MEDAL: The Medical Algorithms Project

Gareth Kantor[a], John R Svirbely[b], Kathy Johnson[c], MG Sriram[d], Jorge Raul Rodriguez[e], Jack Smith[c]

[a]*Case Western Reserve University, Cleveland, Ohio; gary.kantor@uhhs.com*

[b]*McCullough-Hyde Memorial Hospital, Oxford, Ohio; drjohn@mhmh.org*

[c]*University of Texas - Houston, Houston, Texas;*

[d]*HelloBrain Corp, Santa Clara, California;*

[e]*Hospital Dr. Cosme Argerich, Buenos Aires, Argentina*

http://www.medal.org

Summary

- *Numerous algorithms in health care, but most practitioners use only a small subset routinely*
- *Algorithms would be more widely used if they were readily available in a practical format to clinicians, educators and researchers*
- *A centralized, free repository of automated medical algorithms would be beneficial*
- *MEDAL is a web-based repository that utilizes spreadsheets for algorithm representation*
- *Discuss benefits, problems & issues for further development and clinical use*

Algorithm Definitions

- “A step-by-step procedure for solving a problem or accomplishing some end especially by a computer”
- Any computation, formula, survey, or look-up table useful in healthcare
- Amenable to spreadsheet representation

MEDAL - Participants

- John Svirbely - drjohn@mhmh.org
- Gary Kantor - gary.kantor@uhhs.com
- MG Sriram
- Jorge Rodriguez - Buenos Aires, Argentina
- Jack Smith - U of Texas informatics group

Medical Algorithms: Barriers to Use

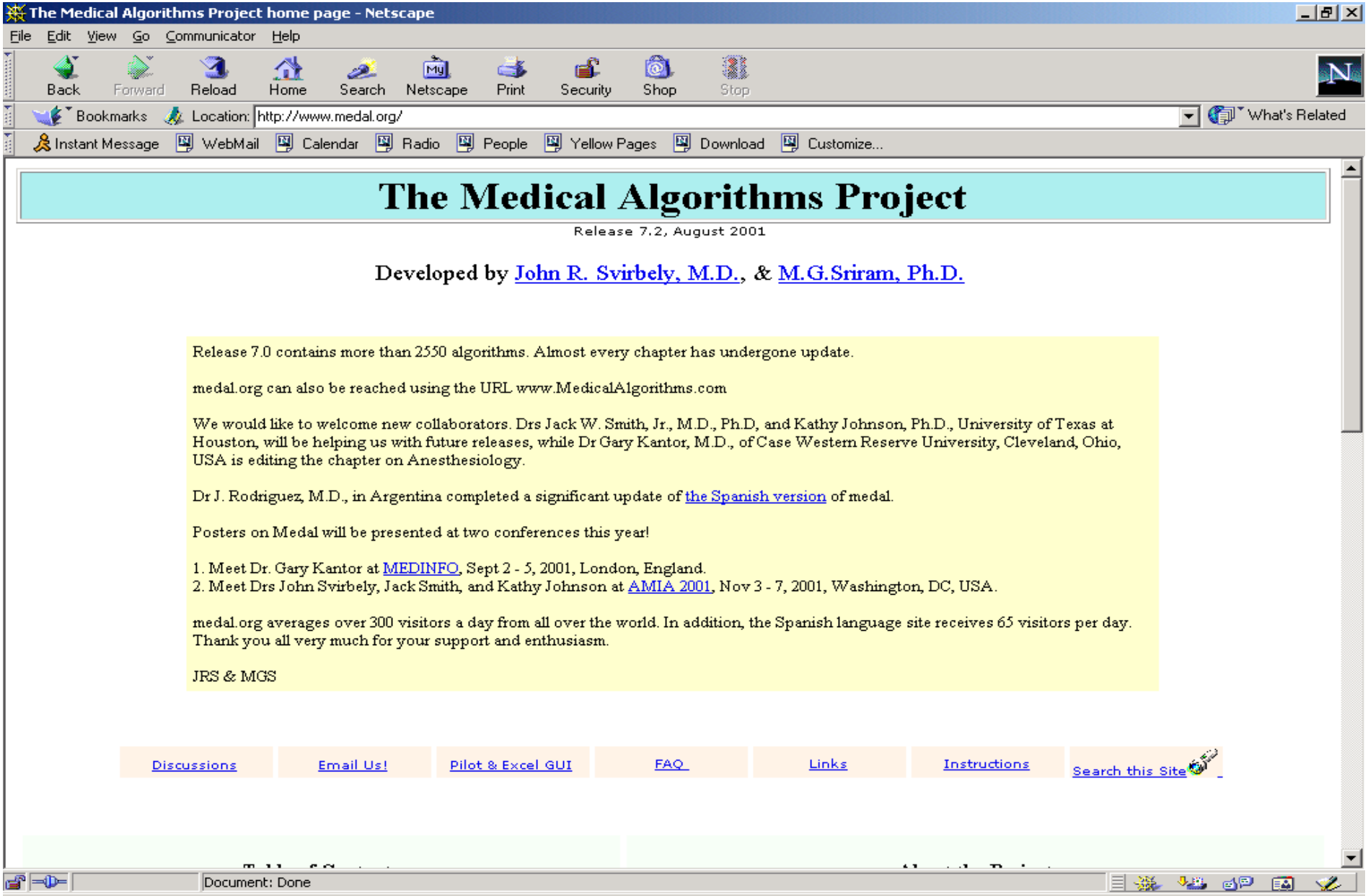
- Difficulty identifying & retrieving the correct algorithm for a particular clinical task
- Lack of reliable documentation on applicability, validity or level of evidence
- Lack of availability in a format suitable for use at the point of care or site of decision-making

