The Importance of Laboratory test results in Clinical Practice

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Director, Pathology
Luton and Dunstable University Hospital, UK

NSMB/NFMB April 2016, Bergen, Norway
Outline

- Introduction
- Understanding value
- Improving outcomes, reducing harm
- The way forward
Importance of lab medicine

- Single highest-volume medical activity
- Patient safety – fast, accurate diagnosis
- Essential to clinically cost-effective delivery of care
- Spans primary/secondary care
- Added value at pre- & post-analytical phases
Throughput

Labs

Medications/other orders
Inpatient/outpatient/ED visits
Non-surgical procedures
Imaging
Surgical procedures

Ramy Arnaout 2015
Global IVD market valued at $44 bn in 2011, growing at a rate of 7.8% from 2011 to 2016

3-5% of healthcare costs
Laboratory Medicine
what is the service?

RIGHT .......patient
test
sample
time
result
decision
action...OUTCOME

price

D P Price
Volume to value

- Focus on improving the value of laboratory services
Clinical chemistry

Sample ➔ PROCESS/QUALITY ➔ Result
Laboratory medicine

Patient

Request

Sample

Result

Information

Outcome

Integrated value chain

VALUE!

ADVICE/GUIDELINES

ADVICE

PROCESS/QUALITY

INTERPRETATION

EVIDENCE

VALUE!
Outline

- Introduction
- Understanding value
- Improving outcomes, reducing harm
- The way forward
Value can be defined in clinical and economic senses

- **Clinical value**
  - Diagnostic accuracy
  - Predictive value
  - Clinical utility in decision-making
  - Improved health-related outcomes

- **Economic value**
  - Economic efficiency and effectiveness compared to standard process of care
The 70% claim

- “70% of critical medical decisions depend on laboratory data”
- “70% of all medical decisions depend on laboratory data”
- “70% of diagnoses depend on laboratory data”
- .............where is the evidence?
IFCC Task Force on the Impact of Laboratory Medicine on Clinical Management & Outcomes

- Formed May 2012
- Chair M Hallworth
- Objectives:
  - To evaluate the available evidence supporting the impact of laboratory medicine in healthcare
  - To develop the study design for new retrospective and prospective studies to generate evidence-based data to support IFCC promotional activities to the healthcare community and the public
Health outcomes

\[ \text{VALUE} = \frac{\text{Outcome}}{\text{Cost}} \]

Porter ME: What is value in health care? NEJM 2010; 363: 2477-81
The need for an outcomes research agenda for clinical laboratory testing

Lundberg G. JAMA 1998; 280: 565-6

“clinicians and laboratorians should all be concerned about the effects of that laboratory test and whether the performance of it was useful for the patient or for the public’s health,“
Evaluation of diagnostic tests

Effectiveness

Efficiency

Efficacy

Economic evaluation

Patient outcomes

Therapeutic decisions

Diagnostic decisions

Diagnostic accuracy

Technical efficacy

Questions for lab tests (Bossuyt)

- Is the test trustworthy? (efficacy)  
  TECHNICAL PERFORMANCE

- Is the test meaningful? (efficiency)  
  CLINICAL PERFORMANCE

- Is the test helpful?  
  CLINICAL EFFECTIVENESS
### Chain of inquiry for valuation of lab tests (The Lewin Group)

<table>
<thead>
<tr>
<th>Technical validity</th>
<th>Clinical validity</th>
<th>Clinical utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to measure the analyte accurately and reliably</td>
<td>Ability to detect and predict the disorder that is associated with an analyte measurement</td>
<td>Clinical effectiveness – the balance of risks and benefits associated with using the test in routine practice</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Clinical sensitivity</td>
<td>Intermediate/surrogate outcomes</td>
</tr>
<tr>
<td>- analytical specificity</td>
<td>Clinical specificity</td>
<td>Health outcomes (mortality, morbidity, quality of life)</td>
</tr>
<tr>
<td>- analytical sensitivity</td>
<td>Positive predictive value</td>
<td>LOS</td>
</tr>
<tr>
<td>Precision</td>
<td>Negative predictive value</td>
<td>Adverse effects of diagnostic use</td>
</tr>
<tr>
<td>Robustness</td>
<td></td>
<td>Adverse effects of treatment</td>
</tr>
</tbody>
</table>
Value

\[ \text{Value} = \text{Delivered benefits} - \text{delivered harm} \]
(undesirable effects of testing)

