

# The Burden of Medical Error

The Case for Clinical Decision Support

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October 2003

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Everyone complains about their  
memory but no one complains of  
having poor judgement

# Computer-aided Diagnosis of Acute Abdominal Pain I

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• The computing system's overall diagnostic accuracy (91.8%) was significantly higher than that of the most senior member of the clinical team (79.6%) (304 patients)

# Computer-aided Diagnosis of Acute Abdominal Pain II

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`The overall diagnostic accuracy of the computer-aided system was 91.5% and that of the senior clinician to see each case 81.2%. However the clinician's diagnostic performance improved markedly during the period of the trial' (552 patients)

# Computer-aided Diagnosis of Acute Abdominal Pain I

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de Dombal et al BMJ 1972

# Computer-aided Diagnosis of Acute Abdominal Pain II

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**De Dombal et al BMJ 1974**

# Errors and Adverse Events in Medicine

# Patients' descriptions of incidents

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- ◆ Operation for gall stones ended with losing pancreas, most of stomach, small bowel, spleen. They stitched through mesenteric artery and failed to give a proper diagnosis in the beginning (patient died)
- ◆ A swelling on my cheek was diagnosed as a malignant tumour and part of my jaw and extensive tissue was removed without my consent. The lab. test showed that it was not a tumour, malignant or benign

# An Organisation with a Memory

Learning from adverse events in the NHS

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Every year in Britain:

- ◆ 400 people die or are seriously injured in events involving medical devices
- ◆ 10,000 reported serious adverse drug reactions
- ◆ 1,150 suicides by people in recent contact with mental health services
- ◆ NHS pays £400 million in litigation
- ◆ Hospital acquired infections cost nearly £1billion and 15% are regarded as preventable

# BMJ

No 7237 18 March 2000



Reducing error  
Improving safety

# Adverse event

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- ◆ `Unintended injury caused by medical mismanagement rather than disease process’
  - Patient must experience an injury (minimum one extra day in hospital)
  - Injury may result from intervention or failure to intervene
  - Management includes actions of individual and healthcare system
  - May or may not be preventable

# Harvard Medical Practice Study

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- ◆ 3.7% of admissions involve adverse event
- ◆ 1% admissions involve negligent treatment
- ◆ 13% of adverse events involve death of a patient
- ◆ 7% lead to long term disability
- ◆ 16 times as many negligent adverse events as paid claims

# Adverse events record review

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Californian insurance study 1974

