



School of Health Professions

## **Doctor of Clinical Laboratory Science (DCLS) Contributing Quality and Value in Clinical Laboratory Services Delivery**

**Nadine A. Fydryszewski, PhD, MLS(ASCP)<sup>CM</sup>**

Professor and DCLS Program Director

Rutgers University, School of Health Professions

Dept. of Clinical Laboratory and Medical Imaging Sciences

**Brandy Gunsolus, DCLS, MLS(ASCP)<sup>CM</sup>**

Pathology Utilization Director

AU Health System, Dept. of Pathology

Adjunct Assistant Professor

Rutgers University, School of Health Professions

Dept. of Clinical Laboratory and Medical Imaging Sciences

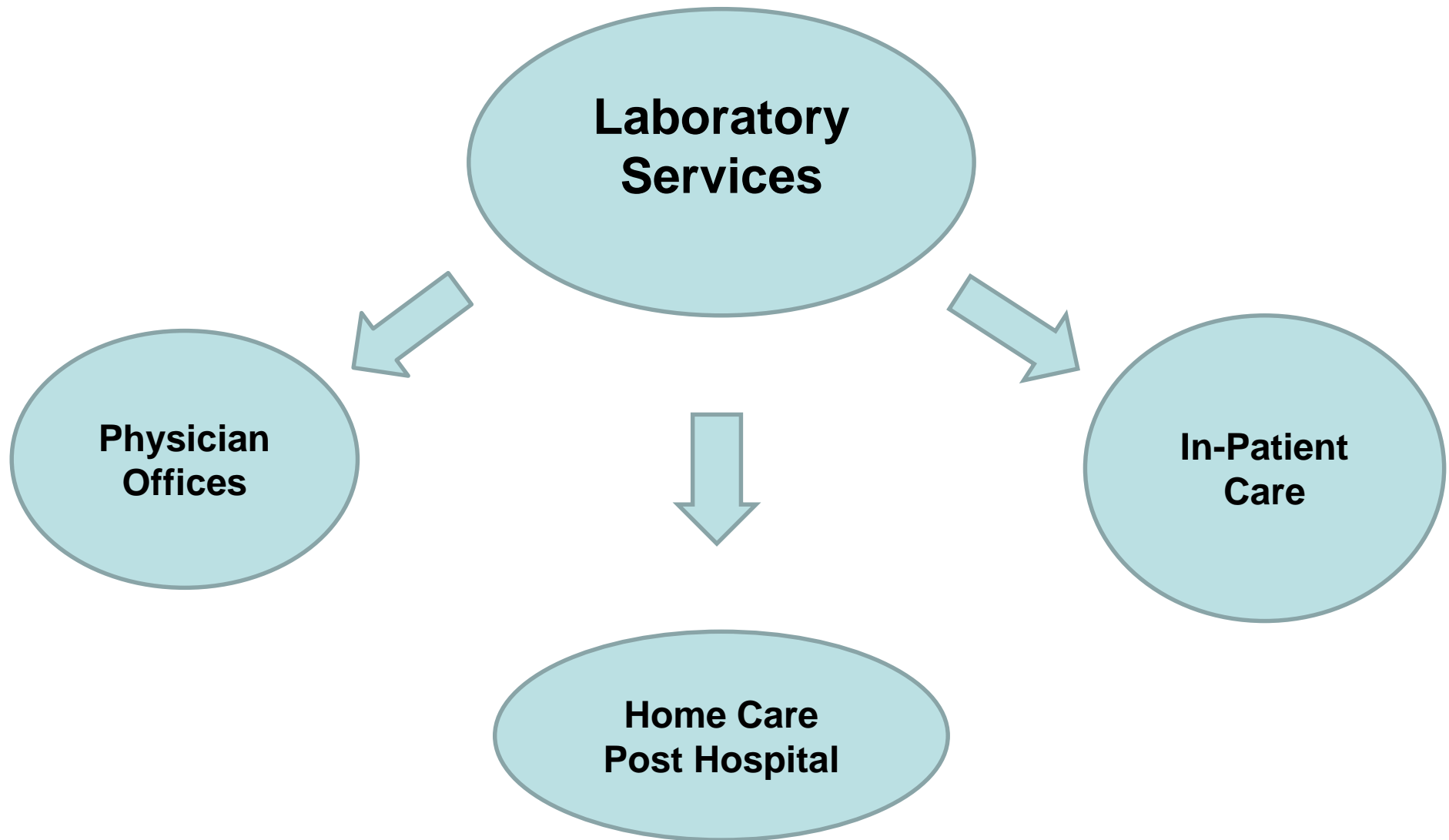
## **Nadine Fydryszewski**

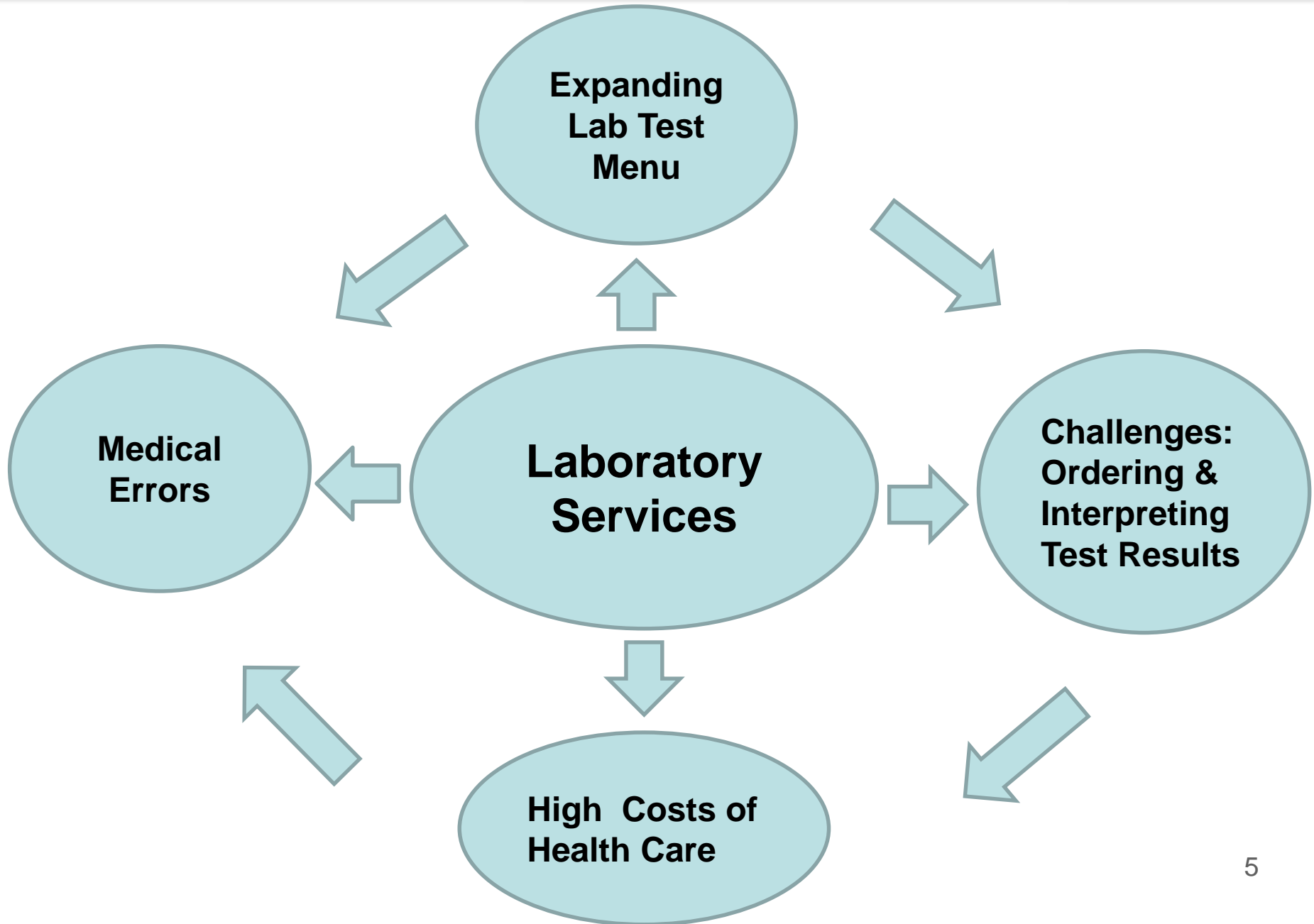
- Professor, Vice Chair, DCLS Program Director- Rutgers University  
Dept. of Clinical Laboratory and Medical Imaging Sciences
- Board of Director – American Society of Clinical Laboratory Science

## **Brandy Gunsolus**

- Pathology Utilization Director – AU Health System
- Adjust Assistant Professor – Rutgers University, Dept. of Clinical Laboratory and Medical Imaging Sciences
- National Patient Safety Committee Vice-Chair – American Society of Clinical Laboratory Science
- American Society of Clinical Laboratory Science – Georgia Chapter State President
- NAACLS Doctorate Review Committee Member

- Assess the evidence of the need to improve the delivery of clinical laboratory diagnostic services.
- Define the Doctorate in Clinical Laboratory Science.
- Describe the Diagnostics Consultation Model (DCM<sup>©</sup>).
- Evaluate the contribution of DCLS consultations related to patient safety, quality patient care, and cost.





