The LEWIN GROUP
an INGENIX company

Clinical Laboratory Improvement Advisory Committee Meeting

The Status of Laboratory Medicine
Working Draft

Clifford Goodman (clifford.goodman@lewin.com)
Julie Wolcott
Amanda Schwartz

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Defining Best Practices in Laboratory Medicine

CDC Office of Strategy and Innovation

- Primary contractor: Battelle Memorial Institute
  - Subcontractor for Task 1: The Lewin Group
- Task 1 – Status Report
- Task 2 – Workgroup on Best Practices and Policy
- Task 3 – Evaluation of Proficiency Testing Services

Our Discussion Today

- Study purpose
- Main sections
- Selections of draft content
- Where we seek your input

Study Purpose

Prepare a report on the field of laboratory medicine, describing its current status and projecting the future status of the field. Address the following main areas:

- Scope and magnitude of the field
- Customers for laboratory testing and services
- Factors affecting the delivery and quality of laboratory services
- Impact of regulatory oversight (including CLIA) and of accreditation practices on the field
- Common practices, performance measures, status of workforce and related trends
- Expected evolution of the field over the next decade

Table of Contents

Broad Health Care Trends Affecting Laboratory Medicine

Demographic

- Aging population
- Longer life expectancy
- Increase chronic disease burden

Science & Technology

- Rapid advances (biotech, computing, etc.)
- Better, faster, smaller, less invasive, point-of-care
- Induces demand

Data & Evidence

- Faster, more comprehensive data collection, mining
- Evidence-based medicine
- Clinical practice guidelines
- More emphasis on outcomes, total (incl. downstream) costs

Broad Health Care Trends Affecting Laboratory Medicine

Regulation

- Multiple authorities
- Strained by volume, technological advances
- Pressure to enable innovation, protect safety

Payment

- Higher thresholds for coverage
- Downward pressure on payment
- Coding and payment processes often unresponsive, outdated
- More uninsured, underinsured

Quality

- Greater scrutiny on safety
- More objective/quantitative assessment
- Advances in quality management
- Expectations for standardized products and service

Broad Health Care Trends Affecting Laboratory Medicine

Workforce

- Shortages in some professional/technical areas
- Constrained/shrinking educational programs
- Education, training straining to keep pace with state-of-the-art

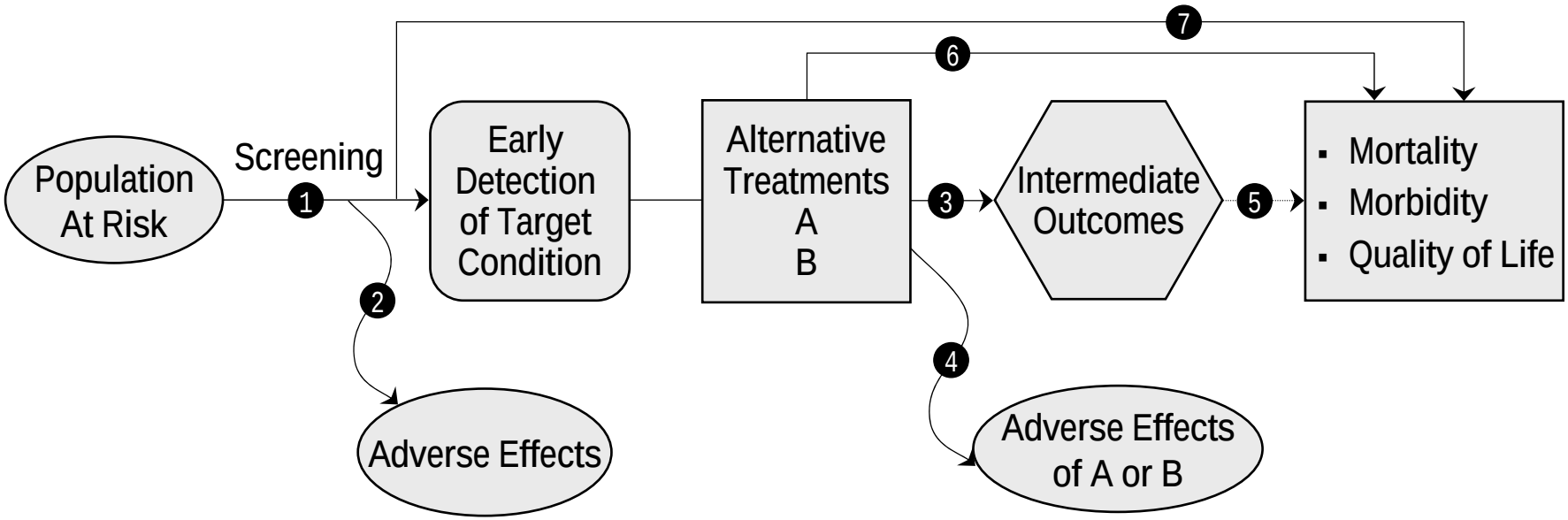
Consumers

- Greater consumer awareness
- Direct-to-consumer advertising
- Health literacy barriers