» adverse event rate of 4.6%

Harvard Medical Practice Study 1990

» adverse event rate of 3.7%

Colorado-Utah study 1998

» adverse event rate of 3.2%

Quality in Australian Health Care Study 1995

» adverse event prevalence rate of 16.6%

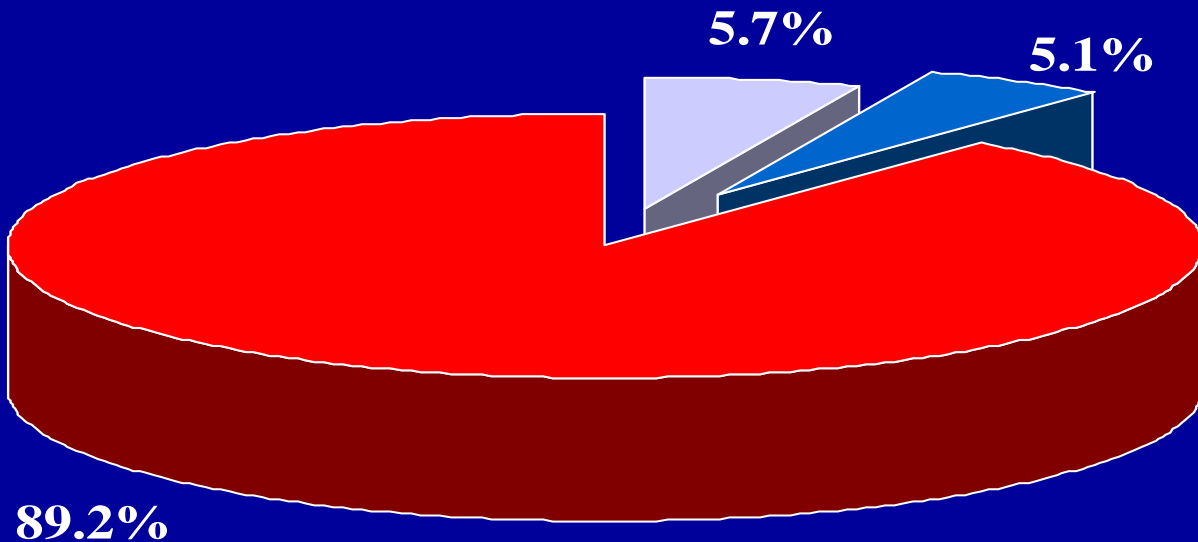
# London Pilot Study - Design

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- ◆ Retrospective review of 1014 medical and nursing records
- ◆ Screening followed by clinical review
- ◆ General medicine, General surgery, Orthopaedic surgery and Obstetrics
- ◆ Two acute hospitals in the London area

# London Pilot Study - Results

Percentage of patients who experienced an AE



- Patients with unpreventable AE
- Patients with preventable AE
- No adverse event

# National Cost of Adverse Events

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- ◆ Average of 8.7 extra days in hospital for each adverse event (Range 0 - 60)
- ◆ Specialty costs £171 - 305 per day
- ◆ 8 million admissions per year in England
- ◆ 856,000 adverse events
- ◆ Cost in extra days in hospital £2 billion per annum (£1 billion for preventable AEs)

# Acute Trust

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- ◆ 50,000 admissions per year
- ◆ 5000 adverse events per year
- ◆ 500-1000 with serious consequences
- ◆ 35,000 additional bed days
- ◆ £10 million per annum
- ◆ ..... Plus litigation, complaints, staff time, additional treatment etc etc

# Error in medicine

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- ◆ Medication errors in 2-14% of patients admitted to hospital (Leape, 1994)
- ◆ Autopsy studies show 35-40% missed diagnoses leading to death (Leape, 1994)
- ◆ Junior doctors in A & E missed 35% fractures
  - Is error an appropriate term for failure in a complex task by relatively untrained staff?

# Incidence of diagnostic error

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- ◆ Harvard Study 13.8% of adverse events
  - Failure to use indicated tests
  - Failure to act on tests
  - Use of inappropriate tests
  - Avoidable delay in diagnosis
  - Practicing outside area of expertise
- ◆ London pilot – similar figures

# Incidence of diagnostic error

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- ◆ Inappropriate decisions in 45% patients on surgical units; 17.7% patients suffer disability (Andrews 1997)
- ◆ Autopsies in ICU. Discordance clinical causes and post-mortem findings in 19.8% cases. (Tai et al, 2001)
- ◆ Primary care. 28% of reported incidents
  - Error in judgement
  - Failure to recognise signs and symptoms (Bhasale, 1998)

# Types of diagnostic error

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- ◆ No-fault errors
  - Illness, silent, masked, atypical
- ◆ System errors
  - Organisational and technical failures
- ◆ Cognitive errors
  - Inadequate knowledge, faulty data gathering, inaccurate clinical reasoning, faulty verification

Human Judgement &  
Decision Making  
Under Uncertainty

# Intuition in judgement and decision making?

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- ◆ Expertise in judgement
  - From chess players to fire fighters
  - Recognising sepsis in the NICU
- ◆ `It's intuition, it comes from experience'
- ◆ Recognising a pattern of cues and signs
- ◆ .... but may not be aware of how they do it

# Heuristics and biases

## Powerful but can mislead

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- ◆ Representativeness
- ◆ Availability
- ◆ Base rate neglect
- ◆ Confirmation
- ◆ Search satisficing
- ◆ Gambler's fallacy
- ◆ .....

