

# Prevention of Venous Thromboembolism: Can Computers Help?

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## Medical Error Rates

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- Two errors per day = 99% proficiency level
- If 99% was good enough:
  - Airline industry = 2 airplane crashes per day
  - Banking industry = 32,000 checks deducted from the wrong account per hour
- How do we transform the health care into a high reliability industry?

Leape, 1994

## Background

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- At Brigham and Women's Hospital, we have initiated a series of trials aimed at increasing prophylaxis by:
  - **changing MD behavior** and
  - **improving implementation** of prophylaxis

## Types of Interventions

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- Electronic Computer Generated Mechanism
  - Single Screen Alert
    - RCT
    - Cohort study
  - Multi-Screen Alert

## First Generation Electronic Alerts

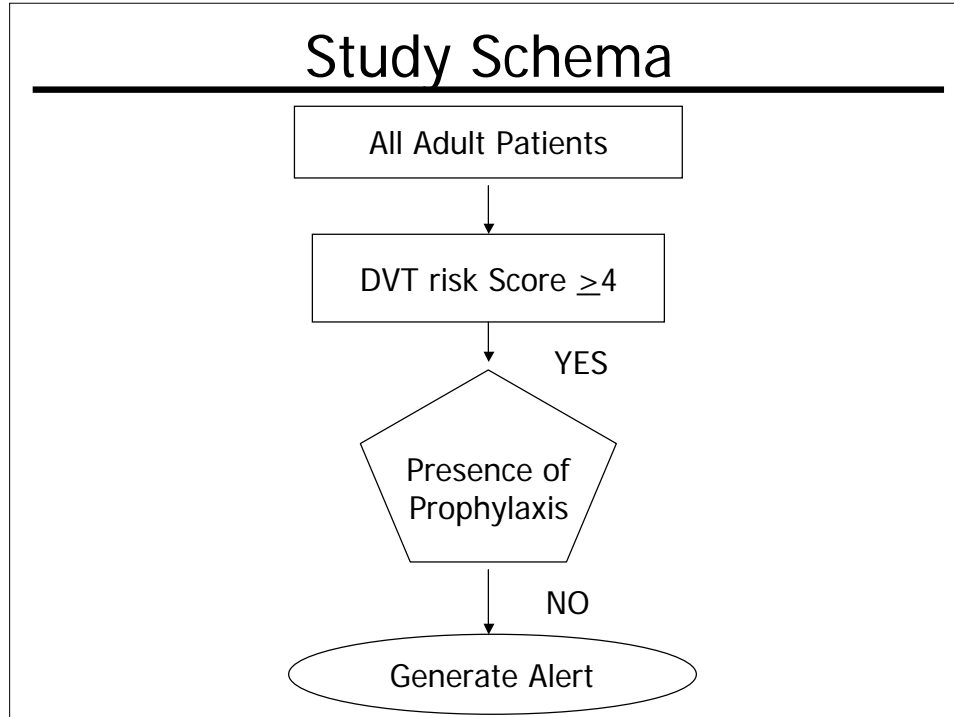
- BWH utilizes BICS (Brigham Integrated Computing System) for all order entry functions
  - Admitting records, demographic information, lab results, medication orders, etc.
- VTE group utilized computer system to screen all patients admitted to the hospital for High Risk VTE Status

## First Generation Alert: Development

- Aim: to increase rate of prophylaxis in patients at risk for DVT and PE
- Developed computer program to detect and identify which patients were at risk
- Alert the responsible physician of high risk patient (via e alert) and offer opportunity to order appropriate prophylaxis

## Study Schema

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## DEFINITION OF "HIGH RISK"

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### VTE risk score $\geq 4$ points:

- Cancer 3 (ICD codes)
- Prior VTE 3 (ICD codes)
- Hypercoagulability 3 (Leiden, ACLA)
- Major surgery 2 (> 60 minutes)
- Bed rest 1 ("bed rest" order)
- Advanced age 1 (> 70 years)
- Obesity 1 (BMI > 29 kg/m<sup>2</sup>)
- HRT/OC 1 (order entry)

