Navigating Through Disruptions:

Ensuring Operational Resilience and Sustainability in an Environmental Laboratory

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National Environmental Monitoring Conference 2025

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Why is this Topic Important?

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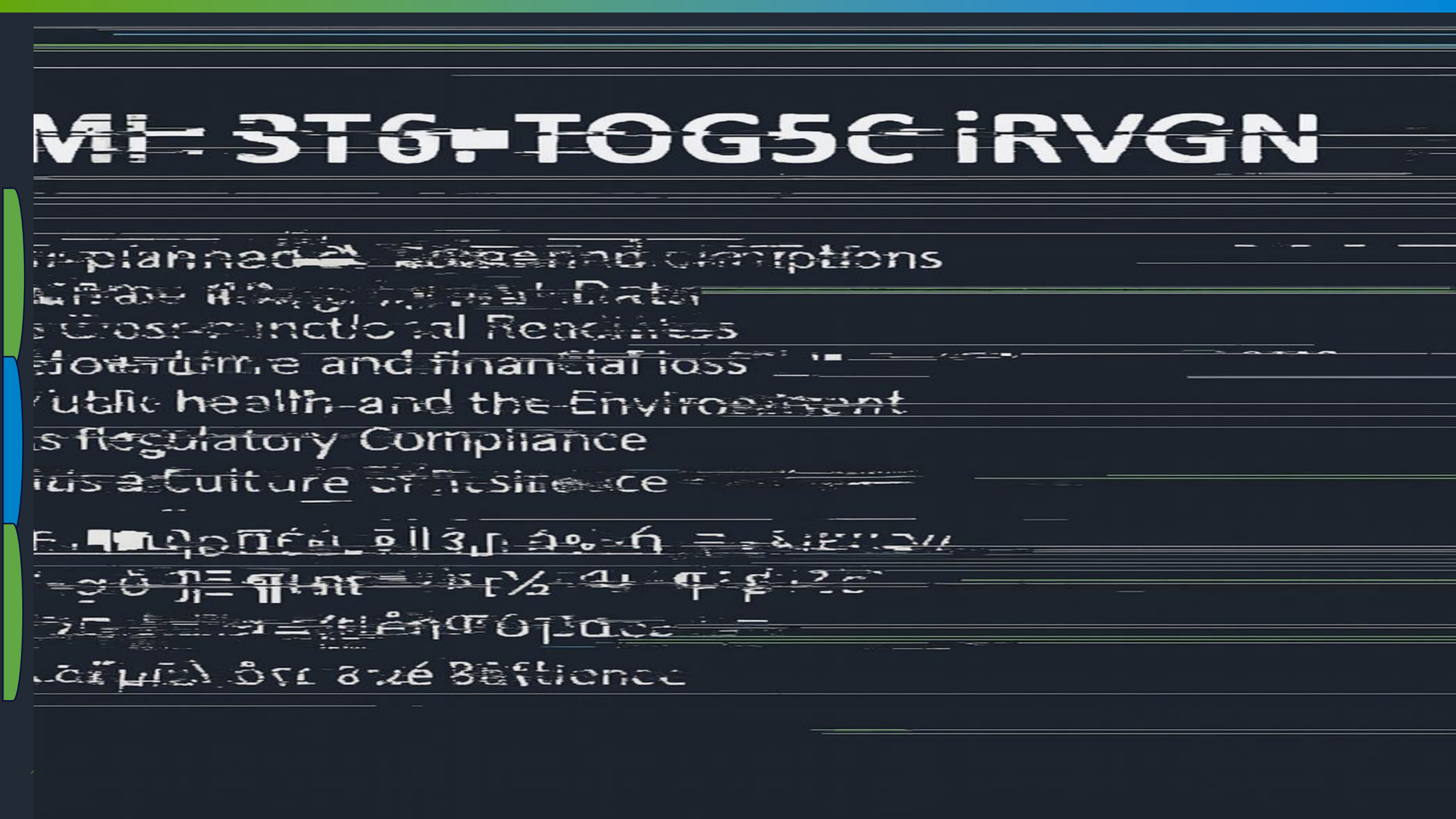