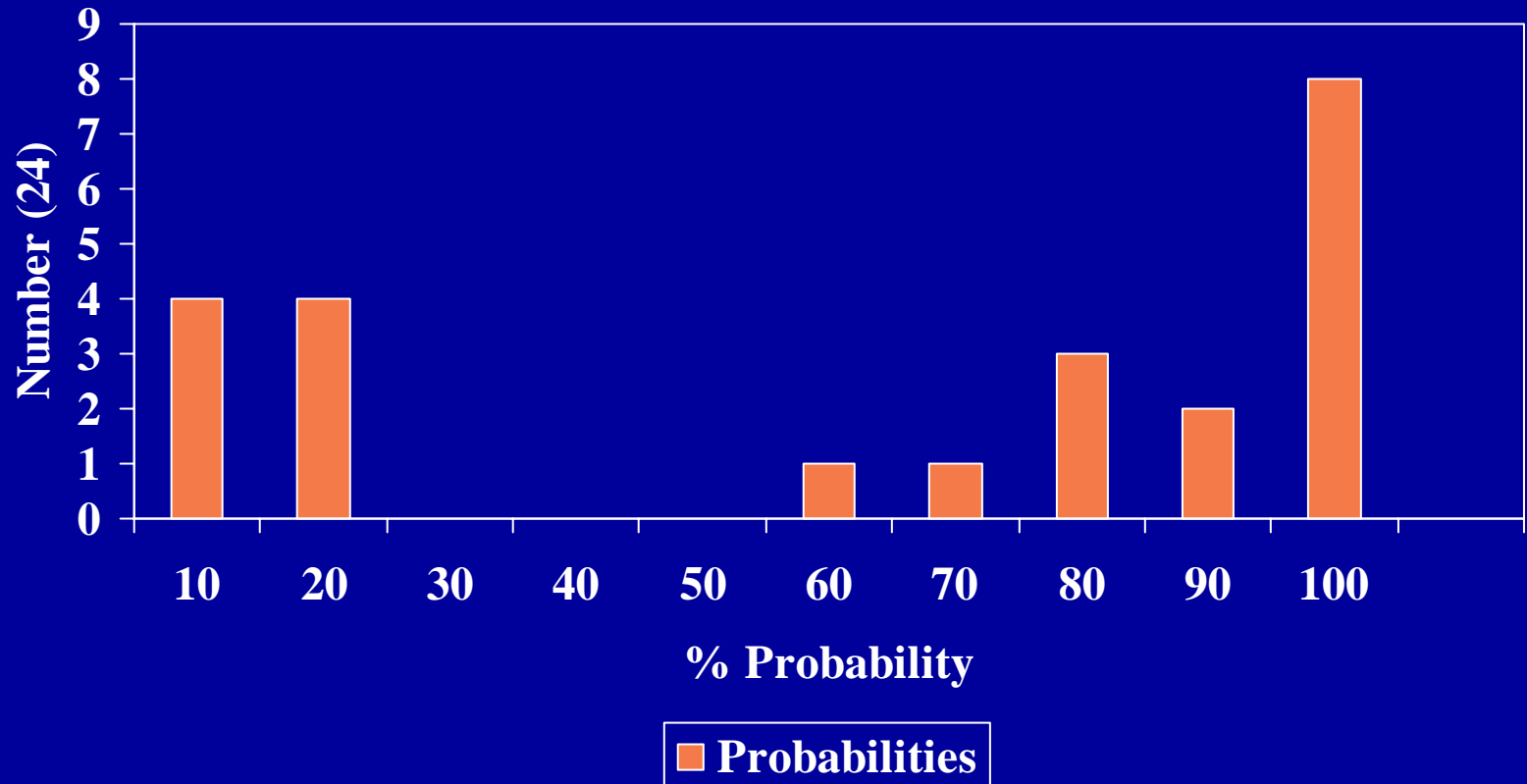
# Interpreting test results

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- ◆ The probability of a woman aged 40-50 attending screening having breast cancer is 0.8%. If a woman has breast cancer, the probability is 90% that she will have a +ve mammogram. If a woman does not have breast cancer the probability is 7% that she will still have a +ve mammogram.
- ◆ What is the probability that a woman with a +ve mammogram actually has breast cancer?

