

Master of Public Health

Applied Practice Experience

Improving Clinical Laboratory Safety Knowledge Through Multi-Modal Interventions

by

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MASTER OF PUBLIC HEALTH

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Chapter 1 - Portfolio Products

The Applied Practice Experience (APE) was completed at Irwin Army Community Hospital within the Department of Pathology and Laboratory Services. The goal of this project was to improve safety knowledge and practices within the clinical laboratory environment through the development of structured, evidence-based educational tools and resources. This initiative focused on fostering a proactive culture of safety, enhancing regulatory compliance, and ensuring that all laboratory personnel possess the knowledge, skills, and competencies necessary to maintain a safe, high-reliability work environment.

This project aligned with key public health competencies by addressing workforce development, occupational health, and systems-based approaches to quality and safety. It emphasized the intersection between environmental health, health education, and leadership, promoting sustainable improvements in laboratory safety performance and culture.

Portfolio products detailed in Table 1.1 summarize the major deliverables completed during the APE. Each product demonstrates integration of Master of Public Health (MPH) Foundational and Emphasis Area Competencies, as detailed in Table 1.2, and the complete products are attached as appendices to the Integrated Learning Experience (ILE) Final Report.

Table 1.1 Summary of Portfolio Products

Portfolio Product		Description
1	Laboratory Safety Competency Survey	Developed and implemented a comprehensive survey instrument to evaluate the safety knowledge of clinical laboratory professionals across core domains (biosafety, chemical safety, equipment use, emergency response, and waste management). The survey provided baseline data to identify knowledge gaps, assess training effectiveness, and prioritize targeted safety interventions.
2	Safety Signage and Fact Sheets	Designed visually engaging safety signage and fact sheets covering critical laboratory safety topics. These materials were

		displayed throughout the laboratory to reinforce key safety practices, increase awareness, and promote a culture of continuous safety engagement through just-in-time reminders.
3	Clinical Laboratory Safety Curriculum	Developed a comprehensive written laboratory safety curriculum designed to meet regulatory standards from CLIA, CAP, OSHA, CDC, EPA, and The Joint Commission. The curriculum outlines 15 instructional modules with defined learning objectives, regulatory citations, assessments, and competency verification tools. It serves as a foundational framework for onboarding, annual retraining, and inspection readiness within the clinical laboratory.
4	Sample Hospital-Wide Safety Topic Presentations	Created a sample PowerPoint-based safety education presentation on key clinical laboratory safety topics. This material was designed for hospital leadership to distribute as part of existing monthly safety communication. The intent was to support leadership in maintaining consistent safety messaging, reinforce awareness across departments, and align content with hospital-wide safety priorities.
5	Report: Safety Training Recommendations for Leadership	Compiled a formal report for laboratory and hospital leadership summarizing survey findings, training outcomes, and data-driven recommendations for continuous improvement. The report outlined strategies to sustain competency, enhance compliance with CLIA, CAP, OSHA, and

		The Joint Commission standards, and strengthen the hospital's overall safety culture.
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Table 1.2 Portfolio Products and Competency Addressed

Portfolio Product		Number and Competency Addressed	
1	Laboratory Safety Competency Survey	1	Apply epidemiological methods to settings and situations in public health practice.
		2	Select quantitative and qualitative data collection methods appropriate for a given public health context.
		3	Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.
		4	Interpret results of data analysis for public health research, policy, or practice.
		7	Assess population needs, assets, and capacities that affect communities' health.
		9	Design a population-based policy, program, project, or intervention.
		11	Select methods to evaluate public health programs.
		15	Evaluate policies for their impact on public health and health equity.
2	Safety Signage and Fact Sheets	21	Integrate perspectives from other sectors and/or professions to promote and advance population health.
		3	Analyze quantitative and qualitative data using informatics.
		5	Compare the organization, structure and function of health care, public health, and regulatory systems.
		8	Apply awareness of cultural values and practices to the design, implementation, or critique of public health policies or programs.
		13	Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes.