## 2007: CDC: Division of Laboratory Systems

**Institute: Managing for Better Health.** Executive Summary: Action Plan Priorities. Explore ways of improving the integration of lab medicine within the health system....

*“to institutionalize **new models of clinical consultation** provided by the laboratory medicine professionals to clinicians to guide their decisions about utilization of laboratory tests or services”.*

## 2013: Clinical Laboratory News January 2013, Vol. 39, No.1 A Family Physician's Perspective on Laboratory Testing and Diagnostic Errors *Interview with Peter Weir, MD, MPH*

- Potential for **ordering the wrong test**.....over-order tests if uncomfortable with a clinical situation
- Ordering panels of lab tests, not well thought-out, leads to confusion, **unnecessary referrals**
- **Bring clin lab expertise to our clinic**
- Collaboration with colleague's for better patient care

**2014: Primary Care Physicians' Challenges in Ordering Clinical Laboratory Tests and Interpreting Results.** *Journal of the American Board of Family Medicine* March-April 2014;27:2, 268–274.

- Challenges in ordering
- Interpreting diagnostic laboratory tests
- Safe and efficient use of laboratory testing resources
- Quick access to laboratory consultations

**2015: Institute of Medicine Improving Diagnosis in Health Care**

- Diagnostic errors cause patient harm
- Improvement in the diagnostic process requires collaboration among physicians and laboratory professionals.

**2017: Opportunities to Enhance Laboratory Professionals' Role On the Diagnostic Team.** *Laboratory Medicine*. Vol 8. Issue1, Feb 2017