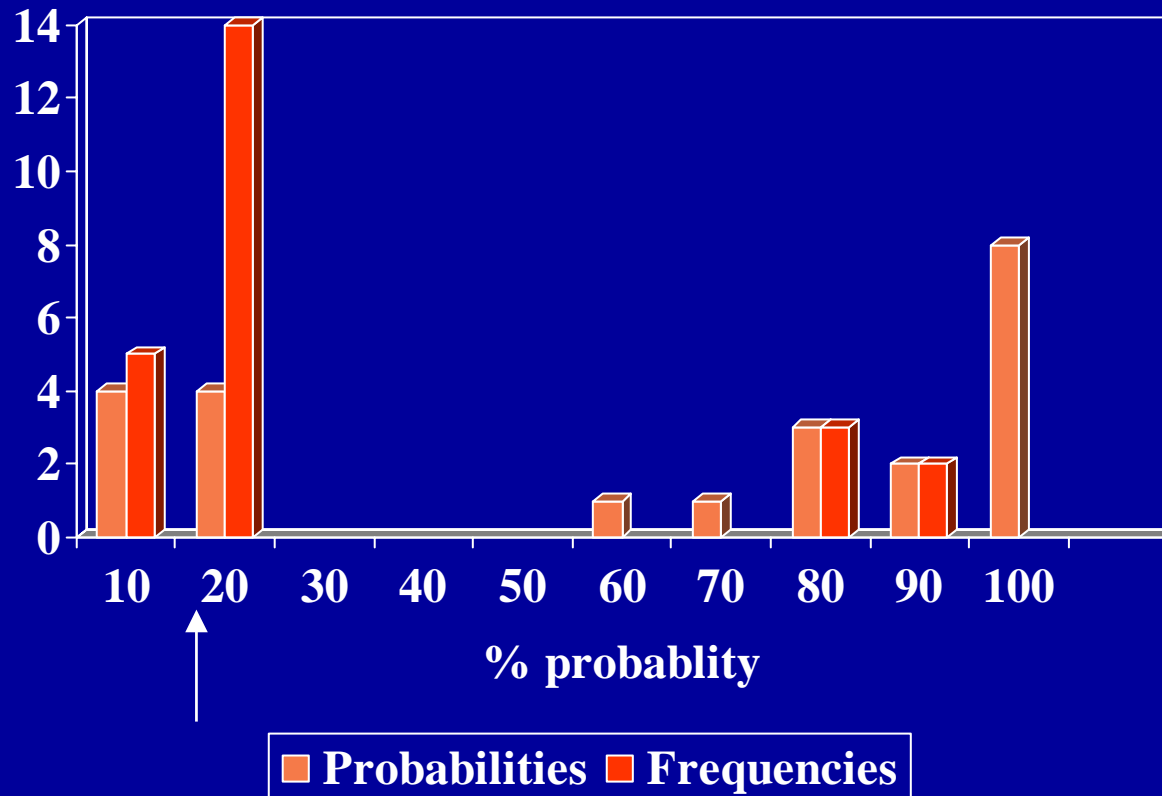
# Interpretation of test results

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# Interpretation of test results

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# Frequency formats

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- ◆ Eight out of every 1000 women have breast cancer. Of these 8, 7 will have a +ve mammogram. Of the remaining 992 who don't have breast cancer, some 70 will still have a +ve mammogram. Imagine a sample of women with a +ve mammogram. How many will have breast cancer?