Health Information Technology

- Fueled by advances in hardware, software
- Expanding unevenly
- Insufficiently standardized, interoperable

Beyond Analytic Validity: Impact on Outcomes



1. **Is screening test accurate for target condition?**
2. **Does screening result in adverse effects?**
3. **Do treatments change intermediate outcomes?**
4. **Do treatments result in adverse effects?**
5. **Are changes in intermediate outcomes associated with changes in health outcomes?**
6. **Does treatment improve health outcomes?**
7. **Is there direct evidence that screening improves health outcomes?**

Source: Adapted from Harris, Helfand, Woolf, et al. 2001

Laboratory Medicine Role in Quality

Laboratory medicine has a role in supporting each of the six aims of quality identified by the IOM:

- Safety
- Effectiveness
- Patient-centeredness
- Timeliness
- Efficiency
- Equity

Contributions of laboratory tests and services to health system and patient and population health remain under-recognized.

Excerpts from Chapters

Market Profile

- Laboratory testing revenues 2007: $51.7 billion
- Market growth factors include, e.g.:
  - Demographic trends and burden of disease
  - Scientific, technological, medical advances
  - Increased consumer awareness, demand for high quality, safe health care

Source: Terry, M. Lab industry strategic outlook: Market trends and analysis 2007. New York, NY: Washington G-2 Reports, 2007.

Market Profile

Revenue by Segment

Laboratory Testing Segment	Revenues 2006	Market %, 2006	Expected Growth Rate, 2007
Clinical pathology	$32 billion	66%	10.5%
Anatomic pathology	$9 billion	21%	5.1%
Highly complex, low volume tests	$4 billion	9%	10.5%
Cytology	$2 billion	4%	3.7%

Source: Terry, M. Lab industry strategic outlook: Market trends and analysis 2007. New York, NY: Washington G-2 Reports, 2007.

Market Profile

- > 4,000 laboratory tests currently available
- 1,162 tests covered by Medicare
- 500 performed regularly
- Approx. 1,430 conditions currently detectable using genetic testing; 287 tested only in research settings
- > 200,000 CLIA-registered laboratories
- 106,000 are physician office laboratories
- Approx. 80% POLs certified to perform only waived and/or provider-performed microscopy tests

Market Profile

CLIA-waived tests increasing

- 338 million performed in 2006 (13% of all lab tests)
- Examples: b-type natriuretic peptide, lithium, TSH, HIV

Popularity of OTC and DAT increasing

- 35 laboratory testing types currently sold OTC

New Laboratory Testing Technology

Simplified/user-friendly

- Noninvasive: O_2 saturation, blood glucose, CBC
- Home testing: more user-friendly, connections with home health monitoring system and physician's office

Biotechnology-based

- Genetic: inherited predisposition to disease, gene therapy
- Proteomic: detect protein profiles associated with disease states, deeper analysis of molecular forms of traditional biomarkers
- PGx: tailor Rx to individuals based on genetic makeup

New Laboratory Testing Technology

Miniaturized

- Micro total analysis systems ("lab on a chip"): multiple laboratory functions carried out on one chip, consume fewer reagents and require reduced sample volume, enable point of care testing
- Nanotechnology: potential to remotely control functions of nanodiagnostics, monitoring of diseased tissue in real time

Workforce

Number of MT/CLS, lab tech education programs declined >50% since 1980

- 70% closed 1970 – 2003
- Contributing factors:
  - Decrease in hospital revenues resulting from Medicare PPS
  - Expense of operating clinical lab science program

Current enrollment in MT/CLS and lab tech educational programs lowest in blood banking and histotechnology

Workforce

Recent recruiting efforts appear to be having an effect

- Effective recruiting methods include
  - Targeting minority and male students
  - Efforts to raise awareness of laboratory careers among students
  - Dedicating program staff and budget to recruitment

Growing shortage of MT/CLS and laboratory technicians

- Aging of workforce
- Under-replacement
- Competing career opportunities
- Difficulty recruiting and retaining staff

Workforce

Staff-level vacancy rates

- Highest in 2000 (11 - 22%)
- Steady during 2002 – 2005 (4 - 7%)

Evidence unclear regarding shortage of MT/CLS and lab techs next 5 - 10 years

Sources: HRSA. The clinical laboratory workforce: The changing picture of supply, demand, education and practice. 2005; Steward CA, Thompson NN. ASCP 2005 wage and vacancy survey of medical laboratories. Laboratory Medicine 2006;37(8):465-9.