Epner PL, Gans JE, Graber ML
When diagnostic testing leads to harm: a new outcomes-based approach for laboratory medicine.
Outline

- Introduction
- Understanding value
- Improving outcomes, reducing harm
- Towards better evaluations
- The way forward
Improving lab performance

- Quality assurance ✓
- Standardization/harmonization ✓
- Process optimization ✓
- Method development ✓
- Reference intervals ✓

Is the use of the test associated with improved outcomes ??
IBD and IBS – UK (pop. 60m)

Bloating / distension, abdominal pain, altered bowel habit – common
Clinical exam / history alone not always reliable –
**DIAGNOSTIC DILEMMA**
Coeliac, somatisation, infective, gynae pathology.

? IBD

**Patients per year**
- Ulcerative Colitis 120,000
- Crohn’s 60,000
- IBS (ave incidence 15%) 9 million
CALPROTECTIN CLINICAL USE

- Distinguishes functional (IBS) symptoms from organic symptoms (inflammatory) - >95% sensitivity and specificity

- Normal result excludes IBD and requirement to scope
  - Sigmoidoscopy tariff = $790, Colonoscopy $1040
  - Faecal calprotectin testing = $70

- Luton experience (patients referred where diagnosis of organic versus functional disease uncertain):
  - In secondary care, – 70% reduction in Endoscopy
  - Potential saving $68,000 per 100 patients
HOW WIDELY USED IS IT?

Map 15A: Rate of colonoscopy procedures and flexible sigmoidoscopy procedures per population by PCT
Indirectly standardised rate, adjusted for age, sex and deprivation 2011/12

Domain 1: Preventing people from dying prematurely

Map 67: Estimated annual rate of use for calprotectin tests ordered by GPs per practice population by PCT
2012

Domain 2: Enhancing quality of life for people with long-term conditions

© Crown copyright and database rights 2013 Ordnance Survey 100039906
High sensitivity TnI on presentation enables early safe discharge

- Admission hs-cTnI of 1.9 ng/L (Architect) used to stratify patients:
  - ≤1.9: discharge unless high-risk of ACS or sample taken within 1h of pain
  - >1.9: admit to CDU for 2nd cTnI
- Admissions fell from 60.9% to 38.4%
- Mean LOS fell from 23h to 9.6h
- Follow up:
  Negative Predictive Value for major adverse cardiac event: at 30 days = 99.6%
  at 9 months = 98.4%

Ford, C: personal communication 2016
The problem with getting evidence of added value

“In order to improve outcomes, a laboratory test must be **appropriately** ordered, conducted, returned with results on a timely basis, **correctly interpreted** and affect a decision for further diagnosis and treatment”

- Lewin Group report on The Value of Laboratory Screening and Diagnostic Tests for Prevention and Health Care Improvement, 2009
Lab-related causes of diagnostic error

- Inappropriate test ordered (overuse)
- Appropriate test not ordered (underuse)
- Appropriate test result not used properly
  - Knowledge deficit – wrong interpretation
  - Misleading result
- Appropriate test result delayed/missed
- Appropriate test result wrong – RARE!

(Epner & Astion, 2013)

Wrong test choice accounts for up to 50 – 60% of missed / delayed diagnoses (Plebani, 2010)
Diagnostic error in particular needs attention

- Diagnostic errors are defined as misdiagnosis, missed diagnosis, or delayed diagnosis.
- Diagnostic errors occur in 10-15% or cases, with more than 50,000 DxE in primary care and 40-80,000 annual deaths in hospitals.
- One in twenty adults in outpatient settings experience a diagnostic error annually.

Analysis of malpractice claims – US
Ann Intern Med 2006; 145: 488-496

Faulty process leading to missed diagnosis:

- Failure to order diagnostic/lab test: 55%
- Inappropriate/inadequate follow-up: 45%
- Failure to obtain adequate history/exam: 42%
- Incorrect interpretation of diag test: 37%
- Failure to refer: 26%
- Provider did not receive test results: 13%
- Tests ordered but not done: 9%
- Tests performed incorrectly: 8%
Primary care in Ordering Clinical Laboratory Tests and Interpreting Results

Physicians order tests in 31% of patient encounters. 14.7% report uncertainty about ordering. 8.3% report uncertainty about interpreting. Potentially affects 23 million patients.