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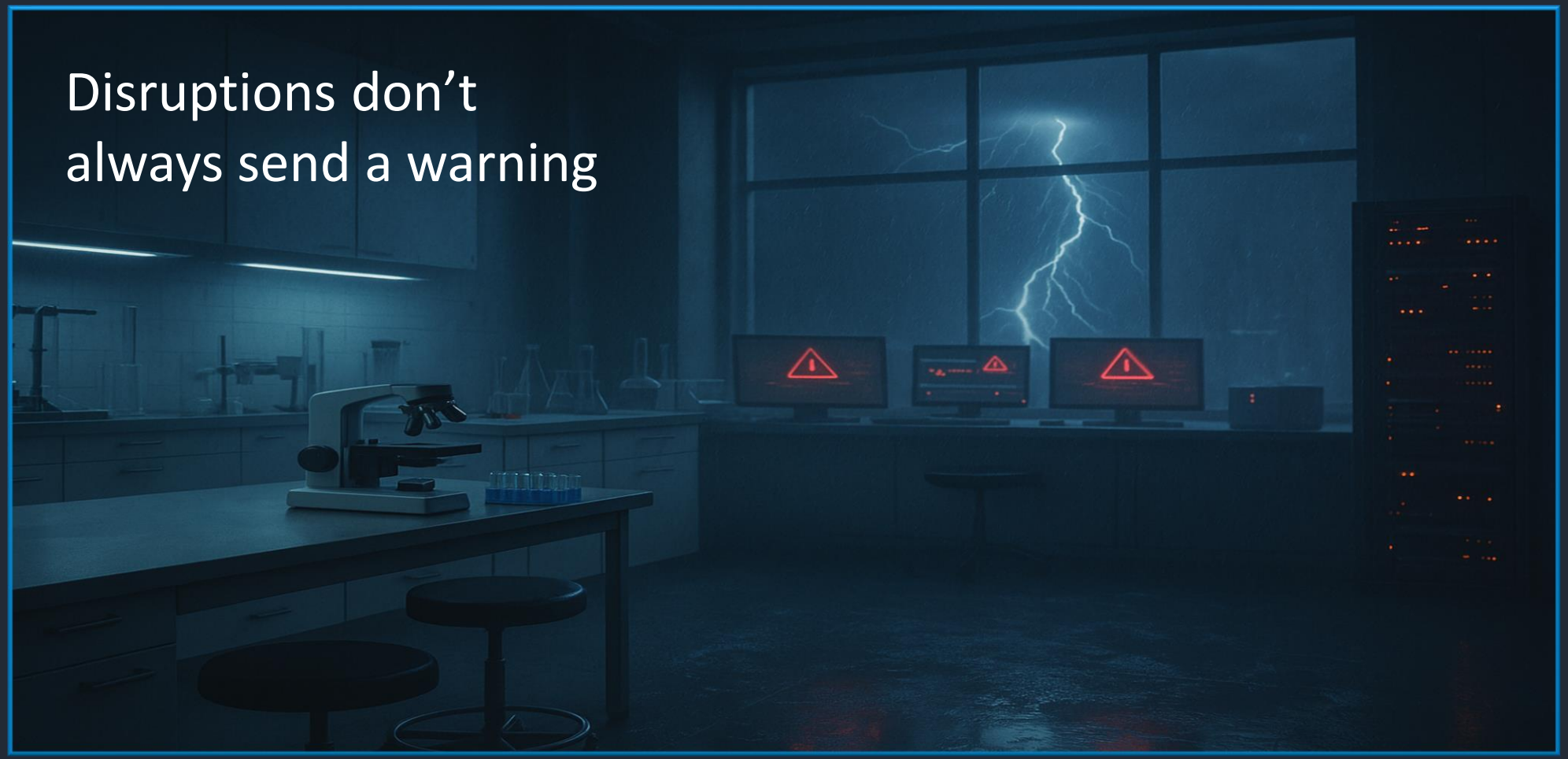