Workforce

Qualifications for MT/CLS and laboratory technicians could change with:

- Technological advances in laboratory testing
- Emerging PGx and proteomic testing
- Greater automation

To maintain pace with these and other changes, lab sector needs to adapt, refine:

- Staff qualifications
- Workforce level requirements

Total Testing Process

Factors Affecting Quality

- Higher rates of error occur in the preanalytic and postanalytic phases; quality initiatives have focused on analytic phase
- Chief quality and safety issues:
  - Poor laboratorian-clinician communication during test ordering (preanalytic) and interpretation (postanalytic) can affect diagnoses
  - Specimen collection in clinical pathology
  - Patient and specimen misidentification in all disciplines
- Chief issues affecting customer satisfaction:
  - Turnaround time, notification of critical values
- Error distribution in clinical pathology varies widely from one institution or setting to another
  - High potential for patient harm in, e.g., genetic testing

Total Testing Process

Distribution of Errors – Clinical Pathology

Based on MEDLINE Search 1994-2001

	Frequency	Preanalytic	Analytic	Postanalytic	Potential Harm
Clinical Chemistry	0.05%	32%	32%	31%	n/a
Whole Lab	0.61%	53-75%	16-23%	9-24%	26% moderate 8% severe
Primary Care	0.11%	56%	13% overall 4% referral 40% POCT	30%	13% moderate
Stat Lab	0.47%	68%	13%	19%	6% moderate
Molecular Genetics	0.33-0.38%	44-60%	19-31%	13-15%	10-50% moderate 6-25% severe

Source: Bonini P, Plebani M, Ceriotti F, Rubboli F. Errors in laboratory medicine. Clin Chem 2002; 48(5):691-8.

Total Testing Process

Needs:

- Adapt to proliferation of molecular and genetic tests that will change sector (e.g., errors, knowledge, reporting)
- Research to examine effect of health information technology (e.g., CPOE) in appropriateness of test orders and errors
- Standardized reporting systems for laboratory-related errors to promote learning and improvement
- Re-evaluate restrictions on reimbursement for interpretive consultations in certain clinical pathology tests
- Address quality and safety issues for direct access testing
- Examine measures for quality control, performance evaluation, and test reproducibility
- Research on quality and errors in POLs

Quality Systems & Performance Measurement

- Traditional QC, QA, and PT have improved quality and performance
  - PT failure rates decreased between 1994-2004 for 8 analytes commonly performed in POLs and clinical laboratories
    - Cholesterol: 18.7 → 3.2%; Potassium: 6.3 → 1.1%
- However: Up to 18% of CLIA inspected sites failed to run QC in 2002
- Stakeholders concur on need to move beyond basic QC, QA, and PT by building quality into systems

Quality Systems & Performance Measurement

- Standardized QMS adapted from ISO 9000 series and ISO 15189
  - Implementation tools: CQI, Toyota (lean) production, Six Sigma, FMEA
- Common attributes of QMS methodologies:
  - Scientific approach to process analysis
  - Decision-making based on data from performance measures
  - Improvement vs. regulatory focus
  - Preventive orientation
  - Interdisciplinary teams

Quality Systems & Performance Measurement

Implementation Challenges

- Transfusion medicine is well along in use of QMS (began in 1990)
  - AABB adapted ISO 9000 series to meet FDA GMP requirements
- Early adopters of QMS (from small POLs to large laboratories) have realized benefits
  - CQI and Six Sigma resulted in financial savings and decreased TAT
  - Lean improved test quality and reduced errors
  - FMEA decreased time to report critical values
- Challenges to implementation
  - Resistance to cultural change
  - Lack of leadership and staff commitment
  - Insufficient funding of QMS activities
  - Need for leaders knowledgeable in the specific capabilities for implementation by organizational size and type