		18	Select communication strategies for different audiences and sectors.
		19	Communicate audience-appropriate public health content, both in writing and through oral presentation.
		20	Describe the importance of cultural competence in communicating public health content.
3	Clinical Laboratory Safety Curriculum	2	Select quantitative and qualitative data collection methods appropriate for a given public health context.
		5	Compare the organization, structure and function of health care, public health, and regulatory systems.
		7	Assess population needs, assets and capacities that affect communities' health.
		9	Design a population-based policy, program, project or intervention.
		11	Select methods to evaluate public health programs.
		13	Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes
		16	Apply leadership and/or management principles to address a relevant issue.
		20	Describe the importance of cultural competencies in communicating public health content.
4	Monthly Hospital-Wide Safety Topic Presentations and Quizzes	21	Integrate perspectives from other sectors and/or professions to promote and advance population health.
		12	Discuss multiple dimensions of the policy-making process.
		13	Propose strategies to build partnerships for influencing outcomes.
		14	Advocate for political, social or economic policies that improve health.
		16	Apply leadership or management principles.
		18	Select communication strategies for different audiences.
		19	Communicate audience-appropriate (i.e., non-academic, non-peer audience) public health content, both in writing and through oral presentation.
		21	Integrate perspectives from other sectors.

5	Safety Training Recommendation Report to Leadership for Laboratory Staff	5	Compare the structure and function of health care and public health systems.
		12	Discuss the policy-making process, including ethics and evidence.
		13	Propose strategies to build coalitions and partnerships.
		14	Advocate for political, social or economic policies to improve health.
		15	Evaluate policies for their impact on health and equity.
		16	Apply leadership and management principles.
		17	Apply negotiation and mediation skills.
		21	Integrate perspectives from other sectors.
		22	Apply a systems thinking tool.

Chapter 2 - Competencies

The Master of Public Health (MPH) program at Kansas State University includes 22 foundational competencies within seven major topic areas. Foundational competencies cover evidence-based approaches to public health, public health and health care systems, planning and management to promote health, policy in public health, leadership, communication, interprofessional practice, and systems thinking. The Kansas State University MPH program has five required core courses that collectively provide instruction in all foundational competencies, including MPH 701 “Biostatistics”, MPH 720 “Administration of Health Care Organizations”, MPH 754 “Epidemiology”, MPH 802 “Environmental Health”, and MPH 818 “Social and Behavioral Basis of Public Health”. Table 2.2 illustrates the list of 22 foundational MPH competencies, and which core coursework fulfills achievement of each competency.

Table 2.1 Summary of MPH Foundational Competencies

Number and Competency		Description
7	Assess population needs, assets, and capacities that affect communities' health.	The project assessed the clinical laboratory workforce as a defined population within the hospital system, identifying strengths and gaps in safety knowledge and regulatory compliance. This assessment guided the design of the safety curriculum, fact sheets, and leadership report, addressing needs while leveraging institutional assets such as existing EHS infrastructure and leadership support.
9	Design a population-based policy, program, project, or intervention.	The project produced a comprehensive, evidence-based <i>Clinical Laboratory Safety Curriculum</i> and supporting educational tools that serve as structured interventions to enhance safety culture. Together, these deliverables form a sustainable training model integrating CLIA, CAP, Joint Commission, and OSHA standards into a cohesive educational framework for laboratory professionals.
16	Apply leadership and/or management principles to address a relevant issue.	Leadership and management principles were applied throughout the project—particularly in developing the <i>Safety Training Recommendation Report</i> and <i>monthly safety education templates</i> for

		hospital leadership. The project emphasized interdepartmental collaboration, clear communication, and shared accountability in driving improvement in laboratory and hospital-wide safety culture.
19	Communicate audience-appropriate (i.e., non-academic, non-peer audience) public health content, both in writing and through oral presentation.	Communication was a core component of the project. The development of <i>fact sheets</i> , <i>safety topic presentations</i> , <i>quizzes</i> , and the <i>Safety Training Recommendation Report</i> required tailoring complex regulatory information (OSHA, CLIA, CAP, Joint Commission) to diverse audiences—including hospital leadership, clinical laboratory professionals, and other healthcare staff. Each product demonstrated the ability to translate technical safety data into actionable, comprehensible materials that drive engagement and compliance.
22	Apply a systems thinking tool to visually represent a public health issue in a format other than a standard narrative.	The project utilized both a process map and a stock-and-flow diagram to represent clinical laboratory safety as a dynamic system. The process map illustrated workflows, communication channels, training pathways, and reporting procedures, identifying bottlenecks and opportunities for reinforcement. The stock-and-flow diagram modeled accumulation of safety knowledge and overall safety culture (“stocks”) and the rates of change (“flows”) such as training uptake, reinforcement, and knowledge decay. Feedback loops, including safety incident reporting and leadership review, highlighted system dynamics and leverage points for sustainable improvement. Together, these tools provided a holistic visual representation of the laboratory safety ecosystem and informed actionable, data-driven leadership strategies.