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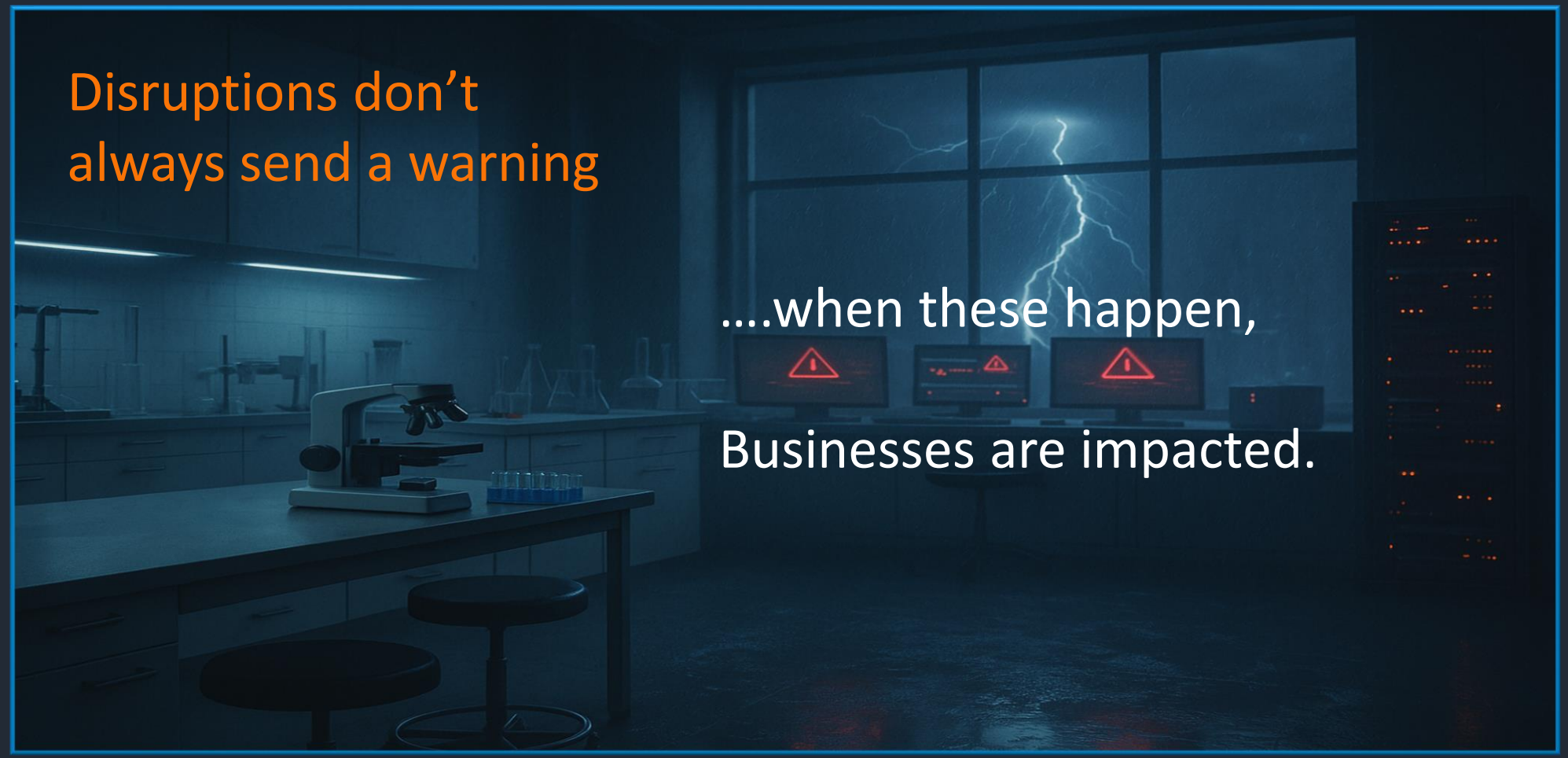