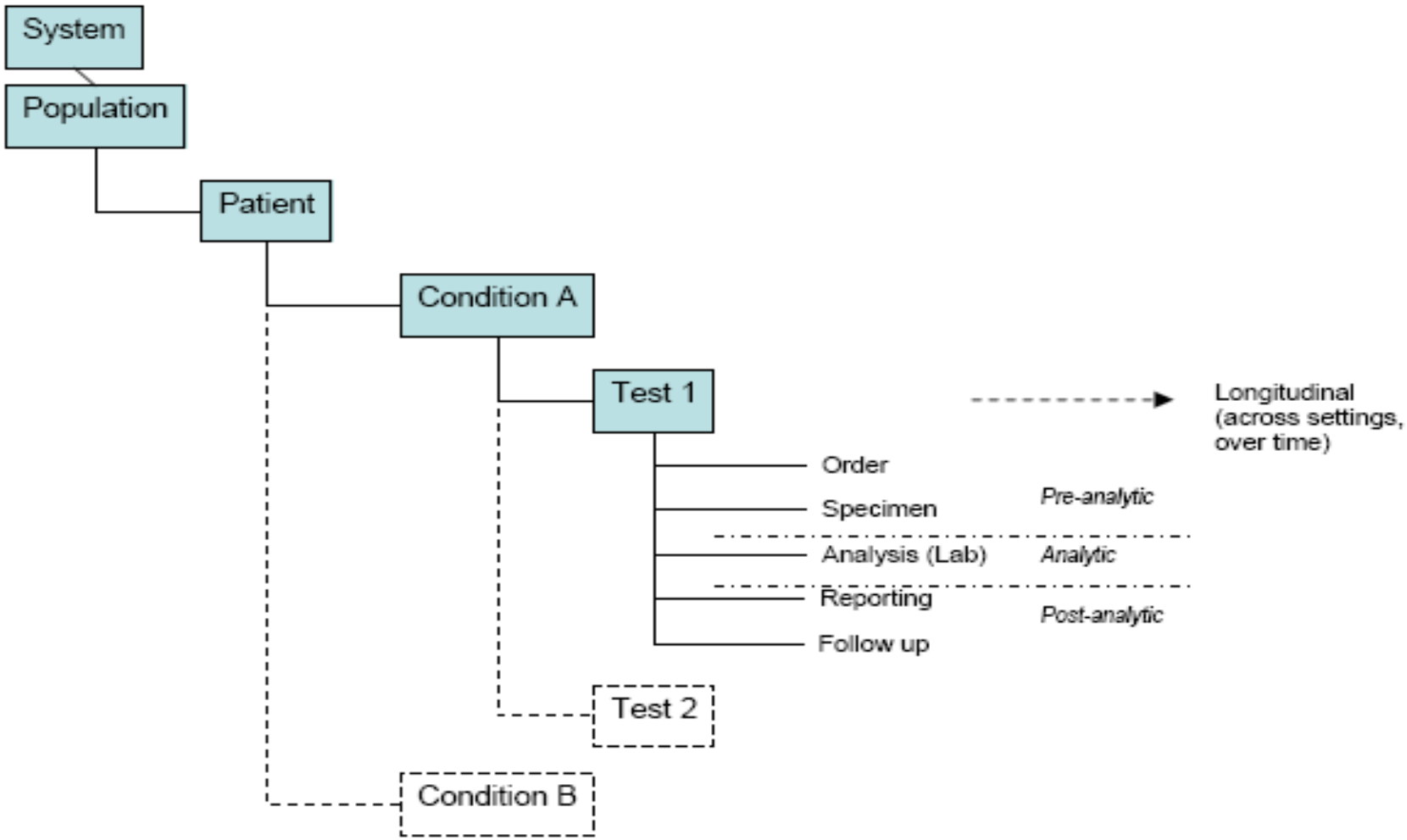
Quality Systems & Performance Measurement

- QMS and PM are complementary: Expanded PM is required to improve quality
- Current approach to analytic-focused PM cannot support comprehensive QMS or quality improvement programs
  - Only 'official' PM to date is PT
  - Other CLIA-related quality systems requirements are more structural, less process or outcomes related
- Preanalytic and postanalytic PM are lacking, yet most errors originate here