Table 2.2 MPH Foundational Competencies Course Mapping

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
Evidence-based Approaches to Public Health					
1. Apply epidemiological methods to settings and situations in public health practice	x		x		
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	x	x	x		
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	x	x	x		
4. Interpret results of data analysis for public health research, policy or practice	x		x		
Public Health and Health Care Systems					
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings		x			
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and systemic levels					x
Planning and Management to Promote Health					
7. Assess population needs, assets and capacities that affect communities' health		x		x	
8. Apply awareness of cultural values and practices to the design, implementation, or critique of public health policies or programs					x
9. Design a population-based policy, program, project or intervention			x		
10. Explain basic principles and tools of budget and resource management		x	x		
11. Select methods to evaluate public health programs	x	x	x		
Policy in Public Health					
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence		x	x	x	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes		x		x	x
14. Advocate for political, social or economic policies and programs that will improve health in diverse populations		x			x
15. Evaluate policies for their impact on public health and health equity		x		x	
Leadership					
16. Apply leadership and/or management principles to address a relevant issue		x			x
17. Apply negotiation and mediation skills to address organizational or community challenges		x			
Communication					
18. Select communication strategies for different audiences and sectors	DMP 815, FNDH 880 or KIN 796				
19. Communicate audience-appropriate (i.e., non-academic, non-peer audience) public health content, both in writing and through oral presentation	DMP 815, FNDH 880 or KIN 796				

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
20. Describe the importance of cultural competence in communicating public health content		x			x
Interprofessional Practice					
21. Integrate perspectives from other sectors and/or professions to promote and advance population health		x			x
Systems Thinking					
22. Apply a systems thinking tool to visually represent a public health issue in a format other than a standard narrative			x	x	

Table 2.3 Application of Systems Thinking Tools to a Public Health Issue

Systems Thinking Tool	Description of Use
Stock and Flow Diagram	A quantitative systems-thinking tool used to illustrate non-linear dynamics within the safety system and demonstrate how key elements evolve and influence one another over time.
Process Mapping	A visual systems analysis tool used to describe the six phases of the clinical laboratory safety competency enhancement project, from initial knowledge assessment through continuous improvement.

Systems thinking tools provide structured, data-driven approaches for designing and evaluating public health and safety interventions across complex systems. In the context of clinical laboratory operations, these tools help identify interdependencies, feedback loops, and process inefficiencies that influence workforce safety and performance outcomes. Two systems thinking tools were implemented at Irwin Army Community Hospital as part of the Clinical Laboratory Safety Knowledge Enhancement Project: the Stock and Flow Diagram and Process Mapping.

The use of systems thinking tools supported a structured framework for identifying leverage points and aligning safety interventions with organizational learning goals. These approaches promote transparency, adaptive decision-making, and sustainability by linking leadership engagement, staff behavior, and institutional feedback mechanisms.

The following sections describe the Stock and Flow Diagram and Process Mapping models developed for this project. Each model captures the systemic nature of safety performance and provides insight into how education, leadership, and feedback interact to sustain long-term safety improvement.

Stock and Flow Diagram

The stock-and-flow model conceptualizes the dynamic interrelationships among four primary components that underpin a sustainable safety system: Leadership Support, Training and Safety Curriculum, Staff Safety Knowledge, and Safety Culture. This framework applies to a systems-thinking perspective to explain how safety performance develops through the continuous exchange of information, behaviors, and institutional values within an academic or clinical laboratory environment.

Leadership Support serves as a foundational element in this model, providing strategic direction, resource allocation, and accountability mechanisms necessary for effective safety management. Leadership functions as both a driver and a responsive feedback component within the system. Positive reinforcing flows demonstrate that visible commitment from leadership enhances the strength of the training infrastructure, the depth of staff knowledge, and the overall maturity of safety culture. Conversely, feedback loops indicate that leadership decisions are shaped by staff engagement and cultural norms; when personnel demonstrate competence and shared responsibility for safety, leadership tends to sustain or expand its support, creating a reinforcing cycle of Improvement.

The Training and Safety Curriculum represents the central conduit for transferring safety values, technical knowledge, and behavioral expectations. It both derives from leadership priorities and influences staff knowledge and organizational culture. A robust, evidence-based training program ensures that learning is continuous, relevant, and responsive to emerging risks. Bidirectional connections between training, knowledge, and culture indicate that curriculum quality directly shapes staff competence while also embedding safety as an organizational value. Feedback from practice and incident data into curriculum design reinforces the need for iterative assessment and improvement of training content.

