Clinical decision support systems: beneficial for everyone?

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Disclosures

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Learning Questions

- Decision support: Do benefits outweigh disadvantages?
- Is implementation of decision support harmless?
- Will intelligent decision support systems create less intelligent users?

Learning Objectives

After attending the seminar delegates should be able to:

- Deliberately use CDSS
- Prevent uncritical use of CDSS
- Deal successfully with strengths, weaknesses, opportunities and threats of CDSS

Content

- What is CDSS?
- Why CDSS?
- SWOT-analysis

Definition CDSS

Clinical decisions support systems contain decision support algorithms or 'clinical rules'

Definition:

"A **clinical rule** is an algorithm in which **patient characteristics** are linked to generate **patient specific** advises and therefore increase **patient safety**."

Definition CDSS

Definition:

"CDSS combine **patient data** with an **electronic data base** in order to **support decision-making** "

(Beeler et al, SMW, 2014)

➡ **A CDSS encompasses an 1) algorithm fed by 2) patient data and 3) a data base**

Functionalities

Six basic CDS functionalities:

- **Medication dosing support**
- **Electronic order facilitators**
- **Point-of-care alerts and reminders**
- **Relevant information display**
- **Expert systems**
- **Workflow support**

(Wright et al, JAMIA, 2011)

Why CDSS?

- Medication errors occur frequently

- Increasing complexity of healthcare
- Alert fatigue with current systems

New generation drug surveillance

- Drug surveillance → Patient surveillance

CDSS overview

Basic or advanced CDSS?

- **Basic CDSS:**
  - Drug-drug interactions, duplicate therapy, drug-allergies and generalized drug dosing
- **Advanced CDSS:**
  - For example: contra-indications (disease and drugs), individualized dosing support during renal impairment or guidance for medication-related laboratory testing

EHR and CPOE is not enough

ORIGINAL INVESTIGATION

High Rates of Adverse Drug Events in a Highly Computerized Hospital

ARCHIVES EXPRESS

Jonathan R. Nebeker, MS, MD; Jennifer M. Hoffman, PharmD; Charlene R. Weir, RN, PhD; Charles L. Bennett, MD, PhD, MPP; John F. Hurdle, MD, PhD

The incidence density of 6.6 serious and 0.9 fatal ADEs per 1000 patient-days highlights the frequency with which serious iatrogenic injuries can result during inpatient care.

Conclusions: High rates of ADEs may continue to occur after implementation of CPOE and related computerized medication systems that lack decision support for drug selection, dosing, and monitoring.

Arch Intern Med. 2005;165:1111-1116

Why CDSS?

Too many…

Useless and clinical irrelevant information…

Information does interrupt workflow

Technical problems

About 90% of electronically implemented drug safety alerts are ignored

Van der Sijs et al. J Am Med Inform Assoc. 2006;13:138-47

SWOT-analysis on CDSS

Strengths

- CDSS are one of the most powerful tools for improving patient safety and healthcare quality
- Main strength is generating relevant and patient specific recommendations

- Success factors of CDSS
- Quality of system, software, rules and knowledge

The added value of CDSS

Knowledge: guidelines and protocols
Rules: *clinical rules*
Software: Link between rules ⟷ patient data

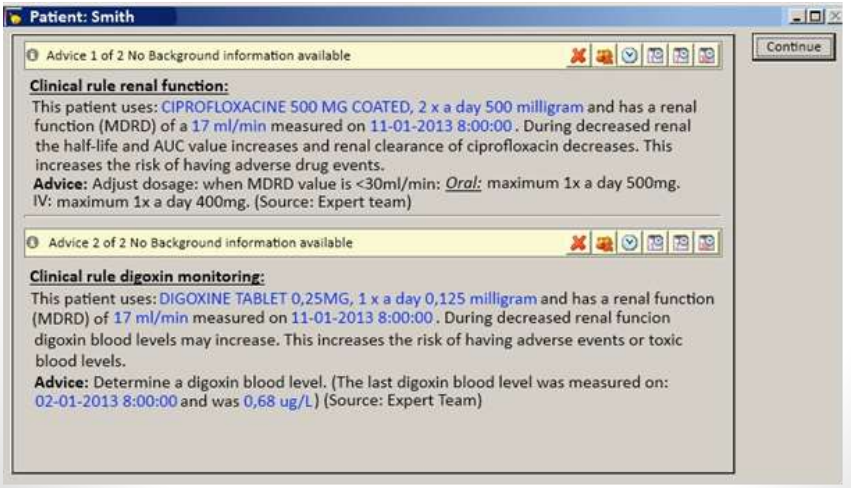
The added value depends on:
- Quality of database
- Quality of software
- Quality of *clinical rules*