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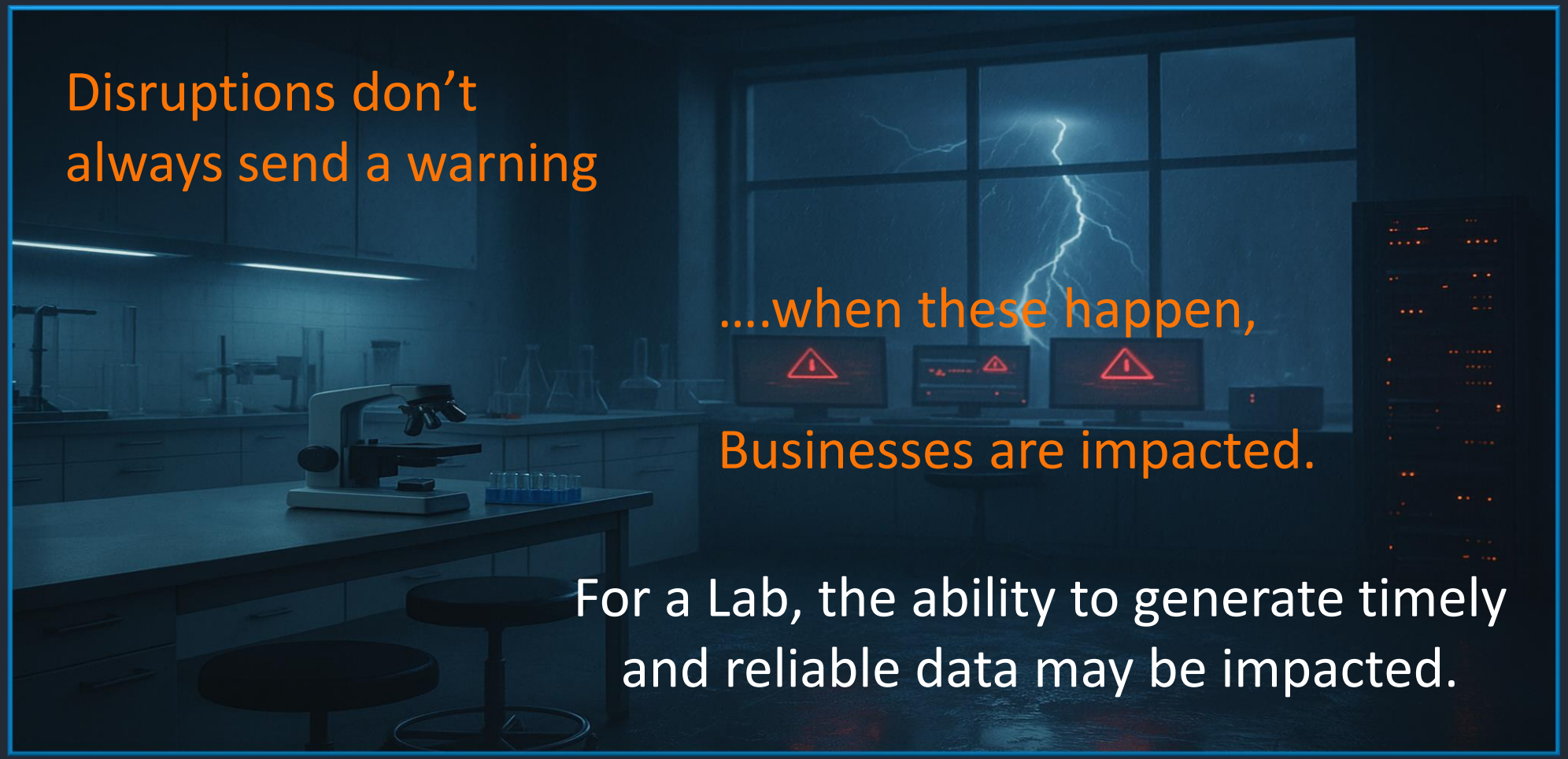

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What Are The Likely Impacts?