Hickner et al JABFM 2014; 27: 268-274
Map 37: Estimated annual rate of use for lithium tests ordered by GPs per practice population by PCT

2012

Domain 1: Preventing people from dying prematurely
Domain 2: Enhancing quality of life for people with long-term conditions
Preventing overdiagnosis

- “Medicine’s much-hailed ability to help the sick is fast being challenged by its propensity to harm the healthy”
- “Too many people are being overdosed, overtreated and overdiagnosed”
  Moynihan et al, BMJ 2012

5% of healthy patients get abnormal test results
Some Causes of Overutilization

- Patient pressure
- Duplicate requesting
- Lack of understanding of the diagnostic value of a test
  - “just in case”
- Ordering ‘wrong’ test
- Failure to understand the consequences of overutilization
- Defensive testing
- Perverse financial incentives (more tests = more revenue)
- “Availability creates demand “
Consequences of Overutilization

- Increased resource utilization
- Incorrect diagnosis and treatment
- Incorrect test ordering delays diagnosis
- Increased length of stay
- Patient alarm
- Contribute to blood loss
In the UK

- Laboratory investigations £2.5 billion / year (ie $3.6b)
- Approximately 4% of total NHS expenditure
- Annual increase in workload 8-10%
- 25% of pathology tests unnecessary
  - Department of Health Independent Review of Pathology Services 2009
- BUT same amount of under requesting?
- Local audit July 2012 – Inpatients 34% “inappropriate”
Studies outside the UK

4.5 – 95% (US)  van Walraven JAMA: 1998
5.1% (US)       Weydert  Arch Pathol Lab Med: 2005
21% (India)     Pal et al JMGIMS: 2009

30% “Consensus” estimate  AACC Webinar 2010

30% (Canada)    van Walraven Clin Chem  2003
Unnecessary testing

- Australia – Vit D requests increased by 4,600% from 2002/3 to 2011/12!!
- 73,000 requests to 3.5 million requests pa

Vasikaran, Ann Clin Biochem 2013: 50: 283 - 4
Zhi et al (2013)

- 1997-2012, 42 studies

- Overall mean rate of inappropriate overuse = 20.6% (95% CI 16.2 – 24.9%, n=114)

- Overall mean rate of underuse = 44.8% (95% CI 33.8-55.8%, n= 18)
Results: overuse vs. underuse

Note, P-values uncorrected for multiple possible binnings

Zhi et al, 2013
Physicians’ professional responsibility, and calling, is to provide the highest quality of care for patients. We base our care on scientific evidence to guide our recommendations to patients. *Choosing Wisely Canada* is a campaign to help physicians and patients engage in a conversation about tests, treatments and procedures that are not needed and to support them in making smart and effective choices to ensure high quality care. *Choosing Wisely Canada* is not about cost cutting or rationing.
Do users understand tests?

- Primary Care Physicians Challenges in Ordering Clinical Laboratory Tests and Interpreting Results  
  JABFM 2014; 27: 268-274
- Physicians order tests in 31% of patient encounters
- 14.7% report uncertainty about ordering
- 8.3% report uncertainty about interpreting
UK junior hospital doctors: “How confident are you in requesting laboratory tests?”

(Khromova & Gray, 2008)
How confident are you in interpreting laboratory tests?

- **LFT**: 80%
- **U & E**: 90%
- **Proteins**: 80%
- **Mg, PO4**: 70%
- **Haematinics**: 50%
- **PTH**: 60%
- **Short Synacthen Test**: 70%
- **Urine sodium and osmolality**: 40%
<table>
<thead>
<tr>
<th>Questions</th>
<th>Answer Options</th>
<th>Correct Answer</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Which of the following blood groups would it be unsafe to transfer to a man of blood group O Rhesus positive?</td>
<td>O Rh positive</td>
<td>A Rh positive</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>O Rh negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Rh positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. In a patient on Warfarin in whom there is no, or only minor bleeding, at what INR would you consider administering Vitamin K?</td>
<td>3, 5, 7, 8, 10</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>3. The following test result would confirm a diagnosis of iron deficiency:</td>
<td>A low serum iron</td>
<td></td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Both a low serum iron and low transferrin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A low serum ferritin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SYSTEMATIC REVIEW:

In the US, extent of tests not followed up: anything up to 62% of lab tests and 35% of radiology reports

Goal 2:
Enhance health care professional education and training in the diagnostic process
- Appropriate use of diagnostic tests
Lab-related causes of diagnostic error