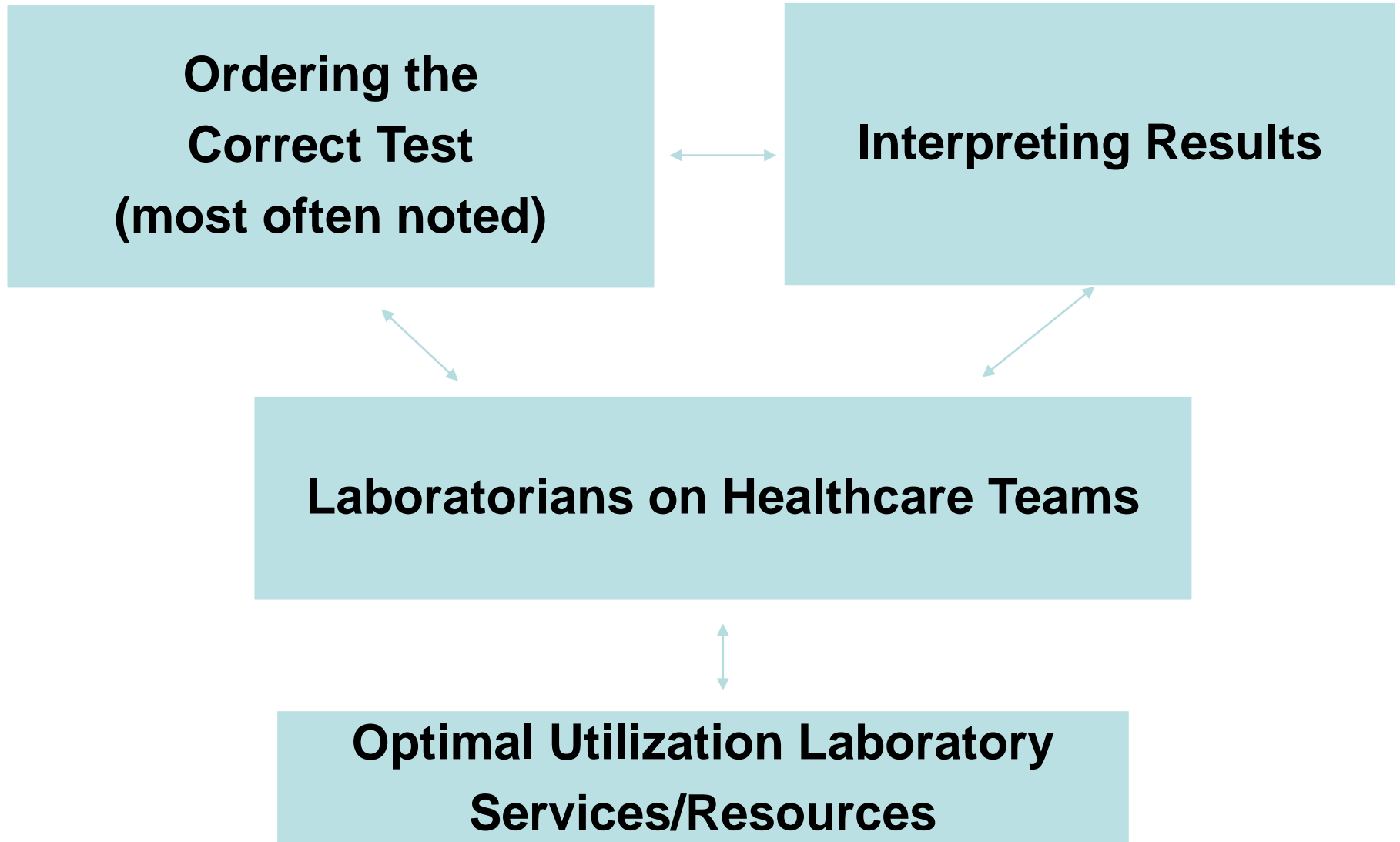
- 31,689 with 1768 (5.6%) response; Diagnostic challenges, use electronic resources
- Difficult and time-consuming to contact the lab
- "Laboratory professionals have an opportunity to play a greater role in the diagnostic process by becoming active members of the clinical care team, beyond providing results."

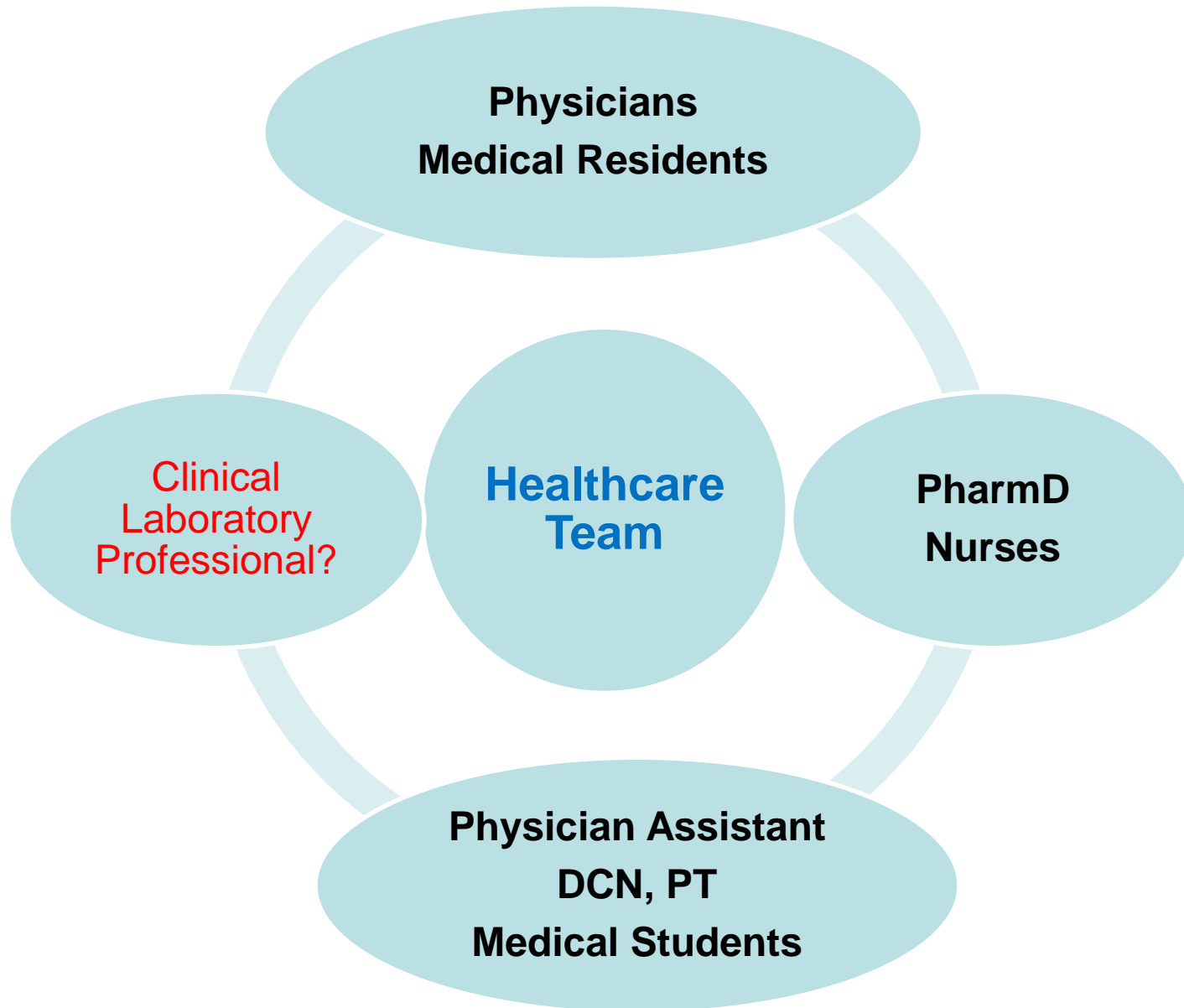
**2018: The Laboratorian as a Clinical Consultant: Identifying Needs and Building New Roles** *Cardinal Health Webinar April 25, 2018*

Need for laboratorians.....