# RANDOMIZATION

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VTE risk score  $\geq 4$   
No prophylaxis  
N = 2506

**INTERVENTION**  
Single alert  
n = 1255

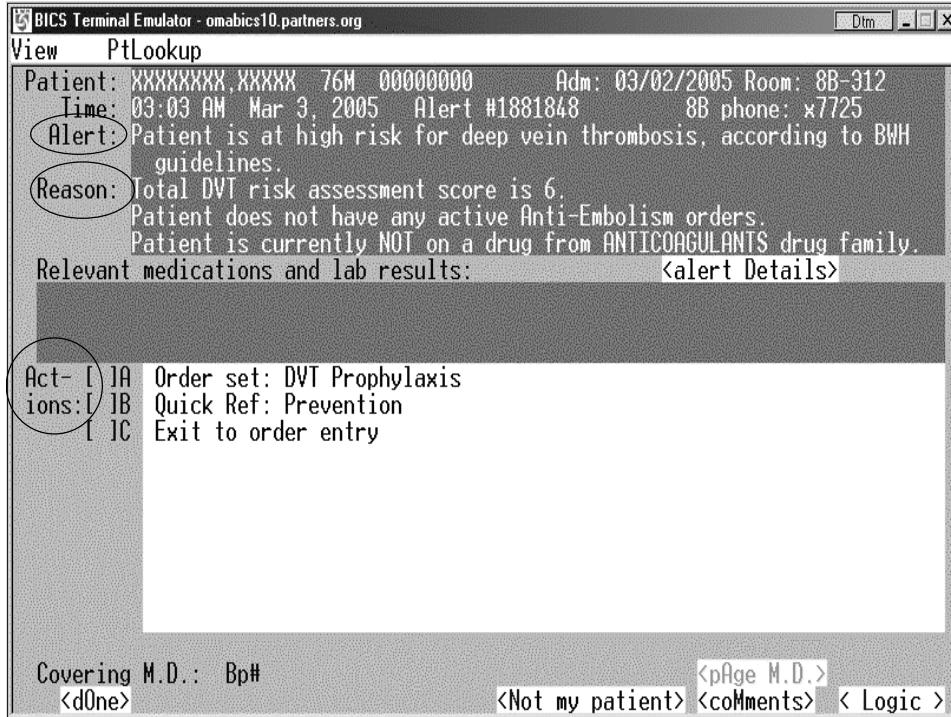
**CONTROL**  
No alert  
n = 1251

(Kucher N, et al. NEJM 2005;352:969-977)

## Physician Notification of Alerts

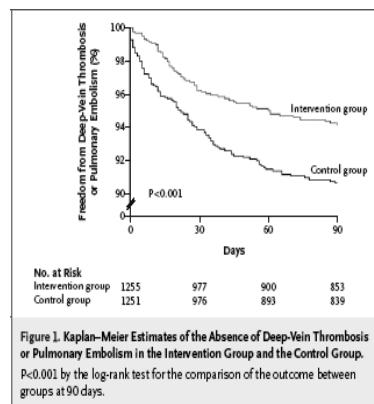
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## First Generation Computerized Alerts for VTE prevention

- Utilization of computer generated alerts to house staff reduced the incidence of VTE by 41%
- VTE prophylaxis was prescribed in 33.5% of patients in the intervention group
- Following study conclusion a multidisciplinary team was convened to enhance the VTE alerts at BWH



Kucher N, et al. NEJM. 2005;352:969-977.