- Inappropriate test ordered
- Appropriate test not ordered
- Appropriate test result not used properly
  - Knowledge deficit
  - Failure of synthesis
  - Misleading result
- Appropriate test result delayed/missed
- Appropriate test result wrong/inaccurate

(Epner & Astion, 2012)
# International Health Rankings (Commonwealth Fund, 2014)

<table>
<thead>
<tr>
<th></th>
<th>AU</th>
<th>CH</th>
<th>CA</th>
<th>DE</th>
<th>FR</th>
<th>NL</th>
<th>NO</th>
<th>NZ</th>
<th>SE</th>
<th>UK</th>
<th>US</th>
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<tbody>
<tr>
<td><strong>Overall rank</strong></td>
<td>4</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td><strong>Safe care</strong></td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>6</td>
<td>2</td>
<td>7</td>
<td>11</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td><strong>$ Per capita 2011</strong></td>
<td>3800</td>
<td>5643</td>
<td>4522</td>
<td>4495</td>
<td>4118</td>
<td>5099</td>
<td>5669</td>
<td>3182</td>
<td>3925</td>
<td>3405</td>
<td>8508</td>
</tr>
</tbody>
</table>
## Safe Care measures

<table>
<thead>
<tr>
<th></th>
<th>AU</th>
<th>CH</th>
<th>CA</th>
<th>DE</th>
<th>FR</th>
<th>NL</th>
<th>NO</th>
<th>NZ</th>
<th>SE</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delayed abnormal results</strong></td>
<td>7%</td>
<td>5%</td>
<td>11%</td>
<td>5%</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
<td>8%</td>
<td>9%</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Incorrect diagnostic test</strong></td>
<td>4%</td>
<td>3%</td>
<td>5%</td>
<td>2%</td>
<td>3%</td>
<td>6%</td>
<td>4%</td>
<td>5%</td>
<td>3%</td>
<td>2%</td>
<td>5%</td>
</tr>
</tbody>
</table>

(Commonwealth Fund, 2014)
Proper systems to ensure results are actioned

- Electronic systems for acknowledgement of results
- Lab follow up of critical results which have not been viewed/actioned
Notification of critical results

“Urgent physician notification of critical results, both qualitative and quantitative, has become the standard of care because of high impact on patient welfare”

Global trends in critical value practices and their harmonization
Kost GJ and Hale KN
Perceptions of missed test results

In the past year I have missed an abnormal result that led to delayed patient care

- Yes (%): 53.9
- No (%): 19.2
- Don't know (%): 26.9

In the past year a colleague has missed an abnormal result that led to delayed patient care

- Yes (%): 38.5
- No (%): 11.5
- Don't know (%): 50

AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
FACULTY OF MEDICINE AND HEALTH SCIENCES

Andrew Georgiou
Too many electronic health record alerts may be leading doctors to skip them

Your doctor may be more likely to ignore your test results if they come electronically.

A new study published in the JAMA Internal Medicine on Mar. 4 revealed that doctors receive about 63 electronic health record (EHR)-based alerts each day, which are supposed to let them know about abnormal patient results. And, almost one-third of the doctors surveyed — about 30 percent — admitted that they had missed some results because of too many alerts.

"If you're getting 100 emails a day, you are bound to miss a few. I study this area and I still sometimes miss emails. We have good intentions, but sometimes getting too many can be a problem," Dr. Hardeep Singh, chief of health policy, quality, and informatics at the Michael E. DeBakey Veterans Affairs Medical Center, in Houston, told TIME.
Information overload

- Survey of 2590 primary care physicians
- Median number of alerts (path/Xray) per day: 63
- 86.9% felt number of alerts excessive
- 69.6% reported more alerts than they could effectively manage
- 29.8% reported having missed results leading to care delays

- Singh et al. JAMA Intern Med 2013; 173: 702-4
The Problems

- Too many tests
- Different names
- Different units
- Different reference intervals
- Different alert limits
- Inconsistent guidelines
UK implementing an England-wide model for EHR presented with an initial pathology catalogue derived from a multiplicity of sources:

- Duplications
- Inconsistent naming formats
- Ambiguity. Unclear what the lab response to a request should be
- Not fit for purpose of applying national codes (SNOMED)
Example: Vitamin Ds

