD of CPN, VAN, FQ reduced but CAR increased; Increase in ESBL *E. coli* and *K. pneumoniae*
Connor et al, 2007; US	Prospective observational	Empiric therapy automatic stop order	1 month study period: 72 hours empiric VAN automatic stop order. All VAN requires approval, continuation beyond 72 hours required re-approval from ASP. All VAN should have warning sticker for automatic stop	64% of VAN missing warning sticker. 6% of patients experienced interruption to therapy
Cook et al, 2011; US	Retrospective pre-post	Electronic medical record (EMR)	5 year study period: ASP reports for all patients receiving abx ≥ 48 hours and all patients receiving 49 predefined abx. ASP pharmacists conduct chart review for monitoring and recommendation	98.1% increase in abx recommendation made; 124% increase in recommendation acceptance; 28.8% reduction in 41 abx DDD; Reduction in nosocomial CDI and MRSA
Filice et al, 2013; US	Retrospective case-control	Optional CDSS available at order entry	1 year study period: optional CDSS at order entry provide abx information, disease state mgmt. 500 cases identified comparing appropriateness of abx therapy with controls	44% of CDSS abx courses were more likely to be appropriate vs. 33% for non-CDSS
Hermsen et al, 2012; US	Quasi-experimental	Clinical surveillance decision support	1 year study period: alert types, total number of actionable alerts were collected	10,545 alerts in study period, 30% actionable: low proportion of alerts for redundant anaerobic coverage, drug-bug mismatch and VAN for CoNS; average of 11 alerts per patient
Hooper et al, 2012; US	Prospective RCT	Real time surveillance tool: automated identification of SIRS	4 month study period: patients with SIRS admitted to MICU serve as control, automated program is a real time electronic surveillance tool to detect patients positive for modified SIRS and generate pages and EMR notifications to alert prescribers	No difference in time to first antibiotic, fluid administered or LOS
McGregor et al, 2006; US	Prospective RCT	Clinical surveillance decision support	4 month study period: non-CDSS vs. CDSS. CDSS was programmed with 32 alerts to identify: IV to PO opportunity, unnecessary double coverage, MDROs	Intervention arm has 2x more abx interventions (16% vs. 8%); hospital abx expenditures were lower in expenditure arm with $84,194 cost savings; no significant difference in mortality or LOS
Mullett et al, 2004; US	Retrospective observational	CDSS algorithm match patient's past culture data and account for patient's RF to provide statistical analyzed therapy recommendation	Patients with positive blood culture were included in study retrospectively (n=226). The appropriateness of therapy initiated by physician vs. microbiological CDSS were compared	Physician effectiveness rate was 66% vs microbiological CDSS for a rate of 86%
Patel et al, 2012; US	Retrospective observational	Clinical surveillance decision support	1 year study period: Pip-Tazo de-escalation alert was built into CDSS, pharmacists evaluate patient's profile in EMR to determine continuation criteria	With the use of CDSS, de-escalation interventions were increased from 6% to an average of 60%. Appropriate de-escalation increased from 44% to 80%
Sawyer et al, 2011; US	Prospective observational pilot	Automated identification of sepsis	1 year study period: sepsis alerts generated from medical informatics systems to identify non-ICU patients at risk for sepsis	Within 12 hours of alert, 70.8% of IG received ≥ 1 intervention vs. 55.8% for NIG; significant increase in abx, IV fluid and oxygen administered. No difference in mortality or LOS
Schulz et al, 2013; US	Quasi-experimental	Best Practice Alerts (BPA) tool addition to EMR	Abx use and response data were collected 1 day before and after BPA use. 8 broad intervention themes were programmed into BPA: de-escalation, duration of therapy, duplicate coverage, drug-bug mismatch, microbiology cultures needed, dosing adjustment, IV to PO, drug interaction	244 BPA (18.9%) were de-escalation acted upon within 72 hours of empiric therapy, 169 (69%) were accepted, 30 (12%) were accepted with modifications. Reduction in broad spectrum abx use
Zaidi et al, 2013; Australia	Prospective observational	Computerized antimicrobial approval systems (cAAS)	Survey interview evaluative study to assess the impact of a formative evaluation on the uptake of CDSS by clinicians	Formative evaluation approach increase clinician's acceptance to CDSS

*JH... ; abx = ...; ... assistant; ICU = intensive care unit; ID = infectious disease; mgmt = management; DDD = defined daily dose; CPN = cephalosporin; VAN = vancomycin; CAR = carbapenems; FQ = fluoroquinolones; ES-PCN = extended spectrum penicillins; MDROs = multidrug resistant organisms; CAP = community acquired pneumonia; ED = emergency department; ICC = infection control committee; ESBL = extended spectrum beta lactam; CDI = *C. difficile* infection; MRSA = *methicillin resistance S. aureus*; CoNS = coagulase –negative *S. aureus*; SIRS = systemic inflammatory response syndrome; MICU = medical ICU; RCT = randomized controlled trial; IV = intravenous; PO = oral; LOS = length of stay; RF = risk factors; Pip-Tazo = piperacillin – tazobactam; IG = intervention group, NIG = non-intervention group

FIGURE 3. Definition of Clinical Surveillance Decision Support Tool



SUMMARY

- There is a vast heterogeneity in the definition and use of CDSS
- The aggregate results reveal the use of clinical surveillance decision support software leads to an increase in pharmacist's interventions, appropriate use of antimicrobial and reduction in broad spectrum antibiotic use
- No improvement of mortality or decrease in LOS was demonstrated

CONCLUSIONS

The use of a clinical decision support system has been demonstrated to be safe and effective to:

- Enrich prescriber's knowledge, improve prescribing behavior, increase antimicrobial drug cost savings by a reduction in antimicrobial usage
- Additional large randomized controlled trials are needed to determine the impact of CDSS on clinical outcomes

REFERENCE

Please refer to separate document for a list of references

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