## Cohort Study

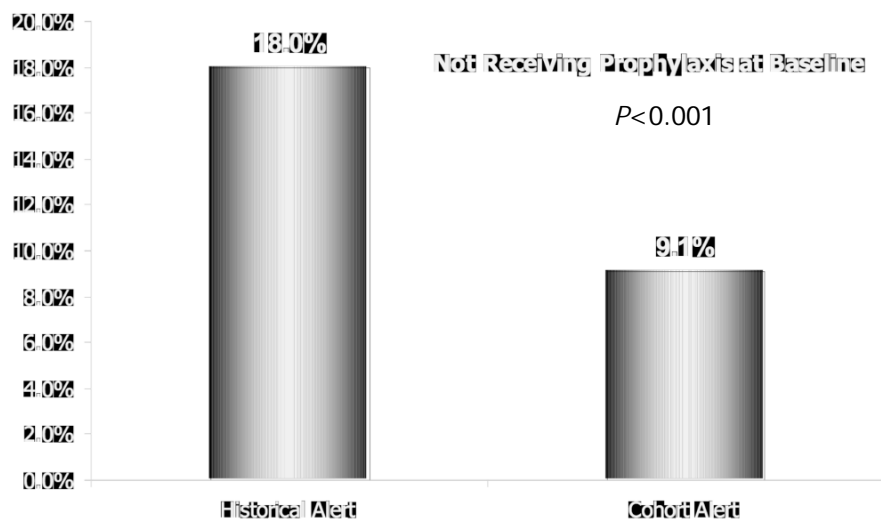
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- Aim: Assess sustainability of electronic alerting system and impact on physician prescribing habits
- Methods: Compared VTE prophylaxis rates and clinical outcomes in cohort study with prior RCT results
- Endpoints: Symptomatic VTE at 90 days, mortality at 30 days, bleeding, MD response to alerts, and prophylaxis selected

Baroletti S, et al. J Thrombosis and Thrombolysis.2007

## Cohort Study: Results

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## Cohort Study: Results

Prophylactic Measure in response to alert	Cohort Alert	Historical Alert	p value
Total	326 (37.7%)	421 (33.6%)	0.052
Pharmacological	234 (27.1%)	296 (23.6%)	0.73
UFH	77 (8.9%)	213 (17%)	<0.001
LMWH	108 (12.5%)	55 (4.4%)	<0.001
Warfarin	49 (5.7%)	28 (2.2%)	<0.001
Mechanical	92 (10.6%)	125 (10%)	0.62
Compression stockings	33 (3.8%)	52 (4.1%)	0.52
Pneumatic boots	59 (6.8%)	73 (5.8%)	0.61

Baroletti S, et al. J Thrombosis and Thrombolysis.2007

## Cohort Study: Results

- Primary endpoint of symptomatic VTE occurred in 5.1% of pts in cohort study vs. 4.9% of patients in historical alert group. (P=0.82)
- Following study conclusion a multidisciplinary team was convened to enhance the VTE alerts at BWH

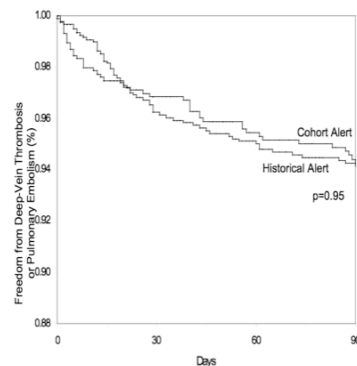


Figure 2. Kaplan-Meier Estimates of the Absence of Deep-Vein Thrombosis or Pulmonary Embolism in the Cohort Group and the Historical Intervention Group. P=0.95 by the log-rank test for the comparison of the outcome between groups at 90 days.

Baroletti S, et al. J Thrombosis and Thrombolysis.2007

## Second Generation: Electronic Computer Generated Alerts

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### **BWH VTE Alerts: The Future**

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- Goals:
  - Engage the house officer with an interactive alert to increase acceptance and gain feedback
  - Update the DVT prophylaxis template to meet current practice guidelines
  - Provide real-time knowledge links

## Interactive Techniques

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- Provide objective data to the house officer that this alert positively impacts patient outcome
- Create opportunity to capture rationale for declining alert
  - Hypothesized that many physicians fear a risk of bleeding with anticoagulation
- Provide a final opportunity to order mechanical prophylaxis
- Alert attending physician if alert is not acknowledged after 24 hours

