به نام خدا

مدیریت بهره وری تست

اول مرداد ماه 1403

تالار زیتون- دانشگاه علوم پزشکی اصفهان

دکتر جلال راستی

Clinical and surgical pathologist

مدیریت بهره وری

- **Utilization management (UM)** in the context of medical laboratory requests involves a **systematic approach** to ensure that laboratory tests are used ***appropriately, efficiently, and effectively***. It aims to optimize patient care by ensuring that the right tests are ordered for the right patients at the right time, while also controlling costs and reducing unnecessary testing.

Objectives of Utilization Management

- 1. Ensure **Appropriate Test** Ordering:
- - Avoid unnecessary tests that do not contribute to patient care.
- - Promote the **use of evidence**
- -based guidelines for test ordering.
- 2. Improve **Patient Outcomes:**
- - **Enhance the accuracy** of diagnoses.
- - **Reduce delays** in diagnosis and treatment by ensuring timely testing.

Objectives of Utilization Management

- 3. Control :**Costs: کنترل هزینه**

- **Reduce healthcare costs (کاهش هزینه)** by eliminating redundant and unnecessary tests.

- Allocate resources **(منابع)** more efficiently within the healthcare system.

- 4. **Enhance Laboratory Efficiency: کارایی**

- Optimize laboratory operations and workflow. **(گردش کار)**

- Ensure that laboratory resources are used for tests that provide the most clinical value. **(بهترین استفاده از منابع ازمایشگاه)**

Components of Utilization Management

اجزا

- 1. Guidelines and Protocols: دستورالعمل ها
- Development and implementation of clinical guidelines for test ordering based on the latest evidence and best practices.

ته‌یه و به کارگی‌ری راهنمای بالی‌نی برای درخواست تست بر پای‌ه به روز تری‌ن شواهد و بهتری‌ن عملکرد

- Protocols for **common conditions** and **diagnostic pathways** to standardize test ordering. **پروتکل برای مواد بالی‌نی شای‌ع جهت استاندارسازی درخواست ها**
- 2. Education and Training: آموزش و پرورش
- - Educating healthcare providers on appropriate test ordering practices.
- - Continuous professional development to keep staff **updated on new guidelines and technologies.**

Components of Utilization Management
اجزا

- 3. **Decision Support Tools**: **ابزار حمایت و تایید تصمیم گیری**

- Implementation of **computerized physician order entry (CPOE) systems** with integrated **clinical decision support (CDS)** to guide test ordering.

- **Alerts and reminders** هشدار و یادآوری for healthcare providers about **appropriate testing**.

- 4. **Audit and Feedback:** ممیزی وباز خورد

- - **Regular auditing** of test ordering **pattern**s to identify areas of **overuse or underuse.**

- **Providing feedback** to clinicians on their test ordering practices compared to benchmarks or guidelines.

Components of Utilization Management

اجزا

- 5. Prior Authorization:

- Requiring **pre-approval** for certain **high-cost or high-volume** tests to ensure they are **medically necessary.**

- Involvement of **UM specialists or committees** in reviewing and approving test requests.

- 6. Review and Analysis:

- **Continuous monitoring** and analysis of test utilization data to identify **trends** and areas for improvement.

- - Use of **metrics** such as **test utilization rates**, **cost per test**, and test turnaround times to assess performance.

Implementation Strategies
پیاده سازی

- 1. **Multidisciplinary Approach**: رویکرد چند رشته ای
- Involving **various stakeholders**, including clinicians, laboratory staff, administrators, and UM specialists, in developing and implementing UM strategies.
- 2. Customization: سفارشی سازی
- - Tailoring **UM programs** to the **specific needs** and context of the healthcare facility or system.
- - Considering the unique **patient population**, available **resources**, and **clinical practices**.
- 3. Engagement and Collaboration: مشارکت و همکاری
- - **Engaging healthcare providers** in the development and refinement of UM programs to **ensure buy-in and compliance**. - Collaborating with other departments and services to integrate UM practices into **overall patient care processes**.

Implementation Strategies
پیاده سازی

4. **Technology and Informatics**: - Leveraging electronic health records (EHRs), laboratory information systems (LIS), and data analytics to **support UM efforts**.

- Using technology to streamline test ordering, monitoring, and reporting.

Challenges and Considerations
چالش ها و ملاحظات

- 1. Provider **Resistance:** - Overcoming resistance from **clinicians** who may view UM as a **restriction** on their clinical autonomy.
- - **Addressing concerns** رسیدگی به نگرانی ها about the potential impact on patient care and workflow.
- 2. Data Quality and Accessibility:

- Ensuring the availability of high-quality, comprehensive **data** to **support UM activities**.

- Integrating data from various sources and systems for a holistic view of test utilization. ادغام داده ها

Example of Guidelines and Protocols for Utilization Management

- Guideline Example: Ordering of **Thyroid Function Tests**
- **Objective:** To ensure **appropriate** use of thyroid function tests (TFTs) to diagnose and manage thyroid disorders.
- Scope محدوده : All healthcare providers involved in **ordering and interpreting** thyroid function tests.