Medical Algorithms: Barriers to Use

- Inaccuracies in formulas or data due to transcription errors
- Misunderstanding concerning appropriate units for data or results
- Need to adjust for physiological extremes – e.g. age, body weight
- Expression of findings without a reference range or methodology, making transfer of results between institutions difficult

MEDAL: Goals

- A comprehensive collection of accurate and reliable algorithms
- Adequate documentation with references to the original sources
- Standardization of data elements, to enable automation of input and output
- Indexing & linking for quick access and retrieval


The Medical Algorithms Project home page - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Shop Stop
Bookmarks Location: http://www.medal.org/ What's Related
Instant Message WebMail Calendar Radio People Yellow Pages Download Customize...
The Medical Algorithms Project
Release 7.2, August 2001
Developed by John R. Svirbely, M.D., & M.G.Sriram, Ph.D.
Release 7.0 contains more than 2550 algorithms. Almost every chapter has undergone update.
medal.org can also be reached using the URL www.MedicalAlgorithms.com
We would like to welcome new collaborators. Drs Jack W. Smith, Jr., M.D., Ph.D, and Kathy Johnson, Ph.D., University of Texas at Houston, will be helping us with future releases, while Dr Gary Kantor, M.D., of Case Western Reserve University, Cleveland, Ohio, USA is editing the chapter on Anesthesiology.
Dr J. Rodriguez, M.D., in Argentina completed a significant update of the Spanish version of medal.
Posters on Medal will be presented at two conferences this year!
1. Meet Dr. Gary Kantor at MEDINFO, Sept 2 - 5, 2001, London, England.
2. Meet Drs John Svirbely, Jack Smith, and Kathy Johnson at AMIA 2001, Nov 3 - 7, 2001, Washington, DC, USA.
medal.org averages over 300 visitors a day from all over the world. In addition, the Spanish language site receives 65 visitors per day. Thank you all very much for your support and enthusiasm.
JRS & MGS
Discussions
Email Us!
Pilot & Excel GUI
FAQ
Links
Instructions
Search this Site
Document: Done

The Medical Algorithms Project home page - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://www.medal.org/ What's Related

Instant Message WebMail Calendar Radio People Yellow Pages Download Customize...

Table of Contents

About the Project

A *Medical Algorithm* is any computation, formula, survey, or look-up table, useful in healthcare. We have collected over 2550 algorithms spanning major medical domains, organized into 44 chapters. An additional chapter contains algorithms contributed by our visitors. To ensure the widest possible audience, the algorithms have been implemented in an Excel workbook which you can freely download to run on your Windows or Macintosh computer. You will need MS Excel, and should be familiar with running spreadsheets.

The chapters

Each chapter has been compressed into a zip file consisting of an MS Excel workbook, containing the algorithms of the chapter, and an MS Word document with descriptions and references for the algorithms. To download, go to a chapter's page and click on this icon  , located on the upper right of the page.

Important

Before downloading any chapters please see the usage instructions containing information relating to all chapters.