- Expand their sphere of influence outside the walls of the clinical laboratory
- Opportunities in institutions for expanding the professional role of clinical laboratorians
- Key clinical and administrative partners for a successful program that fully utilizes the skill set of the laboratorian









## **2005: American Society for Clinical Laboratory Science (ASCLS)**

Advanced Practice Doctorate in Clinical Laboratory Science Position Paper

(Reviewed/revised: 2013, 2016)

***“Development of the medical laboratory scientist to assume a role as a member of the interprofessional healthcare team requires advanced knowledge and clinical training.”***

<https://www.ascls.org/position-papers/178-advanced-practice-doctorate-in-clinical-laboratory-science/154-advanced-practice-doctorate-in-clinical-laboratory-science>

### **DCLS Oversight Committee**

- Development
- Implementation
- Integration
- Evaluation

**DCLS - Advanced practice doctorate**

- Certified medical laboratory scientists

**Partner with clinical pathology** to provide value of diagnostics through consultation throughout the healthcare sector

- *Consult with clinicians and healthcare professionals regarding lab test ordering*
- *Evaluate/interpret lab test results, integrate data*
- *Consult to assure quality utilization of laboratory services*
- *Develop evidence-based guidelines and policy*
- *Utilize EMR and LIS analytics-supports quality programs*

**Conduct Outcomes Research**

- Focus on the impact of diagnostics on clinical/health outcomes.

### PhD, ED.D, D.Sc., etc.

- Curriculum emphasis is on research and scholarship (>50% of overall credits)
- Candidacy exam/dissertation

### Entry-Level Practice Doctoral Degree (MD, PharmD, DPT, D.C. DM.D, J.D.)

- Focus is on clinical practice
- Degree related to becoming licensed and/or 1<sup>st</sup> credential to practice
- Clinical component in the curriculum (not included in PhD)
- Applies research, usually does not include a research project

### Advanced Practice Doctoral Degrees (DCLS, DNP, DCN)

- Focus is on advanced clinical practice, requires clinical expertise
- Prepares for highest level of practice ***beyond the initial preparation in the discipline.***
- Requires certification/credential and/or licensure in the profession **prior to beginning the program**
- Clinical component in the curriculum (not included in PhD)
- Includes an independent research project; < 30% of overall credits related to research

Middle States Commission on High Education Degrees and Credits,2006.

National Center for Educational Statistics. U.S. Department of Education. Retrieved August 2019. <https://nces.ed.gov/ipeds/report-your-data/data-tip-sheet-reporting-graduate-awards>

## Rutgers University-DCLS

- 1<sup>st</sup> advanced practice doctorate for certified MLS in the US
- 1<sup>st</sup> graduate, May 2018; employed as a DCLS

## Curriculum: 80 credits beyond the BS degree

- Certified medical laboratory scientist (MLS)
- Blended: Web-based for theoretical courses + practice/residency
- FT & PT options for pre-residency component (theoretical courses)
  - Advanced Clinical Laboratory Science Core – 30 credits
  - Professional Core – 15 credits
  - Research Core – 21 credits
  - Clinical Practice/Residency – 14 credits
- **FT One Year Clinical Practice/Residency**

# **Institute of Medicine Core Competencies for Health Professionals**

**Provide patient-centered care**

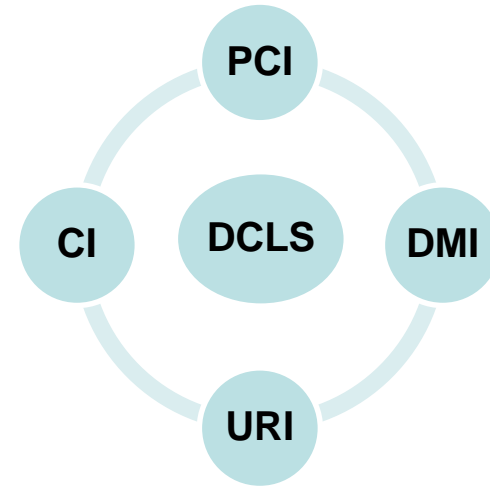
**Work in interdisciplinary  
teams**

**Employ evidence-based  
practice**

**Apply quality improvement**

**Utilize informatics**

## Framework for DCLS to address the quality gap in clinical laboratory services delivery



### Patient Care Intervention (PCI)

- Daily patient-care clinical rounds - Interprofessional healthcare team

### Diagnostics Management Intervention (DMI)

- Encounters received via direct case management requests to the clinical laboratory