Example of Guidelines Recommendations:

- **1. Initial Testing:**
- - **Suspected Hypothyroidism**: Order Thyroid Stimulating Hormone (TSH) as the initial test.
- - **Suspected Hyperthyroidism**: Order TSH and Free Thyroxine (Free T4) as **initial tests**.
- **2. Follow-Up Testing**:
- - Abnormal TSH Result:
- - Low TSH: Order Free T4 and Total Triiodothyronine (T3).
- - High TSH: Confirm with Free T4.
- - Normal TSH with Symptoms: Consider other causes and evaluate the need for additional testing based on clinical presentation

Example of Guidelines

- 3. **Monitoring Therapy: پایش درمان**
- - Hypothyroidism: - Monitor **TSH every 6-8 weeks** after starting or changing dosage of thyroid hormone replacement therapy.
- - Hyperthyroidism: - Monitor TSH and Free T4 **every 4-6** weeks after starting or changing antithyroid therapy.
- 4. **Non-Indicated Testing**:
- - Avoid routine testing of Free T3 in hypothyroidism without specific indications.
- - **Avoid frequent TFTs** in stable patients with normal results.
- 5. **Special Situations:**
- - Pregnancy: Adjust TSH reference ranges and monitor.
- - Amiodarone or Lithium Therapy: Regular monitoring of TSH and Free T4.

Implementation

- - **Education**: Educate healthcare providers on these guidelines through seminars, online modules, and reminders in the electronic health record (EHR) system.
- - Audit and Feedback:
- Regularly **audit test ordering patterns** and provide feedback to clinicians.
- - **Decision Support**: Integrate these guidelines into the EHR system to prompt appropriate test ordering at the point ofcare

- ## Reference Site for Laboratory Guidelines Clinical Laboratory Improvement Amendments (CLIA) - Website: [Centers for Medicare & Medicaid Services (CMS) - CLIA](https://www.cms.gov/Regulations-and-Guidance/Legislation/CLIA) College of American Pathologists (CAP) - Website: [College of American Pathologists](https://www.cap.org) American Association for Clinical Chemistry (AACC) - Website: [AACC](https://www.aacc.org) National Institute for Health and Care Excellence (NICE) - Website: [NICE Guidelines](https://www.nice.org.uk) Clinical and Laboratory Standards Institute (CLSI) - We

concepts

Utilization management in the lab setting often includes the **concepts** of ***standing orders***, ***initial testing***, and a ***hospital formulary*** to **streamline and optimize** the use of laboratory resources.

Standing Orders

- Definition: Standing orders are **predefined sets of medical orders** that are **authorized** by a physician or other licensed healthcare provider. These orders are used to **streamline the process** of ***ordering tests, treatments, or medications*** for patients under specific conditions **without the need** for individual physician approval **each time.**

Implementation in the Lab Setting:

- 1. Standardized Protocols: **Standing orders** can be created for **routine tests** that need to be performed regularly, such as daily **blood glucose monitoring** for diabetic patients or routine **CBCs for patients on chemotherapy.**
- 2. **Efficiency**: They reduce the **administrative burden** حجم کاری on physicians and ensure **timely testing** به موقع , leading to faster diagnosis and treatment.
- 3. Examples: - Diabetes Management: Daily fasting **blood sugar** and HbA1c every three months.
- - Chronic Kidney Disease: **Monthly** creatinine and GFR tests.
- - Inpatient Monitoring: **Daily electrolytes** for patients on IV fluids.

Initial Testing

- Definition: Initial testing refers to the **first set of laboratory tests** ordered to evaluate a patient's condition or diagnose a suspected disease. It serves as a **baseline** for further testing and treatment
- . Implementation in the Lab Setting:
- 1. Diagnostic Protocols: **Hospitals develop protocols** for initial testing based on **common symptoms** or **clinical presentations** to ensure **consistency** and adherence to **best practices**.
- 2. Examples: - **Suspected Infection**: CBC, blood cultures, urinalysis, and C-reactive protein (CRP). **- Chest Pain**: Cardiac enzymes (troponin), ECG, and complete metabolic panel (CMP). - **Abdominal Pain:** CBC, liver function tests (LFTs), lipase/amylase, and urinalysis

Hospital Formulary

- **Definition**: A hospital formulary is a continually updated list of medications, tests, and treatments that
- are **approved** for use within the hospital.
- It serves as a **guideline** for healthcare providers to ensure that the **most effective and cost-efficient** options are used

Implementation in the Lab Setting: formulary

- 1. **Selection Criteria**: Tests included in the formulary are selected based on ***clinical efficacy, safety, cost-effectiveness, and available evidence.***
- 2. **Review and Update**: The formulary is **regularly reviewed and updated** by a committee that includes laboratory directors, physicians, pharmacists, and other stakeholders.
- 3. Examples: - Routine Tests: CBC, CMP, urinalysis, basic metabolic panel (BMP). - Specialized Tests: Genetic testing, specific biomarkers (e.g., PSA for prostate cancer), and infectious disease panels.
- 4. Cost Management: Helps control costs by limiting the use of expensive tests to cases where they are clinically indicated.

Integration and Workflow

- 1. **Clinical Decision Support Systems (CDSS):** - Integrates with the electronic health record (EHR) to provide **real-time guidance on test ordering. –**
- **Alerts and reminders** for appropriate test utilization based on patient's condition and existing guidelines.
- 2. **Education and Training**: - Regular training sessions for healthcare providers on the appropriate use of standing orders, initial testing protocols, and formulary adherence. - Educational materials and updates on new guidelines or changes to the formulary.

Integration and Workflow

- 3. **Audit and Feedback**: - **Regular auditing** of test ordering patterns to identify deviations from established protocols. –
- **Providing feedback to healthcare providers** to encourage adherence to guidelines and improve test utilization practices.