## DVT Alert Screen

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Time: 03:24 AM Dec 4, 2002 Alert #1014346 14B phone: x7905  
Alert: Patient is at high risk for deep vein thrombosis, according to BWH guidelines.  
Reason: Total DVT risk assessment score is 4.  
Patient does not have any active Anti-Embolism orders.  
Patient is currently NOT on a drug from ANTICOAGULANTS drug family.  
Relevant medications and lab results: [Alert Details](#)  
Study at BWH published in NEJM 2005;352:969-977 demonstrated a 41% decrease in incidence of VTE using computer generated alerts to House Staff physicians

Act- [ JA Order set: DVT PROPHYLAXIS TEMPLATE  
ions:[ JB Partners Handbook: VTE Guidebook 4th edition  
[ IC Exit to order entry

Covering M.D.: Bp# [<dOne>](#) [<Not my patient>](#) [<pAge M.D.>](#) [<coMments>](#) [<Logic >](#)

## Rule Logic – Alert Details

Time: 03:22 AM Nov 2, 2004 Alert #1740559 7A phone: x7695

Details for alert #1740559

Rule: Patient is at high risk for deep vein thrombosis, according to BWH guidelines.

The following risk factors were found to be positive (score applied):

Patient is overweight: BMI >29 kg/m2 (1)

has history of deep vein thrombosis or pulmonary embolism (3).

-and-

Patient does not have any active Anti-Embolism orders.

-and-

Patient is currently NOT on a drug from ANTICOAGULANTS drug family.

## Option A

Time: 03:24 AM Dec 4, 2002 Alert #1014346 14B phone: x7905

Alert: Patient is at high risk for deep vein thrombosis, according to BWH guidelines.

Reason: Total DVT risk assessment score is 4.

Patient does not have any active Anti-Embolism orders.

Patient is currently NOT on a drug from ANTICOAGULANTS drug family.

Relevant medications and lab results: [<Alert Details>](#)

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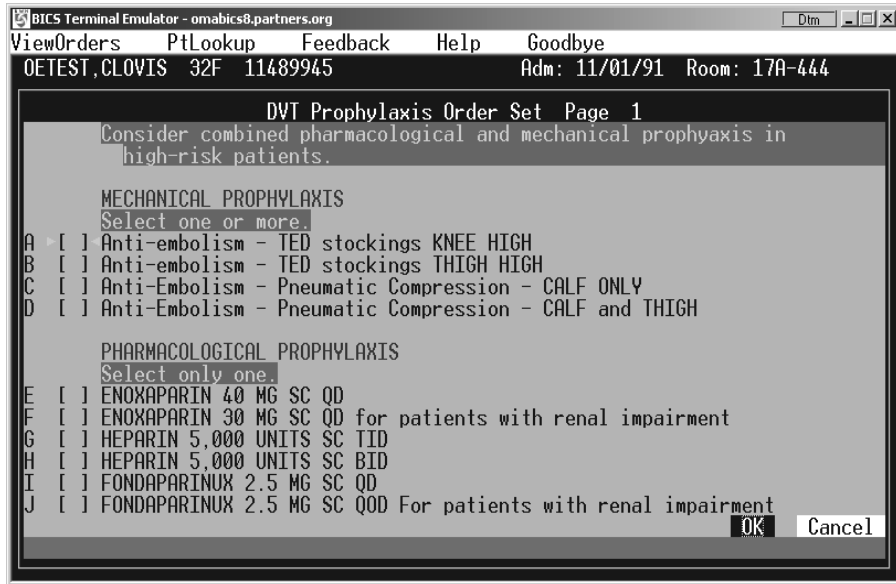
Act- [ 10 ] Order set: DVT PROPHYLAXIS TEMPLATE.