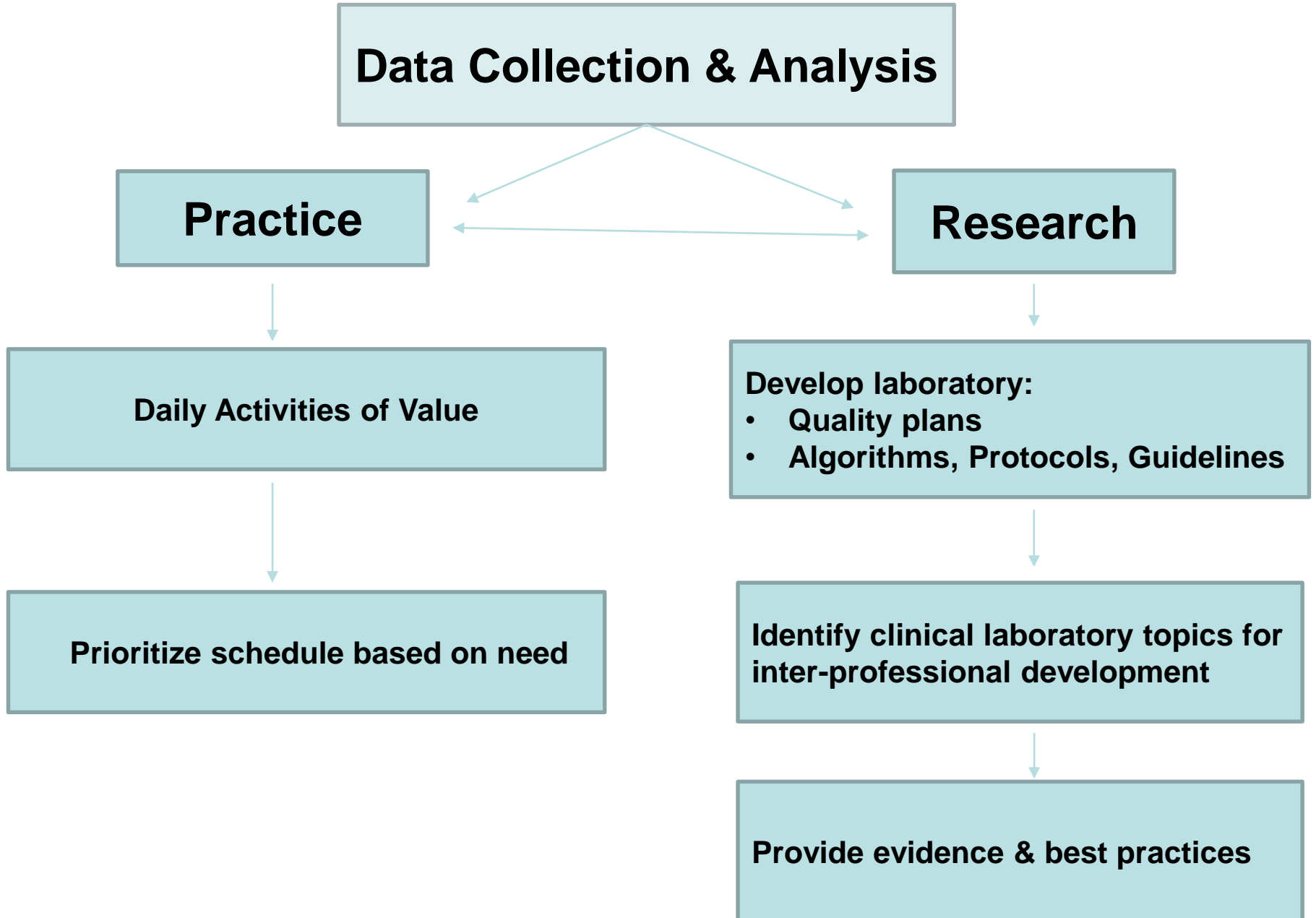
### Utilization Review Intervention (URI)

- Encounters through review of reports generated by the LIS system/rules

### Community Intervention (CI)

- Consumer information response encounters
  - Lab Test Online ([labtestsonline.org](http://labtestsonline.org))
    - Questions answered by a medical laboratory scientist as part of a voluntary service provided by American Society for Clinical Laboratory Science (ASCLS).
  - Other community-based setting





## Diagnosics Consultation Model Implementation

### Case Examples

- Encounters during DCLS residency
- How the DCLS interacts with the healthcare team
- Demonstrates the contribution of DCLS

*Brandy Gunsolus, DCLS, MLS(ASCP)<sup>CM</sup>, documented during her DCLS residency as part of the requirements for completion of the Rutgers University DCLS degree.*

# Case #1 – Patient Care Intervention (PCI)

Daily patient-care clinical rounds - Interprofessional healthcare team

## Patient:

- 34-year-old male, quadriplegic
- Tracheal ventilator dependent
- Admitted from the ER to the Cardiology service for atrial fibrillation

## Inpatient Day 2

- Cardiology care team determines patient needs a pacemaker
- Procedure scheduled for AM of Day 4

## Overnight of Day 2

- Resident notified
  - MSSE growth in tracheal aspirate culture obtained in ER
  - Resident prescribed 10-day course IV vancomycin
- Documents patient as having MSSE pneumonia

# Case #1

## Patient Care Team – Inpatient Day 3

- Attending Physician
- Cardiology Fellow
- Resident Physicians
- Clinical Pharmacist
- DCLS Resident
- RN
- Care Coordinator

**Pacemaker procedure must be postponed until IV antibiotic therapy is complete**

- Requires 10 additional inpatient days

**Attending physician asked the DCLS resident for opinion on culture result**

## Case #1

### **DCLS Consult:**

- Patient has a permanent trach
- Grows a bacterial biofilm overtime
- MSSE is likely representative of this biofilm
- No growth on the Bronchoalveolar lavage (BAL) culture
- Chest x-rays - clear lung fields
- Vital signs do not indicate infection
- No evidence the patient has bacterial pneumonia

## Case #1

### Team Conclusion:

- Patient does not have bacterial pneumonia
- Cancel antibiotic regimen
- Move forward with pace-maker placement as originally scheduled

### DCLS Consultation Contributed To:

- Correct patient diagnosis
- Discontinuation of inappropriate antibiotic therapy
- Decreasing patient length of stay by 10 days
- Patient obtaining pacemaker placement in a timely manner
- Cost savings of \$22,300

## Case #2- Patient Care Intervention (PCI)

**Patient:** 54-year-old male

- PMH:
  - Hypertension (HTN)
  - Aortic valve stenosis
  - Gastroesophageal reflux disease (GERD)

### **Inpatient Day 4 in Cardio-Thoracic ICU**

- Post aortic valve replacement
- Extubated 20 hours earlier
- Now on full diet after 5 days NPO

## Case #2

### Day 3

#### Lab Results

- CBC- within reference range
- CMP- within reference range, except:

| Test       | Result       |
|------------|--------------|
| Creatinine | 1.49 mg/dL ↑ |
| AST        | 54 U/L ↑     |
| ALT        | 62 U/L ↑     |

- Acute Hepatitis Panel:
  - Non-reactive except **HCV Ab +**



## Case #2

### Patient Care Team:

- Attending Physician (CT Surgeon)
- Anesthesiology Fellow
- Resident Physicians
- Medical Students
- Clinical Pharmacist
- DCLS Resident
- RN
- Pharmacy Student

### Day 4 Lab Results

- CBC – within reference range
- BMP ordered, only Potassium resulted
  - Potassium 6.2 mmol/L ↑ (hyperkalemia)

## Case #2

### Team Consult

During patient care rounds and team discussion.....