Example Protocol for Initial Testing in Suspected Sepsis

- 1. **initial testing Orders**: - Immediate blood cultures (two sets from different sites). - CBC with differential. - CMP including liver and kidney function tests. - Lactate level. - C-reactive protein (CRP) and procalcitonin. - Urinalysis and urine culture if urinary source is suspected.
- 2. **Formulary Adherence**: - Ensure that only **approved tests** are ordered unless specific clinical indications suggest otherwise. - Use of **predefined panels for suspected sepsis** to streamline the process and avoid unnecessary tests

Conclusion

- Utilization management in the laboratory setting, through the use of **standing orders, initial testing protocols, and a hospital formulary,** plays a critical role in optimizing patient care.
- It **ensures** that laboratory **resources are used efficiently** and effectively, promotes evidence-based practice, and helps control healthcare costs.
- Implementing these concepts requires collaboration among various stakeholders, continuous education, and regular monitoring and feedback to maintain adherence and improve outcomes

Evidence-based guidelines for test ordering in laboratory utilization

- Evidence-based guidelines for test ordering in laboratory utilization are crucial for ensuring that tests are used effectively and efficiently, minimizing unnecessary testing, reducing costs, and improving patient outcomes. Here are some key aspects:

Key Aspects of Evidence-Based Guidelines

1. Clinical Indications: - Tests should be ordered based on specific clinical indications and patient symptoms. - Guidelines often provide a **list of indications** for when a particular test is appropriate.

2. Diagnostic Algorithms: - Use diagnostic algorithms to determine the sequence of tests. - These algorithms help in narrowing down diagnoses and guiding the next steps in patient management.

Key Aspects of Evidence-Based Guidelines

3.Choosing Wisely Campaigns: - Initiatives like the Choosing Wisely campaign provide recommendations on **avoiding overuse** of certain tests. - These recommendations are based on evidence and expert consensus to promote high-value care

- 4. Guideline Development: - Guidelines are developed through systematic reviews of the literature and expert consensus. -.

Key Aspects of Evidence-Based Guidelines

- 5. Clinical Decision Support (CDS) Systems: - Integration of CDS systems in electronic health records (EHRs) to provide real-time guidance on test ordering.
- - CDS systems use evidence-based guidelines to **alert clinicians to unnecessary tests or suggest appropriate alternatives**
- 6. Regular Review and Updates: - Guidelines need to be regularly reviewed and updated based on new evidence and technological advancements. - This ensures that the guidelines remain relevant and effective.

Benefits -

- **Cost Reduction**: Minimizes unnecessary testing, leading to significant cost savings for healthcare systems and patients. - Improved Patient Care: Reduces patient exposure to unnecessary procedures and potential harm.
- - Efficient Use of Resources: Helps in the efficient use of laboratory and healthcare resources.
- - **Consistency in Care**: Provides a standardized approach to test ordering, leading to consistent patient care.

Examples of Evidence-Based Guidelines

- - **Cardiac Biomarkers**: Guidelines recommend specific scenarios for ordering cardiac biomarkers like troponins, such as in cases of suspected acute coronary syndrome.
- - Vitamin D Testing: Recommendations to limit testing to patients with risk factors for deficiency rather than routine screening. - ------ Imaging for Back Pain: Guidelines advise against imaging for acute low back pain unless there are red flags for serious conditions

Implementation Strategies Evidence-Based Guidelines

- - Education and Training: Regular training sessions for healthcare providers on the latest guidelines.
- - Audit and Feedback: Regular audits of test ordering practices and feedback to providers to improve compliance with guidelines.
- . By following evidence-based guidelines for test ordering, healthcare providers can enhance the quality of care, reduce unnecessary interventions, and ensure the sustainable use of healthcare resources

Surveillance of test ordering

- Surveillance of test ordering in hospital practice, particularly focusing on physician profiles, is essential for identifying trends,
- ensuring adherence to guidelines, and promoting efficient resource utilization.

Surveillance of test ordering

- 1. Electronic Health Records (EHRs):
- - Data Collection: Use EHRs to systematically collect data on test orders from physicians.
- –.Integration with CDSS: Incorporate Clinical Decision Support systems to provide real-time feedback on test ordering.
- - Analytics: Use EHR analytics to monitor ordering patterns and compare them against guideline

Surveillance of test ordering

- 2. Dashboards and Reporting Tools:
- - **Real-Time Monitoring**: Implement dashboards that provide real-time data on test ordering.
- - **Customizable Reports**: Generate reports by physician, department, or test type to identify outliers and trends.
- - **Benchmarking**: Compare individual physician profiles against institutional benchmarks and best practices.

Surveillance of test ordering

- 3. Utilization Review Committees:
- - Regular Meetings: Establish committees that meet regularly to review test utilization data.
- - Peer Review: Conduct peer reviews to discuss cases of overuse or underuse of tests.
- - Action Plans: Develop action plans for physicians who consistently deviate from guidelines.