The Royal College of Pathologists

The National Laboratory Medicine Catalogue

Search results

Test results

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Collected Specimens</th>
<th>Discipline</th>
<th>Request Status</th>
<th>Last Modified By</th>
<th>Last Modified Time</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>NLMC0943</td>
<td>1,25-dihydroxy vitamin D3 level</td>
<td>Blood</td>
<td>Clinical Biochemistry</td>
<td>Board Approved - Active</td>
<td>Scott</td>
<td>18/01/2012 10:15</td>
<td>Show</td>
</tr>
<tr>
<td>NLMC1365</td>
<td>Total 25-hydroxy vitamin D level</td>
<td>Blood</td>
<td>Clinical Biochemistry</td>
<td>Under Review</td>
<td>Geoff Lester</td>
<td>08/05/2012 21:35</td>
<td>Show</td>
</tr>
<tr>
<td>NLMC1367</td>
<td>25-hydroxy vitamin D2 level</td>
<td>Blood, Blood spot</td>
<td>Clinical Biochemistry</td>
<td>Under Review</td>
<td>Howard Beswick</td>
<td>17/05/2012 17:18</td>
<td>Show</td>
</tr>
<tr>
<td>NLMC2757</td>
<td>25-hydroxy vitamin D3 level</td>
<td>Blood, Blood spot</td>
<td>Clinical Biochemistry</td>
<td>Under Review</td>
<td>Howard Beswick</td>
<td>17/05/2012 17:18</td>
<td>Show</td>
</tr>
</tbody>
</table>

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Strategies for Changing Physician Behaviour in Ordering Lab Tests


- Strategies that don’t work by themselves
  - Physician consensus building
  - Test guideline dissemination
  - Traditional education
  - Utilisation audits
  - Inform physicians of lab test charges
Best practice in primary care pathology: review 14

J C Cabrera-Abreu, W S A Smellie, R Bowley, N Shaw

Contributors JCC-A and WSA wrote the tumour markers section and RB and NS undertook the literature searches used to prepare the document.

Accepted 13 July 2011
Published Online First 6 September 2011

Abstract
This 14th best practice review is the second of a pair that examines tumour marker requesting primary care situations. This review considers carbohydrate antigen 125, α-fetoprotein and human chorionic gonadotropin. It is presented in question–answer format, referenced for each question. The recommendations represent a précis of guidance found using a standardised literature search of national and international guidance notes, consensus statements, health policy documents and evidence-based medicine reviews, supplemented by MEDLINE Embase searches to identify relevant primary research documents. They will be updated periodically to take into account new information.

Best practice in primary care pathology: review 11

W S A Smellie, M P J Vanderpump, W D Fraser, R Bowley, N Shaw

Accepted 12 October 2007
Published Online First 26 October 2007

Abstract
This eleventh best practice review examines two series of common primary care questions in laboratory medicine: (i) thyroid testing, and (ii) hypercalcaemia and hypocalcaemia. The review is presented in the same question–answer format as in the previous reviews. These questions and answers deal with common situations in men and non-pregnant women. The recommendations represent a précis of guidance found using a standardised literature search of national and international guidance notes, consensus statements, health policy documents and evidence-based medicine reviews, supplemented by Medline Embase searches to identify relevant primary research documents. In the case of the thyroid series, the recommendations are drawn from the 2006 guidelines published by the Association for Clinical Biochemistry, the British Thyroid Association and the British Thyroid Foundation. They are not standards but form a guide to be set in the clinical context. Most are consensus rather
National Minimum Re-testing Interval Project 2013:
A final report detailing consensus recommendations for minimum re-testing intervals for use in Clinical Biochemistry

Box 1 Minimum Re-testing Interval Work Streams
Renal
Liver and Bone
Endocrine
Lipids and Diabetes
Specific Proteins
Cardiac
Tumour Markers
Gastro-Intestinal
Occupational/Toxicology
Therapeutic Drug Monitoring
Pregnancy and Paediatrics

The Association for Clinical Biochemistry and Laboratory Medicine
Out to consultation Sept – Nov 2015:

**National Minimum Re-testing Intervals:**

- Clinical Biochemistry [see previous]
- Haematology – general, coag, transfusion
- Immunology
- Microbiology
- Virology
- Cellular Pathology
Protecting resources, promoting value: a doctor’s guide to cutting waste in clinical care

**UK:** “*Do not Do*”  
[NICE April 2014]

**US:** “*Choosing Wisely*”  
[NEJM 2014]
Change in number of tests sent for urine toxicology screening (including drugs of abuse) per month after request vetting.