CDSS Success factors

Right message	Accurate content
	Reliable messages
	Easy and actionable messages
	Inclusion of references in the message
Right time	Save time
	Integration in workflow
	High system's speed
Right place	Deliver message at the point of care
	Active alerting mechanism
Right system	Electronic availability of data in the EMR
	Integration with other systems

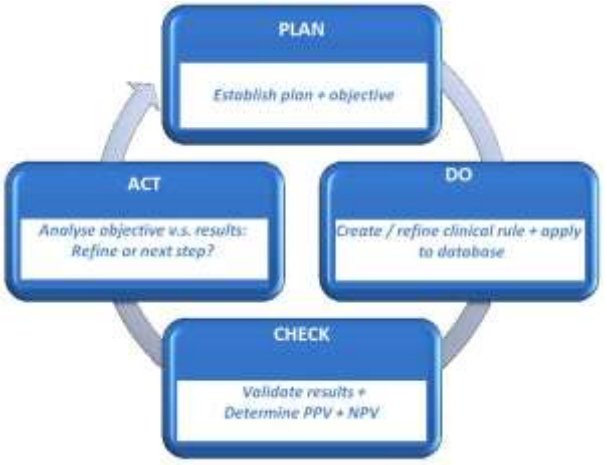
Message example:

- "Make it easy to do it right"



Right message

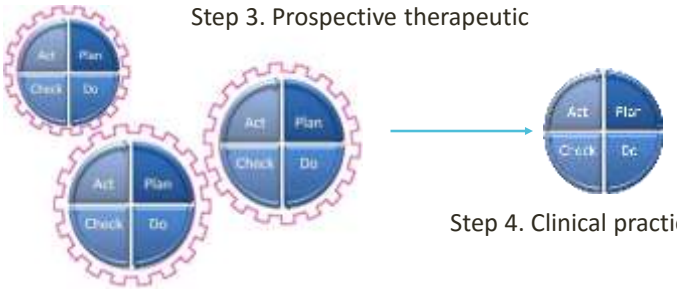
- Validation strategy with expert team:



Technical & therapeutic validation

Step 1: Technical

Step 3. Prospective therapeutic



Step 4. Clinical practice

Step 2: Retrospective therapeutic

Results of validation strategy

Clinical rule	PPV End step 1[1*]	PPV End step 2*	PPV End step 3[2*]
Gastric protection	92% [784/852]	94% [801/852]	99% [83/84]
TDM of aminoglycosides	46% [129/278]	78% [215/278]	100% [53/53]
Potassium	50% [143/285]	78% [222/285]	96% [115/120]
Opioids and laxative	56% [596/1064]	91% [968/1064]	99% [122/123]
Anticoagulation	80% [367/461]	90% [415/461]	100% [35/35]
Renal function	17% [139/819]	28% [230/819]	98% [121/123]

Scheepers at al, EJHP 2013;20:155-160

Right time, place & system

- Local regulations & decisions in hospital
  - Who is the reciever?
  - When?
  - Active v.s. passive alerting
  - Maintenance
- Properties of the CDSS and EHR available
  - Availability of data in EHR
  - Alerts possible
  - Speed system

Active v.s. passive alerting

- Active alerting >> passive alerting

Presentation method	Unique alerts (N)	Unique alerts followed (N / %)
Pop-up alert	166	**68 (41%)**
Pharmacy intervention	244	**80 (33%)**
Physician alert list	199	**40 (20%)**
EHR section	293	**55 (19%)**
Total	**902**	**243 (27% avg.)**

Scheepers at al, AIIM 2013; 59:33-38

Alert method

Presentation method*	Pharmacy intervention	Live intervention	Pop-up alert	Total
Unique alerts (N)	279	151	135	**565**
Unique alerts followed (N (%))	**61 (22%)**	**58 (38%)**	**59 (44%)**	**159 (32%)**

* Unpublised data

Weaknesses

- **Much time and resources needed to implement** (interprofessional teams)
- **More time needed for ward rounds** + 20 Min.
- **False trust in IT systems** e.g. Drug interaction programs
- **Potential failures in implementation**, see example
- **Alert fatigue** (120 alerts as limit; 49-96% overriding (Van der Sijs, JAMIA, 2006)

Weaknesses: Example

Analysis of a Failed Clinical Decision Support System for Management of Congestive Heart Failure

by Wadhwa et al (2008)

- **Implementation steps:**
  - 1. Identification of patients with chronic heart failure (CHF)
  - 2. Alert physicians to CHF patients
  - 3. Encourage physicians to document CHF
  - 4. Expect physicians to complete CHF order set
- **Result**: Alerts deactivated after 3 wks (503 alerts->54 true positive + 449 false positive, 14 false negative) , CDSS stopped after <eight weeks
- **Challenges**: false positive & negative patient selection, excessive alerts for physicians, incomplete physician response to alerts