Surveillance of test ordering

- 4. **Education and Feedback**:
- - Educational Sessions: Conduct regular educational sessions on evidence-based test ordering.
- - Feedback Mechanisms: Provide individual feedback to physicians, highlighting areas for improvement and acknowledging adherence to guideline

Surveillance of test ordering

- 5. Audit and Feedback Programs:
- - Periodic Audits: Perform regular audits of test ordering patterns. - Personalized Feedback: Give personalized feedback to physicians based on audit results.
  - - Follow-Up: Implement follow-up actions for continuous improvement

Surveillance of test ordering

- 6. Automated Alerts and Notifications:
- - **Rule-Based Alerts**: Set up automated alerts in EHRs for tests that are frequently overused.
- - Notification Systems: Use notification systems to remind physicians of guidelines at the point of care

Quantitative Indices for Evaluation

- 1. **Test Utilization Rate** - Definition: The number of lab tests ordered per 1,000 patient visits or admissions. Goal: Track the trend over time to identify reductions in unnecessary testing.
- 2. Redundant Test Rate - Definition: The percentage of lab tests that are repeated unnecessarily within a specified timeframe. - - Goal: Reduce the rate of redundant testing by implementing and monitoring policies.
- 3. **Inappropriate Test Rate** - Definition: The percentage of lab tests ordered without clinical justification. - Goal: Decrease the rate of inappropriate tests through education and decision support tools.
- 4. **Test Cancellation Rate** - Definition: The percentage of lab tests that are ordered but later canceled. - - Goal: Lower the cancellation rate by improving the accuracy of initial test ordering.
- 5. Turnaround Time (TAT) - Definition: The average time taken from ordering a lab test to receiving the result. - - Goal: Improve TAT by streamlining processes and reducing bottlenecks.
- 6. Cost per Test - Definition: The average cost associated with each lab test, including direct and indirect costs. Goal: Reduce the cost per test by optimizing test utilization and negotiating better pricing with suppliers.
- 7. **Compliance Rate with Guidelines** - Definition: The percentage of lab tests ordered that adhere to established clinical guidelines. Goal: Increase compliance with guidelines through provider education and decision support.
- 8. **Patient Satisfaction Scores** - Definition: The average satisfaction score from patients regarding their experience with lab testing. - - Goal: Improve patient satisfaction by enhancing the efficiency and communication related to lab tests.

Implementation Process

- 1. Stakeholder Engagement: - Involve Key Stakeholders: Engage physicians, laboratory staff, IT personnel, and administration in planning and implementation. - Collaboration: Foster a collaborative environment to ensure buy-in and cooperation.
- 2. Pilot Programs: - Start Small: Implement pilot programs in select departments or with a subset of tests. - Evaluate and Scale: Evaluate the pilot program's effectiveness before scaling it hospital-wide.
- 3. Continuous Improvement: - Monitor and Adjust: Continuously monitor the effectiveness of surveillance efforts and make adjustments as needed. - Iterative Feedback: Use iterative feedback loops to refine processes and guidelines.
- 4. Compliance and Accountability: - Set Clear Policies: Establish clear policies for test ordering and compliance. - Accountability Measures: Implement accountability measures for non-compliance, such as mandatory training or performance reviews

Clinical Decision Support System (CDSS)

- Overview A Clinical Decision Support System (CDSS) is a technology designed to assist healthcare professionals in making clinical decisions by integrating and analyzing vast amounts of data within electronic health records (EHRs).
    - کمک به درمانگر برای تصمیم گیری صحیح بر اساس تجمیع انبوه اطلاعات بالینی و پاراکلینکی
- CDSS provides real-time feedback and recommendations based on evidence-based guidelines, patient data, and clinical algorithms

clinical Decision Support System (CDSS) Overview

- 1. Alerts and Reminders: - **Real-Time Alerts**: Notify clinicians about potential issues, **such as drug interactions, allergies**, or **critical lab** values. - **Reminders**: Prompt clinicians to **order necessary tests** or screenings based on patient-specific data and guidelines.
- 2. Order Sets and Protocols:
- - **Standardized** Order Sets: Provide pre-configured sets of orders for **common conditions**, ensuring adherence to best practices.
- - Clinical Pathways: Guide clinicians through **standardized care pathways** for **specific diagnoses**, helping to **streamline decision-making**.
- 3. **Diagnostic Support**: - Differential Diagnosis: Suggest possible diagnoses based on patient symptoms, history, and lab results.
- - **Risk Assessment**: Calculate risk scores for conditions like sepsis or cardiovascular events, aiding in early **identification and intervention**

Examples of CDSS in Practice

- 1. Sepsis Alert System: - Real-Time Alerts: A CDSS monitors vital signs, lab results, and clinical notes for signs of sepsis, providing real-time alerts to clinicians. - Impact: Early detection of sepsis can significantly reduce mortality rates by prompting timely interventions.
- 2. Antibiotic Stewardship Programs:
- - Guideline Adherence: The CDSS recommends appropriate antibiotic choices and durations based on current guidelines and patient-specific factors.
- - Impact: Reduces the **overuse and misuse of antibiotics**, combating antibiotic resistance

clinical Decision Support System (CDSS) Overview

- 4. Therapeutic Suggestions: - Medication Recommendations: Provide suggestions for drug dosing, alternatives, and adjustments based on patient-specific factors like age, weight, and renal function. - Guideline-Based Treatment Plans: Offer treatment recommendations that align with current clinical guidelines and evidence-based practices.
- 5. Documentation Support: - Template and Form Auto-Population: Automatically populate templates and forms with relevant patient data to streamline documentation and ensure completeness. - Clinical Note Suggestions: Assist with generating clinical notes based on patient data and standard templates