Other Implementations

Selected algorithms have been implemented in two other forms. One is as an Excel Add-In with GUI data entry methods, and the other is for a Palm Pilot. Ideally, we would have liked to provide well-designed GUI based interfaces, and/or palm computer versions for each of the algorithms. Since the project is entirely self-funded, done in the authors' spare time, we do not have the

Document: Done

edal Iberoamericano - Netscape

Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://www.medal.org.ar/ What's Related

Instant Message WebMail Calendar Radio People Yellow Pages Download Customize...

ritmos Médicos Electrónicos

Medal iberoamericano

Copyright (c) 1995-2001, Medical Algorithms

- Home Page
- Objetivos
- Autores
- Capítulos en Inglés
- Capítulos en Español
- Otras Planillas
- EBM
- Tutoriales
- Software
- Declaraciones Legales
- Contáctese
- Links

Bienvenido a Medal, la versión 7.1, June 2001, está compuesta por más de 2550 algoritmos médicos. Damos la bienvenida los nuevos colaboradores: Dres. Jack Smith y Kathy Johnson de Texas University, Houston, USA. También al Dr. Gery Kantor del Case Western Reserve University, editor del capítulo de Anestesiología. Medal.org posee más de 220 visitas por día de todo el mundo y Medal Iberoamericano más de 55. Medal Project es mantenido por el aporte y esfuerzo exclusivo de sus autores y colaboradores.
JR Svirbely y MG. Sriram.

www.medal.org
Medal
Algoritmos Médicos
www.medal.org.ar

NOVEDADES en MEDAL

Vea las estadísticas de Medal Iberoamericano.

- dbHelp 3.0: una nueva versión del tutorial de bases de datos
- SheetHelp 3.0: un nuevo tutorial sobre hojas de calculo
- EBM-Inet: nuevo tutorial sobre EBM e Internet
- Capítulo de Nefrología de Medal en castellano.
- Nuevo software: SIP; SIN y SIA; los sistemas de bases de datos del CLAP-OPS: Excelentes.

Visite el material sobre EBM Medicina Basada en la Evidencia que Medal creó para Usted. Baje el tutorial de EBM e Internet básico.

Methods

Selection

↓

Documentation

↓

Spreadsheet Implementation

↓

↓

Implementation in a Software Application

Selection

- Sources: journals and textbooks
- Anything that is simple and modular and which can be implemented in a spreadsheet is suitable
- Not intended to be a complex, vertical system nor an expert system

Selection – Algorithm Types

1. Coding & look-up tables
2. Comparison with normal population standards
3. Data conversion
4. Decision rules & triaging
5. Decision trees & flow diagrams
6. Diagnostic criteria
7. Diaries & symptom tracking
8. Functional state description

Selection – Algorithm Types

9. Grading and scaling
10. Probability & statistical analysis
11. Prognostic scores
12. Questionnaires
13. Risk determination
14. Simple classification
15. Simple formulas
16. Therapeutic indications & contraindications