Staff Safety Knowledge functions as a key operational component, reflecting the cumulative understanding, skills, and attitudes of laboratory personnel. Knowledge is strengthened through formal instruction, mentorship, and reinforcement from leadership. As safety knowledge increases, it contributes to enhanced culture and improved communication across organizational levels. Knowledgeable staff not only perform work more safely but also provide critical feedback that can refine training programs and inform leadership decision-making. This creates a reciprocal relationship in which learning and leadership responsiveness evolve in tandem.

Safety Culture operates as both an outcome and a determinant within the system. It encompasses the shared values, norms, and behaviors that define how safety is perceived,

prioritized, and practiced. A strong safety culture promotes engagement, communication, and accountability, which in turn reinforces leadership commitment and validates investment in safety education. Conversely, cultural weaknesses can limit participation, undercut training effectiveness, and diminish leadership impact, producing balancing feedback loops.

Overall, this systems model emphasizes that safety performance is nonlinear, dynamic, and interdependent. None of the four domains operate independently; rather, safety outcomes rely on the interaction between all four domains. Positive reinforcement loops contribute to sustained safety performance and organizational resilience, while weak or underenforced loops can cause stagnation or other issues. The model provides a conceptual foundation for developing integrated safety strategies that prioritize continuous learning, adaptive leadership, and the co-evolution of knowledge and culture within laboratory environments.

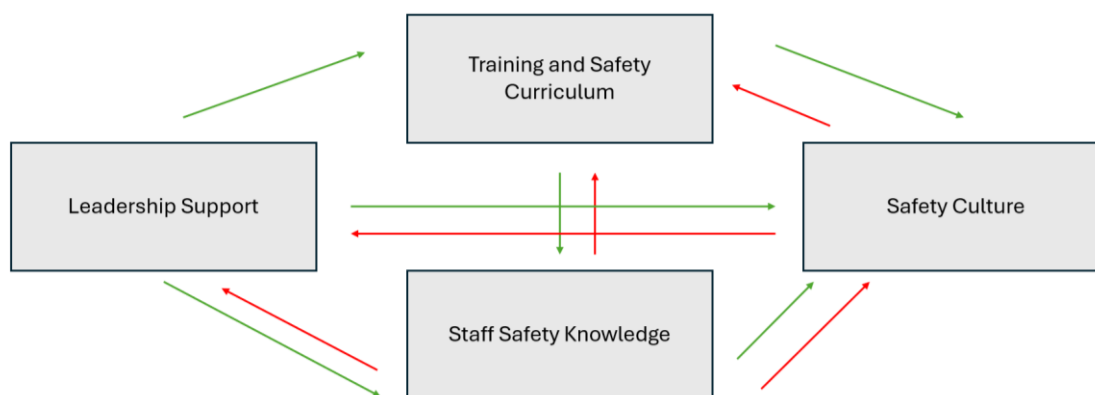


Figure 2.1: Stock and Flow Diagram

Process Mapping

Ensuring the safety of clinical laboratory personnel is critical for both workforce protection and patient safety. Laboratory professionals face diverse hazards, including biological, chemical, and physical risks, which require structured interventions to mitigate. A process map provides a visual and systematic representation of the steps, decision points, and feedback mechanisms involved in improving safety knowledge and practices. This report describes the development and utility of a process map as a systems thinking tool in the context of a clinical laboratory safety improvement project.

The process of enhancing laboratory safety knowledge and practices begins with assessing baseline competency among staff. A comprehensive Laboratory Safety Competency Survey evaluates personnel knowledge across core domains such as biosafety, chemical

safety, equipment handling, and emergency response. Survey results identify knowledge gaps and prioritize targeted interventions.

Following assessment, multiple reinforcement strategies are implemented as seen in Table 1.1:

1. Safety Signage and Fact Sheets

Visual reminders and easy-to-read materials are displayed in laboratory spaces to reinforce safety practices and encourage daily adherence to protocols.

2. Online Course Model for Laboratory Safety Education

Structured, interactive training modules provide on-demand learning opportunities. Modules incorporate multimedia content, knowledge checks, and competency assessments, supporting long-term knowledge retention.

3. Safety Presentations

Brief presentation to engage staff across departments, reinforce key safety concepts, and provide measurable data on comprehension and retention.

4. Leadership Reporting and Recommendations

Data from surveys, assessments, and engagement activities are compiled into reports for leadership. Recommendations inform policy, procedural updates, and allocation of resources to enhance safety culture.