Summary of intervention strategies to improve physician ordering behaviour

(Freedman DB eJIFCC 2015 26: 15-30), 15-30]

- Guidelines, education and audit of adherence, outcomes
- Use of Formularies
- Standardize nomenclature, units, profiles and ref intervals
- Electronic order systems (CPOE)
- Diagnostic algorithms, reflex and reflective testing
- Minimum retesting intervals
- Request vetting and restrictions
- Feedback to users – activity data, appropriateness and costs

**Multiple interventions**
- MUST stay in place otherwise behaviour will drift back to the unwanted condition
Outline

- Introduction
- Understanding value
- Improving outcomes, reducing harm
- The way forward
Special report

From biomarkers to medical tests: The changing landscape of test evaluation

Andrea R. Horvath a,b,*, Sarah J. Lord b,c,1, Andrew StJohn d, Sverre Sandberg e, Christa M. Cobbaert f, Stefan Lorenz e, Phillip J. Monaghan h, Wilma D.J. Verhagen-Kamerbeek i, Christoph Ebert i, Patrick M.M. Bossuyt k,
For the Test Evaluation Working Group of the European Federation of Clinical Chemistry Laboratory Medicine
“From biomarkers to medical tests – the changing landscape of test evaluation”

Horvath et al, EFLM Test Evaluation Working Group

Clin Chim Acta 2014; 427: 49-57
Components of test evaluation

- Analytical performance
- Clinical performance
- Clinical effectiveness
- Cost effectiveness
- Impact of testing on patient, organization, society

Evaluation – asking the questions

- PICO format
  - Identify the clinical need
- Population – which patients?
- Intervention – what test?
- Comparator – what are we doing now?
- Outcome – how do we measure success?
  - DIRECT: clinical outcomes?
  - INDIRECT: surrogate outcomes?
The way forward

- 21st century medicine needs a flexible information resource:
  - that facilitates selection of the *right test* on the *right patients* at the *right time*
  - with results *delivered in a timely fashion* to the *right place*
  - accompanied by context-specific interpretation
  - linked to *guidance on agreed action* to be taken (where appropriate)
  - with *validated patient-oriented clinical and economic outcome measures*
Changing role of lab medicine

- From:
  - Specimen-centred
  - Clinical testing
  - Lab. performance
  - Provider of results

- To:
  - Patient-centred
  - Clinical decision-making
  - Patient outcomes
  - Partner in care
Reflective “Add on” Tests
Case: 65y/o F c/o tingling and cramps

- Initially GP requested Bone profile
  Adjusted Calcium 7.2 mg/dL (9-11)

- Subsequently GP requested PTH and Vitamin D
  PTH Low
  Vitamin D Normal

- Discussion with GP – patient on Omeprazole (PPI) for 3yrs

- Magnesium 0.60 mg/dL
  (1.8-3.6)
Case: 65y/o F c/o tingling and cramps

Hypomagnesaemia

- Cardiac dysrhythmia, including ventricular fibrillation

Emergency Admission $2400

plus

Stay on CCU $1200/day
Lab Tests Online-UK

Lab Tests Online-UK is written by practising laboratory doctors and scientists to help you understand the many clinical laboratory tests that are used in diagnosis, monitoring and treatment of disease. The about this site page describes how the site can help you. Search under conditions and diseases and find information on laboratory tests used for particular diagnosis and/or management or alternatively, if you know the test name, just search under tests.

Let us know what you think of the site and how we might improve it. If you found Lab Tests Online-UK useful, please spread the word!

Topics in the News

Participate in the Lab Tests Online-UK 2014 User Survey

4 March 2014

The survey has been produced to allow the Lab Tests Online-UK team to gain a better understanding of our visitors and to see if the website has helped you during your visit.

We intend to use the information obtained in the survey to guide improvements for the website and gain a view of your satisfaction. A summary of the survey results will be posted on our newsfeed in the summer.

The survey should take 8-10 minutes to complete, please click on the link below to participate in the survey. We would really appreciate your feedback.
References

- Special issue eJIFCC January 2015
  [www.ifcc.org](http://www.ifcc.org)

- IFCC Task Force report
  “Current Evidence and Future Perspectives on the Effective Practice of Patient-Centered Laboratory Medicine”: Hallworth MJ et al.
  Clinical Chemistry 2015 ;61;589-599