Benefits of CDSS

- - Improved Patient Outcomes: نتیجه بخشی برای بیمارEnhances the quality of care by promoting adherence to evidence-based guidelines and best practices.
- - **Increased Efficiency**: افزایش کاراییStreamlines clinical workflows, reducing the time spent on documentation and decision-making.
- - **Reduced Errors** کاهش خطاها: Minimizes the risk of errors related to medication dosing, test ordering, and diagnosis.
- - **Cost Savings**: صرفه جویی هزینه Reduces unnecessary tests and treatments, leading to cost savings for healthcare systems and patient

Implementation Considerations: CDSS

1 .Integration with EHR: Seamless integration with existing EHR systems is crucial for the CDSS to function effectively. ارتباط یا پرونده سلامت

- 2. User-Friendly Interface: The system should have an intuitive interface to ensure **high adoption** rates among clinicians. مقبولیت
- 3. Regular Updates: Continuous updates are necessary to incorporate the latest clinical guidelines and evidence.
- 4. Training and Support: Ongoing training and support for clinicians are essential to maximize the system’s benefit

Example Implementation in a Hospital

- one hospital implemented a CDSS integrated with their EHR system. The CDSS provides:
- - Medication Safety Alerts: Real-time alerts for potential drug interactions, allergies, and dosing errors.
- - Sepsis Detection: Continuous monitoring of patient data to identify early signs of sepsis, triggering alerts and recommendations for immediate intervention.
- - Chronic Disease Management: Tools for managing chronic conditions like **diabetes and hypertension**, providing personalized care plans and monitoring adherence.
- **- Imaging Appropriateness**: Recommendations for appropriate imaging studies based on clinical guidelines, reducing unnecessary tests.
- The implementation of CDSS at Hospital ABC has resulted **in a 20% reduction in medication errors, a 15% improvement in chronic disease management outcomes, and a 10% decrease in unnecessary imaging tests.**

Role of Clinical Decision Support System (CDSS

- Role of Clinical Decision Support System (CDSS) in Test Selection and Laboratory Utilization Management:
- Clinical Decision Support Systems (CDSS) play a pivotal role in **optimizing test selection and managing laboratory utilization**. By integrating **evidence-based guidelines and real-time patient data**, CDSS can enhance decision-making processes, ensuring appropriate and efficient use of laboratory resources. Here's how CDSS contributes to these areas

Role of Clinical Decision Support System (CDSS

Test Selection

- 1. Evidence-Based Recommendations: - Guideline Integration: CDSS incorporates current clinical guidelines and best practices into the decision-making process, helping clinicians choose the most appropriate tests based on specific patient conditions.
- - Condition-Specific Recommendations: For example, the system might recommend ordering a D-dimer test only if the pre-test probability of a pulmonary embolism is moderate to high.
- 2. Diagnostic Algorithms: - Sequential Testing: CDSS can guide clinicians through a series of tests in a logical order, ensuring that each test is clinically indicated based on previous results.
- - Example: In the case of thyroid dysfunction, the CDSS might recommend starting with TSH testing, followed by free T4 or T3 tests if TSH levels are abnormal.

Role of Clinical Decision Support System (CDSS Test Selection

- 3. **Personalized Test Selection**:
- - **Patient-Specific Factors**: The system takes into account patient-specific factors such as **age, gender, medical history**, and current medications, tailoring test recommendations accordingly.
- - Example: A CDSS may suggest different screening tests for cardiovascular risk in patients with diabetes compared to those without.

Test Selection

- 4. Reducing Redundancy: درخواستهای زاید
- - **Duplicate Testing Alerts**: CDSS can alert clinicians if a test has already been performed recently, reducing unnecessary repeat testing.
- - Example: If a patient had a complete blood count (CBC) performed within the last 24 hours, the CDSS can alert the clinician to avoid ordering it again unless clinically necessary.

Laboratory Utilization Management

- 1. Cost-Effective Testing: - Cost Awareness: The CDSS can provide information on the cost-effectiveness of different tests, promoting the selection of cost-effective alternatives without compromising patient care.

- Example: Suggesting the use of a basic metabolic panel (BMP) instead of a comprehensive metabolic panel (CMP) if additional tests in the CMP are not clinically indicated.

- 2. Utilization Metrics and Monitoring: پایش از طریق سنجه ها
- - Dashboard and Reports: CDSS tools can generate dashboards and reports that track test ordering patterns, utilization rates, and compliance with guidelines.
- - Example: Regular reports showing the frequency of certain high-cost tests and identifying outliers among physicians or departments.
-

Laboratory Utilization Management

- 3. **Audit and Feedback**: ممیزی
- - Performance Feedback: Provide feedback to clinicians based on their test ordering patterns, highlighting areas of overuse or underuse.
- - Example: Monthly performance reviews for clinicians, showing **adherence** to recommended test guidelines and suggesting areas for **improvement.**
- 4. **Clinical Decision Rules:**
- - Embedded Rules: Embed clinical decision rules within the EHR to automatically trigger alerts and recommendations based on specific patient data.
- - Example: An embedded rule might alert a clinician to consider ordering an A1C test for a patient with newly diagnosed hypertension to check for diabetes

Role of Clinical Decision Support System (CDSS Test Selection

- 1. **Evidence-Based Recommendations**:
- - Guideline Integration: CDSS incorporates current **clinical guidelines** and best practices into the decision-making process, helping clinicians choose the most appropriate tests based on specific patient conditions.
- - **Condition-Specific Recommendations**: For example, the system might recommend ordering a D-dimer test only if the pre-test probability of a pulmonary embolism is moderate to high.