Documentation

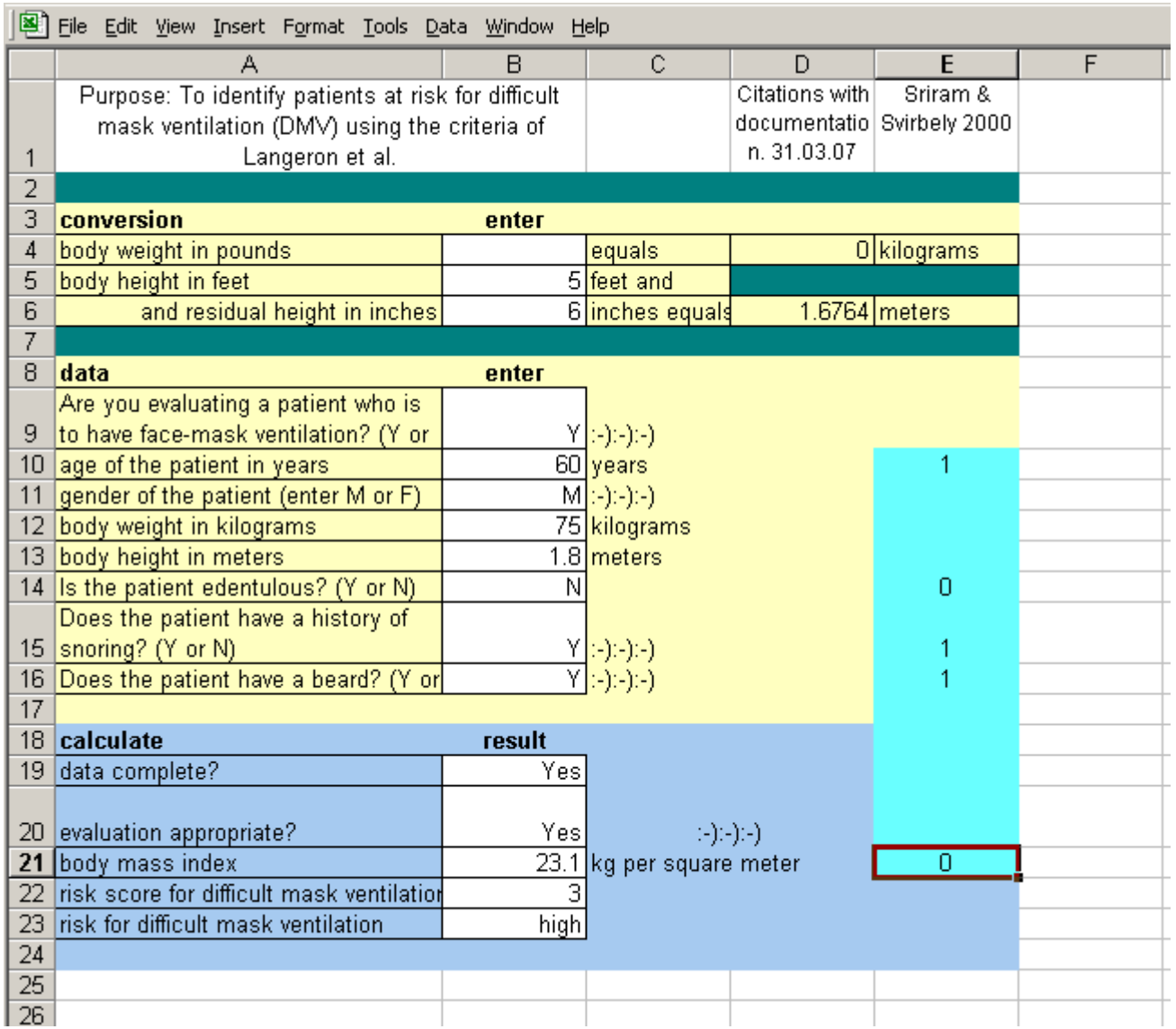
- Documentation abstracted from the medical literature
- The abstract should help the user understand the algorithm implementation and determine if the algorithm is logical and medically valid
- Reviewers can annotate the algorithm worksheet for clarification or commentary

Spreadsheet Implementation

- Provides a degree of functionality that is accessible to most users
- Write-protection - removable
- Use by programmers for software development and in the validation of existing software applications

Spreadsheet Implementation

- Standardized representation with future automation of software production in mind
- Components sequenced as follows:
  (1) Overview and reference to documentation
  (2) Unit conversion
  (3) Data entry
  (4) Intermediate calculations (variable)
  (5) Interpretation
  (6) Data tables



File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F
1	Purpose: To identify patients at risk for difficult mask ventilation (DMV) using the criteria of Langeron et al.			Citations with documentation. 31.03.07	Sriram & Svirbely 2000	
2						
3	**conversion**	**enter**				
4	body weight in pounds		equals	0	kilograms	
5	body height in feet	5	feet and			
6	and residual height in inches	6	inches equals	1.6764	meters	
7						
8	**data**	**enter**				
9	Are you evaluating a patient who is to have face-mask ventilation? (Y or	Y	:-):-):-)			
10	age of the patient in years	60	years		1	
11	gender of the patient (enter M or F)	M	:-):-):-)			
12	body weight in kilograms	75	kilograms			
13	body height in meters	1.8	meters			
14	Is the patient edentulous? (Y or N)	N			0	
15	Does the patient have a history of snoring? (Y or N)	Y	:-):-):-)		1	
16	Does the patient have a beard? (Y or	Y	:-):-):-)		1	
17						
18	**calculate**	**result**				
19	data complete?	Yes				
20	evaluation appropriate?	Yes	:-):-):-)			
21	body mass index	23.1	kg per square meter		0	
22	risk score for difficult mask ventilation	3				
23	risk for difficult mask ventilation	high				
24						
25						
26						

31.03.07 Predictive Criteria of Langeron et al for Difficult Mask Ventilation

Overview:
Langeron et al identified factors associated with difficult mask ventilation (DMV). The authors are from the Centre Hospitalo-Universitaire Pitie-Saltpetriere of the University of Paris in France.