The process map illustrates how individual interventions are interconnected, forming a cycle of continuous improvement rather than isolated training events. By using a system thinking lens, the laboratory can:

- Visualize the entire workflow, from knowledge assessment to competency verification.
- Identify gaps or bottlenecks in safety education and compliance.
- Integrate feedback from competency assessments and quizzes to adjust interventions dynamically.
- Optimize resource allocation, prioritizing high-impact interventions.
- Reinforce a culture of safety, promoting shared responsibility and accountability across all staff roles.

This approach aligns with public health principles by emphasizing proactive risk management, compliance with regulatory standards (CLIA, CAP, OSHA, CDC, EPA, DOT/IATA), and evidence-based interventions. The iterative nature of the process map ensures that safety improvements are sustainable and responsive to evolving laboratory needs. Regular review of survey data, competency verification, and engagement metrics allows the laboratory to refine educational content, signage, and training frequency.

This structured system benefits public health by:

- Reducing occupational hazards for laboratory staff.
- Ensuring consistent adherence to safety protocols.
- Supporting high-quality, reliable laboratory operations that contribute to patient safety.
- Promoting a just culture where learning from errors and near-misses improves overall laboratory practices.

The process map serves as an essential systems thinking tool, transforming multiple safety interventions into a cohesive, strategic framework. By connecting assessment, education, reinforcement, and leadership oversight, the process map provides a structured pathway to enhance laboratory safety, improve staff competency, and strengthen the safety culture within the clinical laboratory environment.

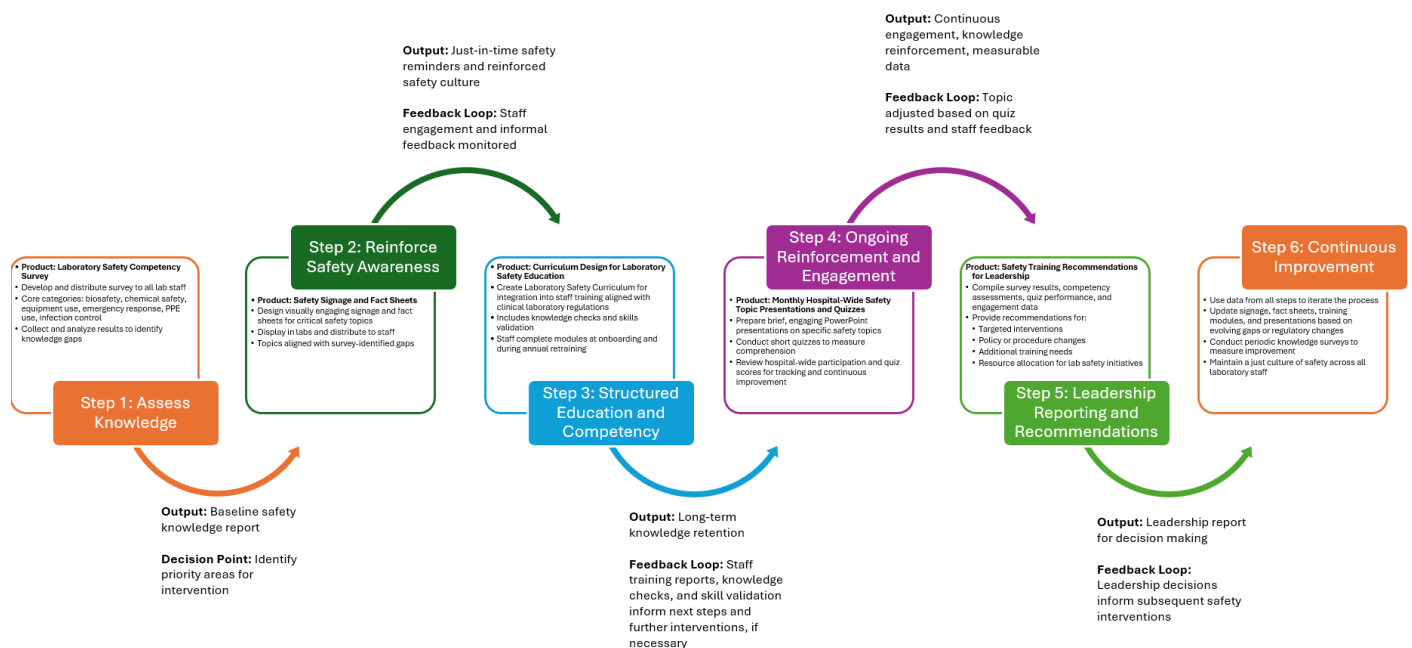


Figure 2.2: Process Map for Clinical Laboratory Safety Competency Project