# 20 AIDS Counsellors

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- ◆ Generally accurate on sensitivity
- ◆ However
  - Denial of false positives (13/20)
  - Failure to understand rate of false positives is higher in low risk clients (19/20)
  - Illusion of certainty (10/20)

# Clinical prediction and probabilities

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## ◆ Assessment of suicide risk

- Past history
- Psychiatric diagnosis
- Current stressors
- Declared intent and preparation
- Pessimism & hopelessness

## ◆ Decision to operate in paediatric cardiac surgery

- Age
- Anatomy of heart
- Echocardiograph
- Pulmonary artery pressure

# Probabilities and prediction

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- ◆ Combining multiple sources of information
  - Prone to bias and inconsistency
  - Vulnerable to time pressure, stress, fatigue
- ◆ Computers or decision aids almost always outperform human beings
- ◆ Meehl's supermarket checkout

# Improving Decision Making

# Contrasting visions of human abilities

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## ◆ Fallibility and irrationality

- Hindsight bias & memory failure
- Extreme over confidence
- Vulnerable to environmental influences
- Lack of control over thought and action

## ◆ Expertise and skill

- Flexibility and adaptability
- Experience and wisdom
- Teamwork and leadership
- Anticipation and recovery

# Training in Decision Making

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- ◆ Evidence based medicine
- ◆ Problem based learning
- ◆ Awareness of heuristics and biases
- ◆ `Metacognitive' training
- ◆ Rapid and reliable feedback
- ◆ Use of cognitive aids and guidelines

# Role of Information Technology in Improving Patient Safety

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- ◆ Improving communication
- ◆ Access to information
- ◆ Requiring information and assisting with calculations
- ◆ Monitoring
- ◆ Tracking of adverse events
- ◆ Decision support

# NHS guidelines for urgent referral

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## **Urgent Referral for a Chest X-ray**

- Haemoptysis
- Unexplained or persistent (more than 3 weeks)
  - » dyspnoea
  - » weight loss
  - » chest signs
  - » ...
- features suggestive of metastasis from a lung cancer

## **Urgent referral to a Chest Physician**

Any of the following:

- Chest x-ray suggestive/suspicious of lung cancer
- Persistent haemoptysis in smokers/ex-smokers over 40 years of age.
- .....

**Patient Details:**

Age:  Gender: M  F

**Referral information** (please tick boxes):

**Chest X-ray?**

- Not done  Abnormal, other
  - Normal  Specify
  - Abnormal, follow-up recommended
  - Abnormal, suspicious of cancer
- Date (dd/mm/yyyy)
- Reference
- Hospital site

**History:**

Current or Ex-smoker? Yes  No

History of COPD? Yes  No

**Clinical examination:**

Chest signs Yes  No

Unexplained or >3wks Yes  No

Signs of SVCO Yes  No

Cervical / Supraclavicular LNS Persistent Yes  No

Stridor Yes  No

Signs of metastases  Yes  No

**Symptoms:**

Haemoptysis?

None  Once  More than 1

Unexplained or persistent (> 3 weeks):