Parameters identified as independent risk factors on multivariate analysis:
(1) age
(2) body mass index
(3) presence of beard
(4) lack of teeth
(5) history of snoring

Other factors identified in univariate analysis, but not passing multivariate analysis:
(1) macroglossia
(2) higher Mallampati grade
(3) shorter thyromental distance

Parameter	Finding	Points
age	<= 55 years	0
	> 55 years	1
body mass index	<= 26 kg per square meter	0
	> 26 kg per square meter	1
beard (for males)	no	0
	yes	1
dentition	good dentition	0
	lack of teeth	1
history of snoring	no	0
	yes	1

where:
• The lack of teeth seems to indicate being edentulous. There does not seem to be any special handling for people with partial dentures.

risk score score =
= SUM(points for the 5 parameters)

Interpretation:
• minimum score: 0
• maximum score: 5 for males, 4 for females
• A score >= 2 indicated a high likelihood of difficult mask ventilation (sensitivity 72 %, specificity 73%, positive predictive value 12%, negative predictive value 98%).

Spreadsheet Implementation

- Algorithms in chapters as MS-Excel 95 workbooks
- Table of contents with hyperlinks
- Data entry areas
- Modification requires extraction of spreadsheet into a separate file
- MS Word 95 document - abstracts & references for the algorithms

Software Implementation

- MS Excel "add-in" with GUI data entry
- Small Palm OS-based application

Software Implementation

- GUI
- Automatic data handling
- Integrated or interfaced with clinical information systems
- Automated alerts, reminders, guideline presentation
- Documentation & spreadsheets provide validation for clinical users

Initial development can be performed by health care professionals who can then pass the work on to programmers once they are satisfied that the essential elements are present. Programming can take advantage of the economy of scale to reduce development and maintenance costs.

Results

- >3000 algorithms
- Spanish language mirror site
- >300 visitors/day
- No formal outcome evaluation
- Discussion group

Results - General Problem Identification

- Predictive algorithms validated in a study population but poorly “generalizable”
- Design tradeoffs between simplicity/elegance vs complex/accurate
- Lack of "responsiveness“ - limited correlation between change in an algorithm's output and the patient's clinical condition

Results - General Problem Identification

- Representation Standards
- Suboptimal formulation or documentation - literature sources may contain ambiguity in documentation and explanation
- Data elements selected may not be transferable to other institutions or countries, e.g. where differences exist in test methodology.
- Misuse of measures, units & laboratory values
  - SI units vs. conventional
  - varying use of percentages (50% as 50 or 0.5)
  - different types of logarithms (natural vs. base 10)
  - Variation in the exact value expected for use in an equation (e.g. a white blood cell count of 10,000 per microliter might be entered as 10000, 10 thousand, or 10*10^9).

Results - Errors During Algorithm Use

(1) Failure to use an algorithm when one is appropriate (error of omission)

(2) Selection of wrong algorithm (use in situations outside of specifications)

(3) Simple algorithm when a more complex one would be better

(4) Error in remembering the algorithm (error of recall)

(5) Error during calculation or execution

(6) Misuse of the output of the algorithm (use for individual when intended for populations; use outside of specified population).

Results - Legal, Regulatory, Security & Privacy Constraints

- Potential for malpractice liability
- Disclaimer “educational and personal use of health care students and professionals”
- Intellectual property issues
- US Food and Drug Administration regulations for medical software
- Selection of a particular algorithm can indicate a patient's underlying diagnosis

Algorithm Automation: Benefits

- **Putative benefits from** increased availability and automation
  - ***Evidence-Based Medicine***
  - ***Enlarge clinician scope of practice***
  - ***Patients make more informed decisions***
  - ***Reduction of medical errors***
  - ***Education***
  - ***Research -*** clinical trials

MEDAL as Open Source Software

- ***Knowledge bank for clinical decision support system development***
- ***Content "upgrade" – quality, evidence assessment, appropriate use***
- ***Legal issues – use, verification, accuracy,***
- ***Commercialization ?Business model***
- ***Spreadsheet production by non-programmer clinicians – professional societies?***
- ***Open Source model for both content and software implementation***
- ***Global Resource***
  - Translation into multiple languages
  - Modification for local needs