- Another patient in the unit coded
- Attending, fellow, and several residents left to take coded patient to surgery

### **A patient care plan had not been determined for the patient**

- 2<sup>nd</sup> yr. resident physician assigned to the patient remained on the unit
- Requested the DCLS resident to assist in patient care planning

## Case #2

### **DCLS Consult:**

- Investigated why there were missing BMP results
- Assisted resident in locating previous test results
  - Patient was a known HCV+
  - Information not included on patient admission history & physical
  - Cancel HCV viral load
- Discussed a rhabdomyolysis case that occurred when full diet was initiated after extended NPO status
  - Rhabdomyolysis causes acute kidney injury and hyperkalemia

### **Suggested the following:**

- Order BMP with new specimen collection
- Order Creatine kinase (CK) to assess for rhabdomyolysis
- Consult with Clinical Pharmacist
  - Therapeutic strategies to reduce potassium level

## Case #2

Patient lab test results following consultation:

| Test       | Current Result | Previous Result   |
|------------|----------------|-------------------|
| Creatinine | 1.79 mg/dL ↑   | 1.49 mg/dL ↑      |
| Potassium  | 6.4 mmol/L ↑   | 6.2 mmol/L ↑      |
| CK         | 6,850 U/L ↑    | <i>Not tested</i> |

- Laboratory studies strongly suggestive of rhabdomyolysis
- Patient now complaining of muscle pain

## Case #2

### **DCLS consultation contributed to the following outcomes:**

- Provided previous lab tests results, cancelled unnecessary testing
  - Direct cost savings of \$133 for test cancellation
- Identified issue with missing labs
- Contributed to timely patient diagnosis
  - Unknown indirect cost savings for reducing time to correct diagnosis

## Case #3- Diagnostic Management Intervention

Encounters received through direct case management requests to the clinical laboratory

### Patient:

- 47year old female, HIV+
- PMH:
  - 2 weeks prior, patient transported to ED by EMS
  - Complaint of non-witnessed seizure
  - Home glucometer reading of 32 mg/dL
- No symptoms documented by EMS or ED
  - CBC within reference ranges, except hemoglobin 10.4 g/dL ↓
  - BMP within reference ranges
  - Repeated POCT glucose: 76-94 mg/dL

## Case #3

### ED referred patient to endocrinology for evaluation for hypoglycemia

- Endocrinology admitted patient for a 72 hour fast with:
  - Renal profile & CBC on admission
  - Renal profile every 8 hours
  - POCT glucose measured every 2-4 hours
  - Every 6 hours -
    - Plasma glucose
    - Insulin
    - Proinsulin
    - C-peptide
    - Beta-hydroxybutyrate

## Case #3

### What initiated the Diagnostic Management Consultation?

Biohazard bag sent via tube system.....

- Contained specimens collected over the 72-hour fasting episode





## Case #3

### Admissions Lab Test Results:

- All renal profiles were within reference range limits.
- CBC in reference range, except hemoglobin of 10.0 g/dL ↓

### Lab Results During the 72 hr. Fasting:

- All POCT glucose results ranged 74-109 mg/dL
- All serum glucose results ranged from 83-99 mg/dL

## Case #3

### **DCLS resident performed initial chart review:**

- Computer Program Order Entry (CPOE) procedures not followed
- Samples sent at the same time were unspun and beyond acceptable specimen stability
- DCLS notified ordering physician explaining why test orders were cancelled

## Case #3

### Attending Physician Response:

*“It is recommended by the Mayo clinic and the endocrine society hypoglycemia guidelines 2009 that hypoglycemic labs (insulin, proinsulin etc.) be drawn every 6 hours while a patient is undergoing a 72 hour fast in house. This is the standard of care.”*

## Case #3

### Initiation of Diagnostic Management Team (DMT)

#### DMT Members:

- Pathologist
- Pathology Resident
- Laboratory Department Manager
- DCLS Resident
- Medical Librarian

## Case #3

DCLS requested Medical Librarian to search for the guideline cited by physician

Guideline states patients should undergo 72-hour fast if:

- Exhibit Whipple's Triad
  - Signs & symptoms consistent with hypoglycemia
  - Low plasma glucose concentration
  - Documentation of symptom resolution after plasma glucose is raised
  - “drugs, critical illnesses, hormone deficiencies, and non-islet cell tumors” have been evaluated first

## Case #3

### DMT concluded:

- Guideline did not apply to this patient
- Whipple's triad criteria was not met
- Entire admission was not medically necessary
- No follow-up on anemic patient that had 96 tubes of blood drawn

### Outcome – Policy Change.....

Pathologist contacted patient's physician & Medical Director of Endocrinology:

- ***All future admissions for 72 hr. inpatient fasting hypoglycemia protocol must have pathology approval prior to admission***

# Case #4

## Diagnostic Management Intervention

### Patient:

- 14-week-old male, born by c-section
- Mom checked on infant in his crib in the middle of night
- Noticed something was “off”
- Spontaneous subdural hemorrhage
- Outside hospital transferred baby under suspicion of shaken baby syndrome
- Social Service and Child Protective Services assigned to infant

## Case #4

### Resident physician contacted DCLS resident requesting assistance:

- States family doesn't fit the profile for child abuse
- Asked.....
  - What coagulopathies could explain infant's presentation?
  - Which tests to order with minimal blood volume due to bleeding?
- Patient going to neurosurgery now
  - Will likely need blood transfusion later in day



## Case #4

**Emergency DMT activated.....**

### **Team members:**

- Pathologist
- Pathology Resident
- DCLS Resident
- Hematology/Coagulation Manager

## Case #4

### Team reviewed :

- Available medical records & limited family history
- Listed non-trauma differential diagnoses
- Diagnoses ranked most probable to least probable

### Testing prioritized

- Limited volume available to test
  - Transfusion would make further testing not accurate
- 
- Patient specific testing algorithm was agreed upon
  - DCLS Resident coordinated testing with PICU patient care team

## Case #4

### Laboratory test results:

|                                  | Test                 | Results      |
|----------------------------------|----------------------|--------------|
| Initial Testing                  | PT                   | 10.9 sec     |
|                                  | PTT                  | 74.8 sec. ↑↑ |
| 2 <sup>nd</sup> Level of Testing | Factor VIII activity | <1% ↓↓↓      |
|                                  | Factor IX activity   | 44%          |
| 3 <sup>rd</sup> Level of Testing | vWF antigen          | 73%          |