cough Yes  No

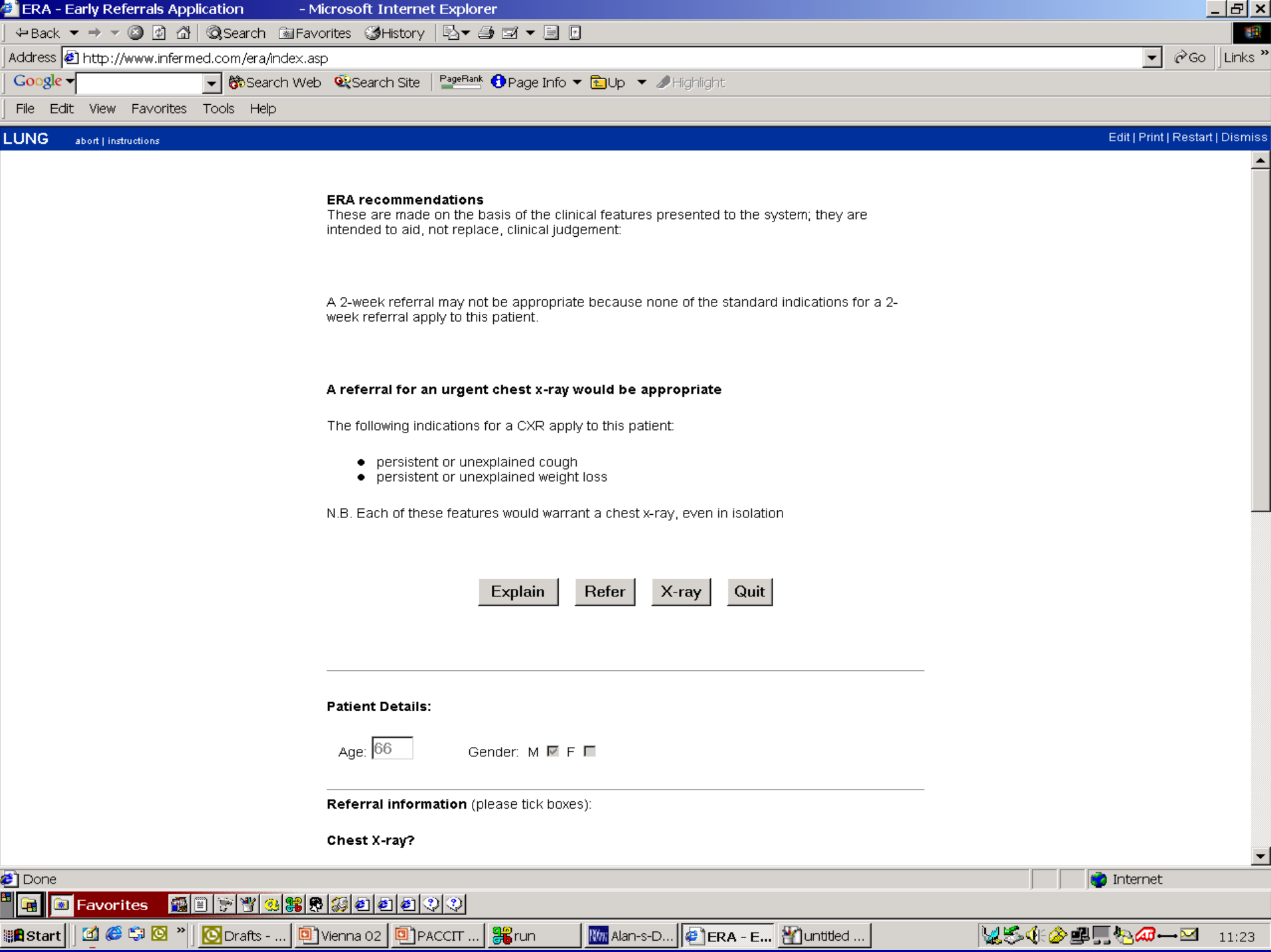
dyspnoea Yes  No

wheeze Yes  No

chest/shoulder pain Yes  No

weight loss Yes  No

hoarseness Yes  No



**ERA recommendations**

These are made on the basis of the clinical features presented to the system; they are intended to aid, not replace, clinical judgement.

A 2-week referral may not be appropriate because none of the standard indications for a 2-week referral apply to this patient.

**A referral for an urgent chest x-ray would be appropriate**

The following indications for a CXR apply to this patient:

- persistent or unexplained cough
- persistent or unexplained weight loss

N.B. Each of these features would warrant a chest x-ray, even in isolation

Explain
Refer
X-ray
Quit

**Patient Details:**

Age:  Gender: M  F

**Referral information** (please tick boxes):

**Chest X-ray?**

# Safety and ethical issues in decision support

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- ◆ Quality of CDSS
- ◆ Safety – usability and risk assessment
- ◆ Ethical issues and patient acceptability
- ◆ Legal liability

# Can we improve clinical judgement and decision making?

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- ◆ When time is short, dynamic environment
  - Experience and feedback
  - Training to reduce biases and errors
- ◆ When time allows and decisions can be framed
  - Decision support brings consistency and accuracy
  - Can now be patient specific
  - Should not be an embarrassment