ions: [ 18 ] Partners Handbook: VTE Guidebook 4th edition

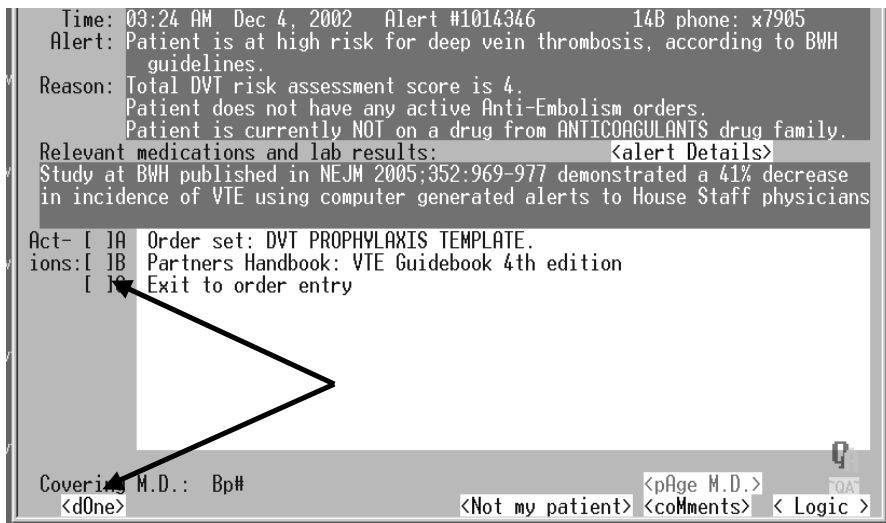
[ 1C ] Exit to order entry

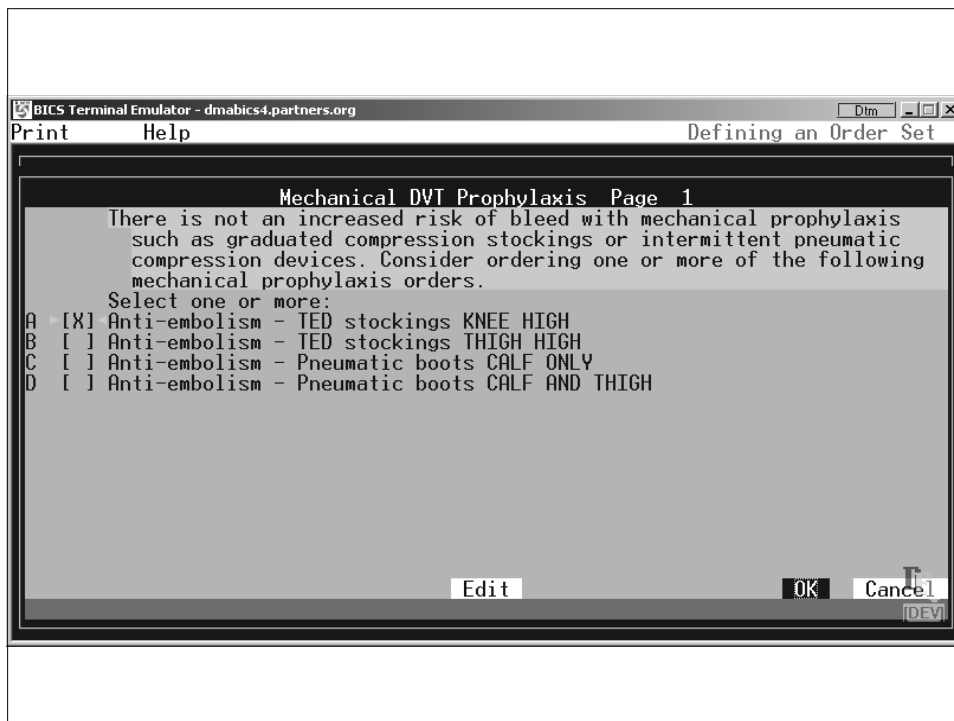
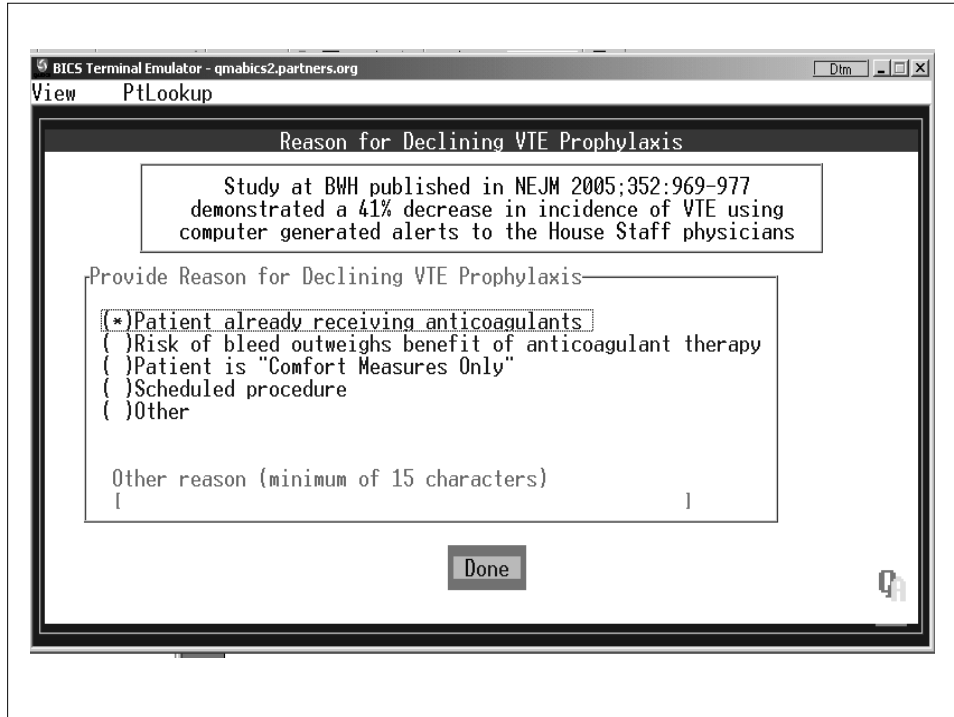
Covering M.D.: Bp#  
<dOne>