Role of Clinical Decision Support System (CDSS Test Selection

- 2. **Diagnostic Algorithms**:
- - Sequential Testing: CDSS can guide clinicians through a series of tests in a logical order, ensuring that each test is clinically indicated based on previous results.
- - Example: In the case of thyroid dysfunction, the CDSS might recommend **starting with TSH testing**, followed by free T4 or T3 tests if TSH levels are abnorma

Role of Clinical Decision Support System (CDSS ### Test Selection

- 3. Personalized Test Selection: -
- Example: A CDSS may **suggest different screening tests** for cardiovascular risk in patients with diabetes compared to those without.
- 4. Reducing Redundancy: -
- - Example: If a patient had a **complete blood count (CBC)** performed within the last 24 hours, the CDSS can alert the clinician to avoid ordering it again unless clinically necessary

نمونه اجرا

Hospital XYZ implemented a CDSS to **enhance test selection and laboratory utilization**:

- - Test Appropriateness Alerts هشدار تناسب تست : When ordering a test, the CDSS cross-references the **patient's clinical data** with evidence-based guidelines. مقایسه دلده های بالینی بیمار با گاید لاین ها :
- For instance, if a physician attempts to order a **brain natriuretic peptide (BNP) test** for a patient without signs of heart failure, the system provides an alert suggesting the test may not be necessary.– ordering practice
- **هشدار عدم نی‌از انجام تست ناتری‌ورتی‌ک پپتی‌د برای بی‌مار فاقد علایم نارسای قلب**

Types of Computer-Assisted Order Entry Rules

- 1. **Duplicate Test Alerts**: - **Rule**: If a lab test has already been ordered within a specified time frame, alert the clinician. - **Pop-up**: "This test was performed on [Date]. Are you sure you want to reorder?“

- 2. **Frequency Limitation Rules**: - **Rule**: Restrict certain tests to be ordered only once within a specific period. - **Pop-up**: "This test can only be ordered once every [X] days. Last ordered on [Date]."
- 3. **Guideline-Based Ordering**: - **Rule**: Ensure that lab orders adhere to clinical guidelines and best practices. - **Pop-up**: "According to [Guideline], this test is **not recommended** for [Condition/Scenario]. Please review."

Types of Computer-Assisted Order Entry Rules

- 4. **Cost-Effective Alternatives**:
- - **Rule**: Suggest **lower-cost or equally effective** alternative tests.
- - **Pop-up**: "Consider ordering [Alternative Test] which is more cost-effective and provides similar diagnostic value."
- 5. **Pre-Test** Requirements:
- - **Rule**: Verify if pre-test conditions (e.g., fasting) are met before allowing the order.
- - **Pop-up**: "Patient must fast for [X] hours before this test. **Confirm patient has fasted**."

Types of Computer-Assisted Order Entry Rules

- **6.Critical Value Alerts**: مقادیر بحرانی
- - **Rule**: Notify clinicians of critical values that require immediate attention.
- - **Pop-up**: "The previous result of [Test] on [Date] was critical. Please review before reordering."
- 7. **Redundant Panel Orders:**
- - **Rule**: Prevent ordering of panels that include tests already ordered separately.
- - **Pop-up**: "You have already ordered [Test] included in this panel. Consider removing redundant orders.“
- 8. **Age/Gender Specific Guidelines**:
- - **Rule**: Tailor test ordering based on patient age and gender-specific guidelines. - **Pop-up**: "For [Age/Gender], [Test] is recommended instead of [Ordered Test]."

Implementation of Pop-Up Reminders

- : 1. **Timing**: زمان مناسب - Ensure that pop-ups appear at logical points in the order entry process to avoid workflow disruption.
- 2. **Relevance**: - مرتبط Customize reminders to be relevant to the specific clinical context and patient data.
- 3. **Actionable Recommendations**: اقدام پذیر
- - Provide clear and actionable suggestions within the pop-ups. :

Implementation of Pop-Up Reminders

- 4**. Education**: دارای مستندعلمی
- - Include educational content when necessary to explain the rationale behind the reminders.
- 5. **Override Functionality**: امکان در نظر نگرفتن
- - Allow clinicians to override alerts with proper **justification** to maintain flexibility in patient care.
- Integrating these **rules** and reminders can **improve the accuracy** and appropriateness of lab test ordering, leading to better patient outcomes and more efficient use of healthcare resources.

Duplicate Ionized Calcium Order

Previous Ionized Calcium (4.7 mg/dl) was within normal reference interval on replaceDate1.
Repeat measurement is NOT indicated except in the following clinical scenarios:

- Dialysis or severe renal failure (eGFR <30)
- Abnormal heart rhythm
- Following multiple/massive blood transfusions
- During or post-apherisis

Replacement of calcium in critically ill patients with normal or moderately low ionized calcium levels is not associated with improved outcome. Repeat Serum Ionized Calcium measurement is not indicated more than every 24-48 hours in most hospitalized patients with normal levels.

How to Proceed:

To **cancel** the order select **"YES"** below. Then select the order from the patient's order profile and D/C (cancel) the order.

To proceed with the **order**, enter the indication in the text box below, and then click on **"NO"**.

If this alert is an error or you have questions send an email to micscds@mayo.edu

Click "YES" to cancel, click "No" and enter reason to proceed with order.