(Wadhwa, R., et al. (2008). AMIA Annual Symposium Proceedings 2008: 773-777)

Weaknesses: Some Solutions

Ten Commandments for Effective Clinical Decision Support: Making the Practice of Evidence-based Medicine a Reality by Bates et al (2003):

1. **Speed Is Everything**
2. **Anticipate Needs and Deliver in Real Time**
3. **Fit into the User's Workflow**
4. **Little Things Can Make a Big Difference**
5. **Recognize that Physicians Will Strongly Resist Stopping**
6. **Changing Direction Is Easier than Stopping**
7. **Simple Interventions Work Best**
8. **Ask for Additional Information Only When You Really Need It**
9. **Monitor Impact, Get Feedback, and Respond**
10. **Manage and Maintain Your Knowledge-based Systems**

(Bates, D. W., et al. (2003), JAMIA 10(6): 523-530.)

Opportunities

- Technical possibilities
  - Advancing systems
  - Advancing availability of data
- Collaboration
  - (Inter)National organisations
  - Between hospitals

Technical possibilities

- Progressing availability of EHR and CPOE
- Improved exchange of patient information

Collaboration

- Standardised protocols
- National attention for clinical rules (Dutch association of pharmacists and hospital pharmacists)
- Anchor in (inter)national database (e.g. G-standard)

- Collaboration between hospitals (e.g. same system)

Threats

- **Time delay, see** ICU study (Han et al 2005)
- **Error in CDSS programming=systematic error** (e.g. Allergy)
- **Wrong or complicated algorithms**
- **Implementation without clinicians (commercial systems)**

Threats: Example I

Unexpected Increased Mortality After Implementation of a Commercially Sold Computerized Physician Order Entry System
by Han et al (2005)

- **Background:** Implementation of commercial CPOE within 6 weeks at tertiary referral childrens' hospital in the US
- **Methods:** Mortality of referred children 15 mo before and 5 mo after CPOE imiplementation
- **Results**: Mortality after implementation higher **(OR 3.28; 95% CI 1.94-5.55)**

(Han, Y. Y., et al. , 2005.Pediatrics 116(6): 1506-1512)

Threats: Example II

- **Discussion, ctd:**
  - **Challenge 1: Time loss!**
    - No drug preparations possible until arrival of patient,
    - Stabilization orders too long (10 clicks=1-2 min. vs. few seconds on paper)
    - "Frozen screen" because of bad wireless connections.
    - Nurse and physician locked out of system while pharmacist is working on order
    - Pharmacist cannot process order until activated by nurse
  - **Challenge 2: New medications' locations!**
    - Emergency medication (vasoactives, antibiotics) with CPOE centrally located at pharmacy department

(Han, Y. Y., et al. , 2005.Pediatrics 116(6): 1506-1512)

Threats: Example III

- **Discussion, ctd:**
  - **Challenge 3: Team factors changed with less face-to-face physician-nurse communication!**
    - Before: convergence of physicians and nurses at patient's bed (team work)
    - After CPOE implementation: Two physicians needed: 1 with patient and 1 entering orders 15'-60' duration not at the bedside, nurse leaves bedside to activate drug orders

(Han, Y. Y., et al. , 2005.Pediatrics 116(6): 1506-1512)

Threats: Some Solutions I

- **Initiate independent national boards to evaluate quality and safety of health information technology products**
- **Set up a CDSS governance such as suggested by Wright et al. (2011):**

1. Prioritize the order of development for new CDS and delegate content development to specialized working groups;

2. Consider the potential impact of new CDS on existing clinical information systems;

(Wright A et al, JAMIA, 2011;18(2):187–94)

Threats: Some Solutions II

- **Set up a CDSS governance such as suggested by Wright et al. (2011), ctd:**

  3. Develop tools to monitor CDS inventory, facilitate updates, and ensure continuity;

  4. Implement procedures for assessing the impact of changes and additions to CDS system's own functionality;

  5. Provide multiple robust channels for user feedback and the dissemination of systems-related information to end users;

  6. Develop tools for ongoing monitoring of CDS interventions.

(Wright A et al, JAMIA, 2011;18(2):187–94)

Answers to Learning Questions

- Decision support: Do benefits outweigh disadvantages?
- Is implementation of decision support harmless?
- Will intelligent decision support systems create less intelligent users?

Take Home Messages

- CDSS: Key stone systems in an increasingly complex healthcare
- Important to increase patient safety now & in the future
- CDSS= decision algorithm + patient data + database
- Strengths: Alert method & (validated) content
- Weaknesses: Time consumption, alert fatigue, false trust
- Opportunities: Expanding & collaboration
- Threats: Systematic errors, respect work flows

Thank you for your attention

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Questions?

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