<Not my patient> <pAge M.D.> <coMments> < Logic >



## Option C or "Done"





## Escalation and Timing of Alerts

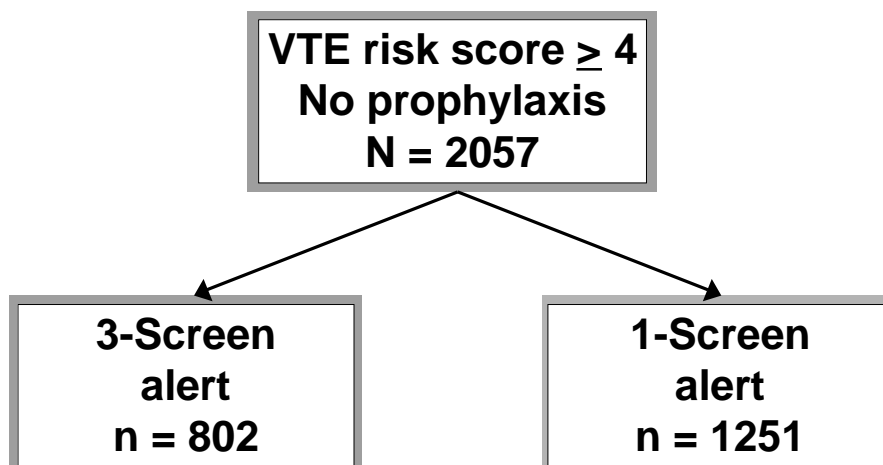
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- Alerts should be set up to generate each day at 8:30 AM
- If an alert was not acknowledged after 24 hours the attending physician on record should be text paged.

Date	Time	Recipient	Message
10/28/2005	02:37:11PM	Goldhaber, Samuel Zachary, MD	8888-19327139 MRN: 19327139 LOC: 17A-301 High risk VTE patient without prophylaxis orders.
10/28/2005	02:36:08PM	Goldhaber, Samuel Zachary, MD	8888-19327147 MRN: 19327147 LOC: 17A-311 High risk VTE patient without prophylaxis orders.

## ENROLLMENT

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## VTE Prophylaxis: eALERT Perspectives

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- eAlert Trial: lead article in March 10, 2005 NEJM, with accompanying Editorial and CME Exam, receives widespread attention.
- Many hospitals don't have comparable IT to replicate BWH.
- Question arises: Are BWH results applicable to other USA hospitals ?

Thank you for your attention!