Please enter reason

Computer-Assisted Order Entry Rules for D-Dimer Testing

- : 1. **Pre-Test Probability Assessment**:
- - **Rule**: Ensure that a clinical pre-test probability assessment (e.g., Wells score for deep vein thrombosis or pulmonary embolism) is performed before ordering a D-dimer test.
- - **Pop-up**: "**Please complete the Wells** score assessment to determine the pre-test probability of **DVT/PE** before ordering the D-dimer test."
- 2. **Age-Adjusted D-Dimer Thresholds**:
- - **Rule**: Adjust D-dimer thresholds based on patient age to reduce false positives in older patients.
- - **Pop-up**: "**For patients over 50 years** old, consider age-adjusted D-dimer thresholds: [Age x 10] ng/mL."."

Computer-Assisted Order Entry Rules for D-Dimer Testing

- 3. **Clinical Indications**:
- - **Rule**: Verify appropriate clinical indications for D-dimer testing (e.g., suspected DVT/PE, disseminated intravascular coagulation).
- - **Pop-up**: "D-dimer testing is indicated for suspected DVT/PE or DIC. Please **confirm the clinical indication**."
- 4. **Recent Imaging or Testing**:
- - **Rule**: Prevent ordering D-dimer tests if recent imaging (e.g., ultrasound, CT angiography) or previous D-dimer testing has already provided **sufficient diagnostic information.**
- - **Pop-up**: "**A D-dimer test was performed on [Date**]. Consider if additional imaging or testing is necessary."
- 5. **Follow-Up on Positive D-Dimer Results**:
- - **Rule**: Ensure appropriate follow-up for positive D-dimer results, such as ordering confirmatory imaging studies.
- - **Pop-up**: "**Positive D-dimer results require follow-up imaging** to confirm diagnosis. Have you ordered the necessary imaging?"

Computer-Assisted Order Entry Rules for D-Dimer Testing

- 6. **Low Pre-Test Probability**:
- - **Rule**: **Discourage D-dimer** testing in patients with **low pre-test probability** of DVT/PE based on clinical scoring systems.
- - **Pop-up**: "Patients with low pre-test probability of DVT/PE based on [Scoring System] **may not benefit** from D-dimer testing. Please review the clinical assessment."
- 7. **Pregnancy Considerations**:
- - **Rule**: **Adjust interpretation** of D-dimer results in pregnant patients due to physiological increases in D-dimer levels.
- - **Pop-up**: "Pregnancy can elevate D-dimer levels. Consider **alternative diagnostic pathways or confirmatory tests**

Computer-Assisted Order Entry Rules for Troponin Testing

- 1. **Appropriate Indications**:
- - **Rule**: Ensure that troponin testing is ordered for appropriate clinical indications such as suspected **acute coronary syndrome (ACS) or myocardial infarction (MI).**
- - **Pop-up**: "Troponin testing is indicated for suspected ACS/MI. Please confirm the clinical indication."
- 2. **Repeat Testing Intervals**:
- - **Rule**: Enforce appropriate intervals for repeat troponin testing to **track trends over time.**
- - **Pop-up**: "The recommended interval for repeat troponin testing is [X] hours. Last test was performed [Y] hours ago. **Do you want to proceed with ordering?"**

Computer-Assisted Order Entry Rules for Troponin Testing

- 3. **Pre-Test Clinical Assessment**:
- - **Rule**: Require documentation of clinical assessment (e.g., chest pain characteristics, ECG findings) before ordering troponin.
- - **Pop-up**: "Please **document clinical assessment** (e.g., chest pain, ECG findings) before ordering troponin."
- 4. **Guideline-Based Ordering**:
- - **Rule**: Ensure compliance with guidelines for troponin testing in specific scenarios (e.g., low-risk chest pain).
- - **Pop-up**: "According to [Guideline], troponin testing may not be necessary for **low-risk chest pain**. Please review."
- 5. **Recent Testing Alert**:
- - **Rule**: Alert if troponin has been recently tested to avoid unnecessary repeat testing. - **Pop-up**: "Troponin was tested on [Date] with a result of [Value]. Are you sure you want to repeat the test?"

Computer-Assisted Order Entry Rules for Troponin Testing

- 6. **Critical Result Follow-Up**:
- - **Rule**: Ensure appropriate follow-up actions for **critical troponin** results.
- - **Pop-up**: "Previous troponin result was critical. Ensure **appropriate follow-up** actions are in place."
- 7. **Alternative Diagnoses**:
- - **Rule**: Suggest considering **alternative diagnoses** when troponin is being ordered for atypical indications.
- - **Pop-up**: "Consider alternative diagnoses for troponin elevation, such as **myocarditis or renal failure."**
- 8. **Age and Comorbidity Considerations**:
- - **Rule**: Adjust interpretation and ordering based on **age and comorbid conditions** that can affect troponin levels.
- - **Pop-up**: "Consider age and comorbid conditions (**e.g., renal failure**) which may affect troponin levels.

Formulary approach

- In the context of **medical diagnosis,** particularly for **complex presentations** like acute abdomen, using a formulary approach can often be **more effective than individual test requests**.

Advantages of a Formulary Approach for Acute Abdomen:

- 1. **Comprehensive Assessment**:
- - **Efficiency**: A formulary approach bundles a **set of tests** that cover a wide **range of potential diagnoses**, ensuring that important conditions are not missed.
- - **Systematic**: It provides a **systematic way** to evaluate the patient, minimizing the risk of **overlooking a critical test**.
- 2. **Standardization**:
- - **Guideline Adherence**: Ensures **adherence to clinical guidelines** and best practices, reducing variability in care.
- - **Consistency**: Offers **consistent evaluation** across different healthcare providers and settings, improving overall care quality.