Quality Systems & Performance Measurement

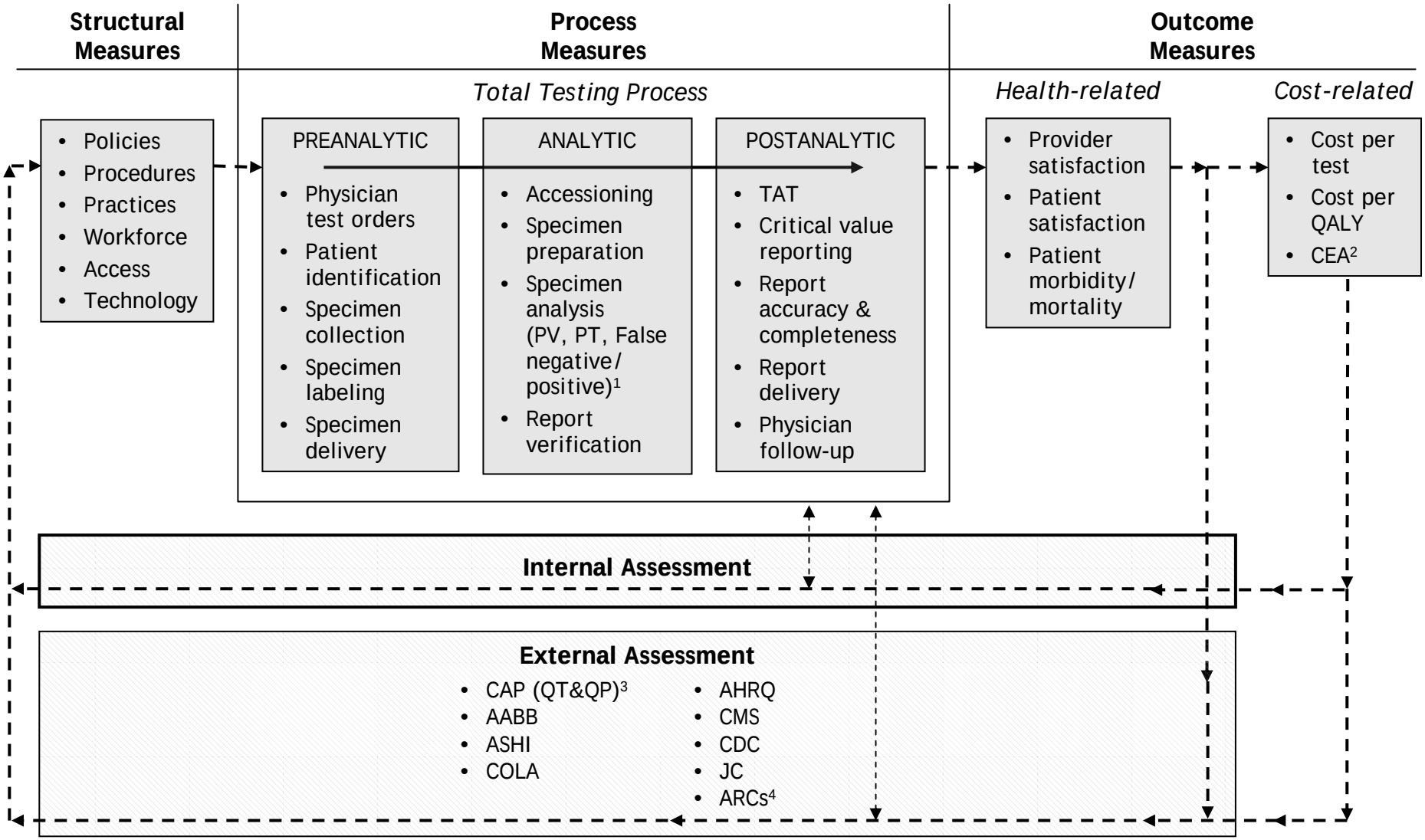
- Public and private sector organizations have sought to fill gap through research studies on certain quality indicators (e.g., error rates)
- Use of laboratory values in general health care PM has been limited to clinician ordering for screening, diagnosis, and disease management

Performance Management: NQF Framework



Source: Behal R. Identification of Performance Measures of Importance for Quality in Laboratory Medicine. National Quality Forum, 2007.