### Diagnosis: Severe Hemophilia A

- Diagnosis obtained within 5 hours of baby leaving the OR
- Sufficient diagnostic information obtained to stabilize & treat appropriately

## Case #4

- Pathologist contacted Child Protective Services and Social Worker
- DCLS resident contacted with patient care team

### **Both communicated:**

- This was an inherited condition of most severe form
- Spontaneous bleeding common in first year with severe hemophilia A
- Life-time treatment regimen will be necessary
- Bleeding episodes still likely to occur
- Genetic testing at a later date (outpatient)

## Case #4

### **DMT Consultation Outcomes:**

- Rapid accurate diagnosis obtained with minimal testing
- Correct patient management initiated in a timely manner
- Prevented a child from entering foster care unnecessarily
- Prevented false charges of child abuse against a parent

- Total cost savings from DCLS consultations during clinical residency:
  - \$628,493 over 9 ½ months (documented)
  
- Total cost savings from DCLS consultation during clinical practice:
  - \$1.6 million (documented)

## **Contribute to:**

- Improve time to correct diagnosis
- Decrease inappropriate test ordering
- Increase correct test interpretation
- Improve patient safety
- Decrease healthcare costs

## **Quality improvement**

- Patient care & safety
- Patient outcomes
- Utilization of laboratory services

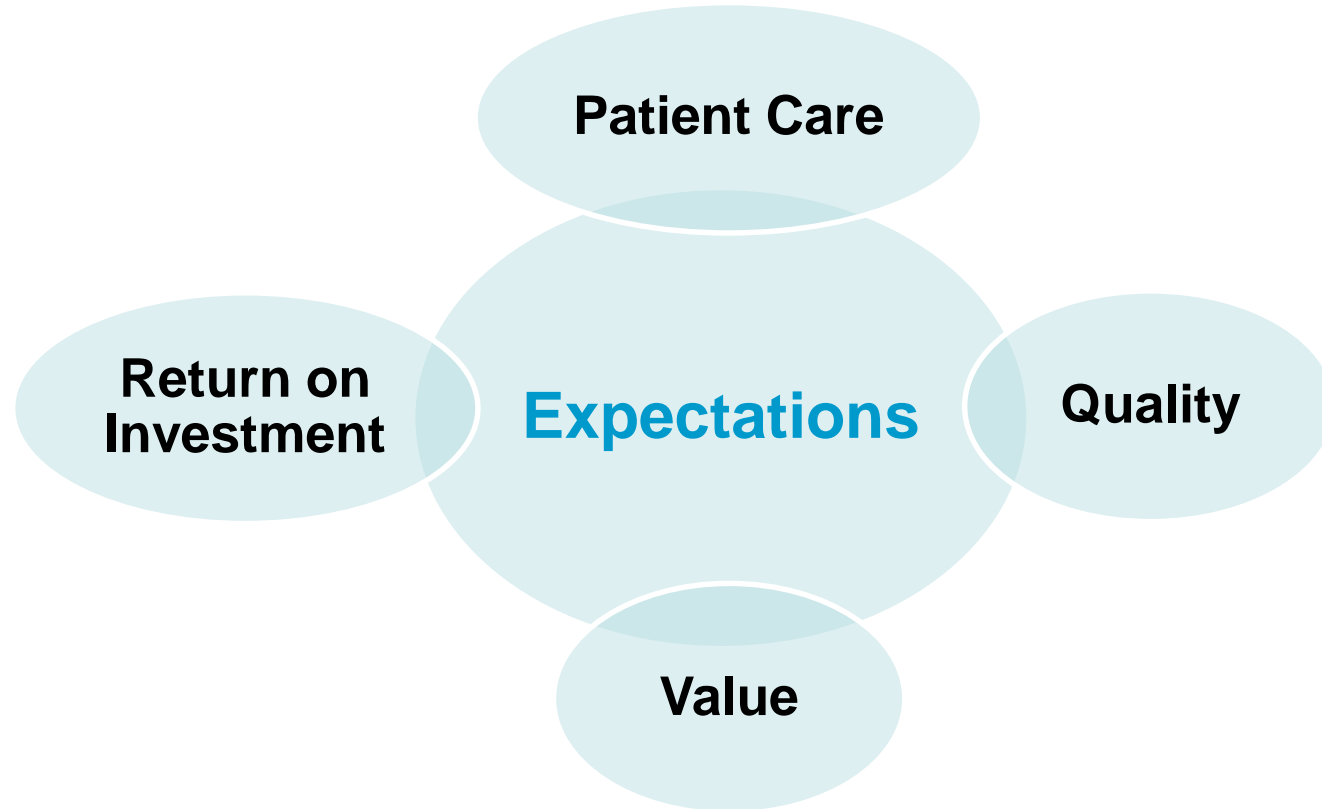
## Requests from medical staff & health system administrative leadership

- Increase physician continuing education in lab medicine
  - Teach in Grand Rounds regularly for many specialty services
  - Teach weekly in Family Medicine
- Expand patient rounding team consultation
- Institute health system-wide pathology utilization program
- Work with Revenue Integrity to resolve billing and revenue issues
  - Increased pathology charges by \$5.5 million per year
- Work with IT to resolve pathology data & quality reporting to Vizient



- Implement and oversee Diagnostic Management Teams
- Oversee resident-driven research in service-specific utilization and algorithm development:
  - 7 Family Medicine
  - 2 Internal Medicine
  - 2 Pediatrics
  - 2 Pharmacy fellows
  - 1 Pathology
  - 1 Psychiatry
  - 2 summer medical student researchers
- Developed 2 grant proposals
  - Improving pathology service delivery
  - Clinical outcomes in transgender patients

## New healthcare model - Change in delivery of lab services



DCLS: Dedicated to increasing the value of diagnostics through:

- Consultation as members of interprofessional healthcare teams
- Conduct research focused on evidence of the impact of diagnostics on healthcare outcomes