Advantages of a Formulary Approach for Acute Abdomen

- 3. **Diagnostic Accuracy**:
- - **Broad Coverage**: **Covers a range of potential** causes of acute abdomen (e.g., infection, inflammation, obstruction, ischemia). - **Reduction of Omissions**: Reduces the likelihood of **missing a diagnosis** due to the omission of a crucial test.
- 4. **Cost-Effectiveness**:
- - **Resource Optimization**: Avoids **unnecessary tests** while ensuring necessary ones are included, optimizing resource use.
- - **Bundling Benefits**: Often, bundled tests can be more cost-effective than ordering multiple individual tests separately.

Key Components of a Formulary for Acute Abdomen

- : 1. **Basic Laboratory Tests**:
- - **Complete Blood Count (CBC)**: To check for infection, anemia, and other hematologic conditions.
- - **Electrolytes and Renal Function Tests**: To assess electrolyte imbalances and kidney function.
- - **Liver Function Tests (LFTs)**: To evaluate liver health and function. - **Amylase and Lipase**: To diagnose pancreatitis. 2. **Inflammatory Markers**: - **C-Reactive Protein (CRP**
- **) - Erythrocyte Sedimentation Rate (ESR)**
- 3. **Urinalysis**: - To detect urinary tract infections, hematuria, or other renal issues.

Key Components of a Formulary for Acute Abdomen

- 4. **Imaging Studies**:
- - **Ultrasound**: First-line imaging for many abdominal conditions, such as gallstones, appendicitis, and gynecological issues.
- - **Abdominal X-ray**: To detect bowel obstruction, perforation, or other acute conditions.
- - **CT Scan**: More detailed imaging for **complex cases** or when initial imaging is inconclusive.
- 5. **Specialized Tests**: - **Pregnancy Test**: For women of childbearing age to rule out ectopic pregnancy. - **Lactate**: To assess for ischemic bowel disease. - **Blood Cultures**: If sepsis is suspected.

Implementation of the Formulary Approach

- : 1. **Integration with CPOE Systems**:
- - **Order Sets**: **Create standardized order sets** for acute abdomen that can be easily selected within the CPOE system.
- - **Guideline Integration**: **Embed clinical guidelines** within the order sets to ensure they are evidence-based.
- 2. **Clinical Decision Support**:
- - **Pop-Up Reminders**: Use **pop-up reminders** to prompt clinicians to consider the formulary when evaluating a patient with acute abdomen.
- - **Educational Tools**: Include **links to guidelines** and educational resources within the CPOE system.

Implementation of the Formulary Approach

- 3. **Training and Education**:
- - **Clinician Training**: **Regular training sessions** for clinicians on the importance and use of the formulary approach.
- - **Feedback Mechanisms**: **Provide feedback** to clinicians on adherence to formulary protocols and patient outcomes.
- ### Conclusion: Using a formulary approach for the diagnosis of acute abdomen can **improve diagnostic accuracy**, **streamline the evaluation process, ensure adherence to guidelines, and optimize the use of healthcare resources**. This approach leverages comprehensive, standardized testing that can be more effective than individual test requests, especially in complex and potentially critical clinical scenarios.

Examples of Standard Order Sets

- : 1. **Diabetes Management** - Blood glucose level - HbA1c - Electrolytes (Sodium, Potassium, Chloride) - Renal function tests (BUN, Creatinine) - Lipid profile
- 2. **Chest Pain** - Cardiac enzymes (Troponin, CK-MB) - Electrolytes - Complete blood count (CBC) - Electrocardiogram (ECG) - Chest X-ray 3. **Sepsis** - Complete blood count (CBC) with differential - Blood cultures (aerobic and anaerobic) - Lactate - Procalcitonin - Comprehensive metabolic panel (CMP) - Urinalysis and urine culture
- .**Consistency and Standardization**: Ensures that all patients with a similar condition receive the same level of care. -

Examples of Standard Order Sets

- 4. **Preoperative Assessment** - Complete blood count (CBC) - Coagulation profile (PT/INR, aPTT) - Electrolytes - Renal function tests (BUN, Creatinine) - Liver function tests (LFTs) - Blood type and screen 5. **Chronic Kidney Disease (CKD) Monitoring** - Serum creatinine and eGFR - Urine albumin-to-creatinine ratio - Electrolytes - Hemoglobin - Calcium and phosphate - Parathyroid hormone (PTH)
- 6. **Pneumonia** - Complete blood count (CBC) with differential - Blood cultures - Sputum Gram stain and culture - Chest X-ray - Arterial blood gas (if respiratory distress is present) - C-reactive protein (CRP) or procalcitonin -

Benefits of Standard Order Sets in CDSS:

- **Efficiency**: Reduces the time clinicians spend on ordering tests individually.
- - **Guideline Adherence**: Promotes adherence to clinical guidelines and best practices.
- - **Reduction in** Unnecessary Testing: Helps to minimize redundant or unnecessary tests, improving cost-effectiveness.
- - **Improved Outcomes**: Facilitates early and accurate diagnosis and treatment, potentially improving patient outcomes. These standardized order sets can be integrated into the CDSS to assist clinicians in making informed, timely, and efficient decisions, thereby optimizing patient care and resource utilization in hospital laboratory services.