Scope of Possible Indicators



1 PV-Predictive Value, PT-Proficiency Testing
2 CEA-Cost effectiveness Analysis
3 QT-QTracks, QP-QProbes
4 ARCs-Academic research centers

Laboratory Information & Automation Systems

- Laboratory information & automation systems (LIS) are evolving from simple designs in workflow to "complete" systems that link data across TTP, including clinician-related pre- and postanalytic activities
- Challenges:
  - Extent, quality of LIS adoption varies widely
  - LIS modules and clinical applications developed by different vendors using different data standards limit interoperability
  - "Next-level integration" of LIS, automated systems, HIS, and broader health information infrastructure requires making data compatible and usable in clinical practice, accessible through efficient networks

Laboratory Information & Automation Systems

- Needs:
  - Implement common data interchange, terminologies, knowledge representation, document architectures
  - Increase computing power and standards adoption to meet increasing volume of data; support genetic, proteomic, PGx tests; link to new applications and devices
  - More rule-based algorithms for generating and integrating accurate alerts, reminders, order sets, results reports, lists of differential diagnoses specific to individual patients
  - Develop Web connectivity to become fully integrated with the health infrastructure
  - Advances in high-power computation, data storage capacity, image formatting, processing algorithms for digital pathology

Regulation

The current regulatory framework for clinical laboratory testing, including its ability to ensure high standards of quality, promote access, and enable innovation toward improving patient care, is limited in its language and implementation. Trends in the health care environment are also challenging and straining this framework.

Regulation

- Technological advances, demographic shifts, lower tolerance for error, higher expectations for personal data security
- CLIA final rule pertaining to quality systems may be insufficient for immediate detection of errors and in monitoring long-range performance
- Available evidence on the long-term impact of PT on laboratory performance is limited.
- Growth in waived tests increases access, but raises concerns that some may fall short on, e.g., specimen adequacy, accuracy, reliability, availability of counseling
- Multiple health, economic, social, other factors challenge roles of CMS and FDA in oversight of lab testing under CLIA and FD&C
- Though accounting for small proportion of all lab tests, the growth and prominence of genetic tests prompts interest in establishing CLIA specialty area

Regulation

Multiple health, economic, social, other factors challenge roles of CMS and FDA in oversight of lab testing under CLIA and FD&C

- Greater attention to implications of regulating lab testing as services vs. as products
- CLIA requirements for lab developed tests often regarded as less rigorous than FDA requirements for IVDs. Some controversy:
  - CLIA requires analytical validity and reliability for lab-developed test
  - FDA requires analytical validity and reliability, as well as clinical validity and utility for IVDs

Regulation

Extent to which FDA actively regulates certain in-house lab tests is emerging

- Draft guidances pertaining to ASRs and IVDMIAs (Sept. 2006)
- Signals shift of oversight for small, yet growing sets of complex tests
- Effect of these guidances may be to expose these tests to premarket review via 510(k) or PMA

Genetic Testing as CLIA Specialty Area?

- Genetic tests account for small proportion of all tests, but are increasingly visible
- Narrower field of clinical cytogenetics is a CLIA specialty area
  - Genetic testing (including molecular, biochemical, PGx) is not recognized as a specialty area
  - Potential need for specialty area: complex new genetic tests; confidentiality concerns with genetic testing, patient counseling needs, increasing demand for PGx testing
- In response to petition, CMS finds that arguments and evidence do not justify rulemaking to establish new CLIA genetics specialty at this time
  - CMS presented an action plan for oversight of genetic testing under current CLIA. CMS will continue to: a) vigorously apply existing quality control and other CLIA requirements to genetic testing, b) monitor further developments in the field of genetics

Source: Letter to Kathy Hudson, Genetics and Public Policy Institute. Aug. 15, 2007. Dennis G. Smith. Center for Medicaid and State Operations, CMS. http://www.dnapolicy.org/resources/CMSresponse8.15.07.pdf

Completing Initial Status Report for 2007

- Revisit: Who is the audience for this report? Relative emphasis on:
  - Experts/insiders: assume knowledge of background/basics; more comprehensive, detailed
  - Interested, non-expert policy-makers and staff: some background/basics; higher-level policy issues
- Complete draft chapters
- Continue receiving feedback from committee members, agency staff for revised chapters
- Complete report December 2007

Update Status Report for 2008

- Additional chapters?
  - From Total Testing Process – Factors Affecting Quality, break out separate chapters on: Clinical Pathology and Anatomic Pathology
  - Public Health Laboratories
  - Evolving Role of Genetic Testing in the Clinical Laboratory
  - The Consumer and Clinical Laboratories (e.g., patient-centered care, self management, DAT, home testing, etc.)
  - From Value of Laboratory Medicine, break out separate chapter on Economic Impact (including cost-effectiveness) of Laboratory Medicine
- Same or different report format for 2008? More on implications, less on status?
- Increase committee member participation in report review