**THANK YOU**

- Centers for Disease Control and Prevention. Division of Laboratory Systems. The 2007 Institute: Managing for Better Health. Executive Summary of Action Plan Priorities, 2007.
- Choosing Wisely <https://www.choosingwisely.org/our-mission/>
- A Family Physician's Perspective on Laboratory Testing and Diagnostic Errors. An Interview with Peter Weir, MD, MPH. *Clinical Laboratory News*. January 2013, Vol. 39, No. 1.
- Elnenaï M, Campbell S, Thoni A, al e. An effective utilization management strategy by dual approach of influencing physician ordering and gate keeping. *Clin Biochem*. 2016;49(3):208-212
- Fydryszewski, NA, Keohane, EM. Cost effective implementation of a doctorate in clinical laboratory science program. *Clinical Laboratory Science*, 28:2, 99-105, 2015.
- Hickner, J., et al. (2014). Primary Care Physicians' Challenges in Ordering Clinical Laboratory Tests and Interpreting Results. *Journal of the American Board of Family Medicine*, 27:268–274.
- Institute of Medicine (2015). Improving Diagnosis in Health Care.
- Institute of Medicine (2003) Health Professions Education: A Bridge to Quality.
- The Laboratorian as a Clinical Consultant: Identifying Needs and Building New Roles *Cardinal Health Webinar* April 25, 2018.
- Laposata M. Patient-specific narrative interpretations of complex clinical laboratory evaluations: who is competent to provide them? *Clin Chem* 2004;50:471-472.
- Verna R, Velazquez AB, Laposata M. Reducing Diagnostic Errors Worldwide Through Diagnostic Management Teams. *Ann Lab Med*. 2019 Mar;39(2):121-124. <https://doi.org/10.3343/alm.2019.39.2.121>
- Leibach, E., Gunsolus, B., Fydryszewski, N. Doctorate in Clinical Laboratory Science (DCLS) - Advancing the Laboratorian's Role on the Healthcare Team and in Patient Centered Care. *Advance for Laboratory Professionals* May 2016.
- Leibach EK. The doctorate in Clinical Laboratory Science: The keystone practitioner for the profession. *Clin Lab Sci* 2007;20(1):4-6.
- Leibach EK. The doctorate in Clinical Laboratory Science: A view of the process of integration into health care. *Clin Lab Sci* 2007;20(2), 69-71.
- Leibach EK. The doctorate in Clinical Laboratory Science: A view of the strategy for continuity, growth, and realization of potential. *Clin Lab Sci* 2007;20(3):189-192.
- Leibach EK. The doctorate in Clinical Laboratory Science: projection of professional outcomes. *Clin Lab Sci* 2007;20(4):197-200.
- Leibach EK. The doctorate in Clinical Laboratory Science: Enhanced quality for health care. *Clin Lab Sci* 2008;21(1):5-6. 5
- Leibach EK. The doctorate in Clinical Laboratory Science: CLS education beyond the baccalaureate. *Clin Lab Sci* 2008;21(2):78-81.
- Leibach EK. The doctorate in Clinical Laboratory Science: The executive summary. *Clin Lab Sci* 2008;21(3):134-137.
- Leibach EK. The doctorate in clinical laboratory science: A view of clinical practice development. *Clin Lab Sci* 2008;21(4):196-198.
- Leibach EK. Evidence based practice in CLS education. *Clin Lab Sci* 2010;23(3)Suppl, 2.
- Leibach, E. K. (2018). Implementation of the Diagnostics Consultation Model@ provides clinical decision support, reduces medical errors, and improves health outcomes (PhD. *Doctoral dissertation in progress*). Virginia Commonwealth University, Richmond, Virginia.
- Leibach, E., **Fydryszewski, N.** Evidence from Consultation Defines the Difference Between Clinical Doctorates and the Ph.D. in Clinical Laboratory Science. *Clinical Laboratory Science*, April 2019, ascls.119.001503; DOI: <https://doi.org/10.29074/ascls.119.001503>.
- Leibach, E., **Fydryszewski, N.**, Gunsolus, B. Implementation of a Diagnostics Consultation Service Improves Health Outcomes. *Clinical Laboratory Science*, April 2019, ascls.119.001495; DOI: <https://doi.org/10.29074/ascls.119.001495>
- Miyakis S, Karamanof G, Lontos M, al e. Factors contributing to inappropriate orders of tests in an academic medical department and the effect of an education feedback strategy. *Postgraduate Medical Journal*. 2006;82:823-829.
- Nadder T. The Development of the Doctorate in Clinical Laboratory Science in the US. *The Journal of the International Federation of Clinical Chemistry and Laboratory Medicine* Vol 24 No1. [http://www.ifcc.org/media/224753/07\\_Nadder.pdf](http://www.ifcc.org/media/224753/07_Nadder.pdf)
- Taylor, JR., et al. (2017). Opportunities to Enhance Laboratory Professionals' Role On the Diagnostic Team. *Laboratory Medicine*, Volume 48, Issue 1, 97-103.
- Advanced Practice: Doctorate in Clinical Laboratory Science. The American Society for Clinical Laboratory Science. <https://www.ascls.org/position-papers/178-advanced-practice-doctorate-in-clinical-laboratory-science/154-advanced-practice-doctorate-in-clinical-laboratory-science>. Published August 2016.
- The Importance of Interprofessional Practice and Education in the Era of Accountable Care. Nestor, Jane, DRPH. *NCMJ*. March-April 2016; 77(2):128-132.
- Interprofessional collaboration: three best practice models of interprofessional education. [Diane R. Bridges](#), MSN, RN, CCM,<sup>1,\*</sup> [Richard A. Davidson](#), MD, MPH,<sup>2</sup> [Peggy Soule Odegard](#), PharmD, BCPS, CDE, FASCP,<sup>3</sup> [Ian V. Maki](#), MPH,<sup>3</sup> and [John Tomkowiak](#), MD, MOL<sup>4</sup>. *Med Educ Online*. 2011; 16: 10.3402/meo.v16i0.6035. Published online 2011 Apr 8.
- Teamwork in Health Care: Maximizing Collective Intelligence via Inclusive Collaboration and Open Communication. Anna T. Mayo, MS and Anita Williams Woolley, PhD. *AMA J Ethics*. 2016;18(9):933-940. doi: 10.1001/journalofethics.2016.18.9.stas2-1609
- National Center for Educational Statistics. U.S. Department of Education. Retrieved August 2019. <https://nces.ed.gov/ipeds/report-your-data/data-tip-sheet-reporting-graduate-awards>
- Middle States Commission on High Education Degrees and Credits, 2006.