Public Health

Policies & Regulatory Compliance

Environmental Protection

Emergency & Crisis Response

What Are The Likely Impacts?

- Life Safety
- Damage to Property or Environment
- Operations/Service
- Compliance Impacts
- Organizational Reputation
- Financial Impacts

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Business Continuity Planning

Build Resilience Before it is Tested

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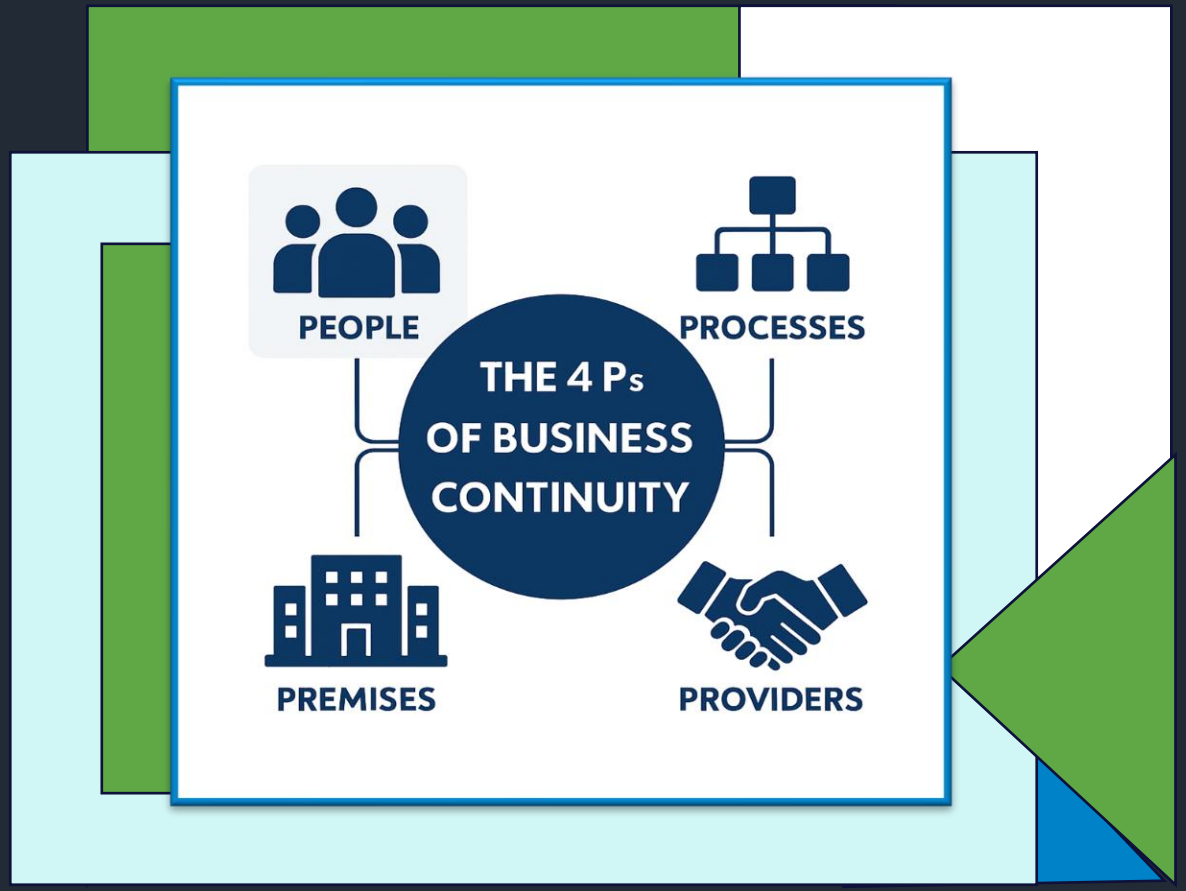
The Beginning…

- The 4 P's of Business Continuity



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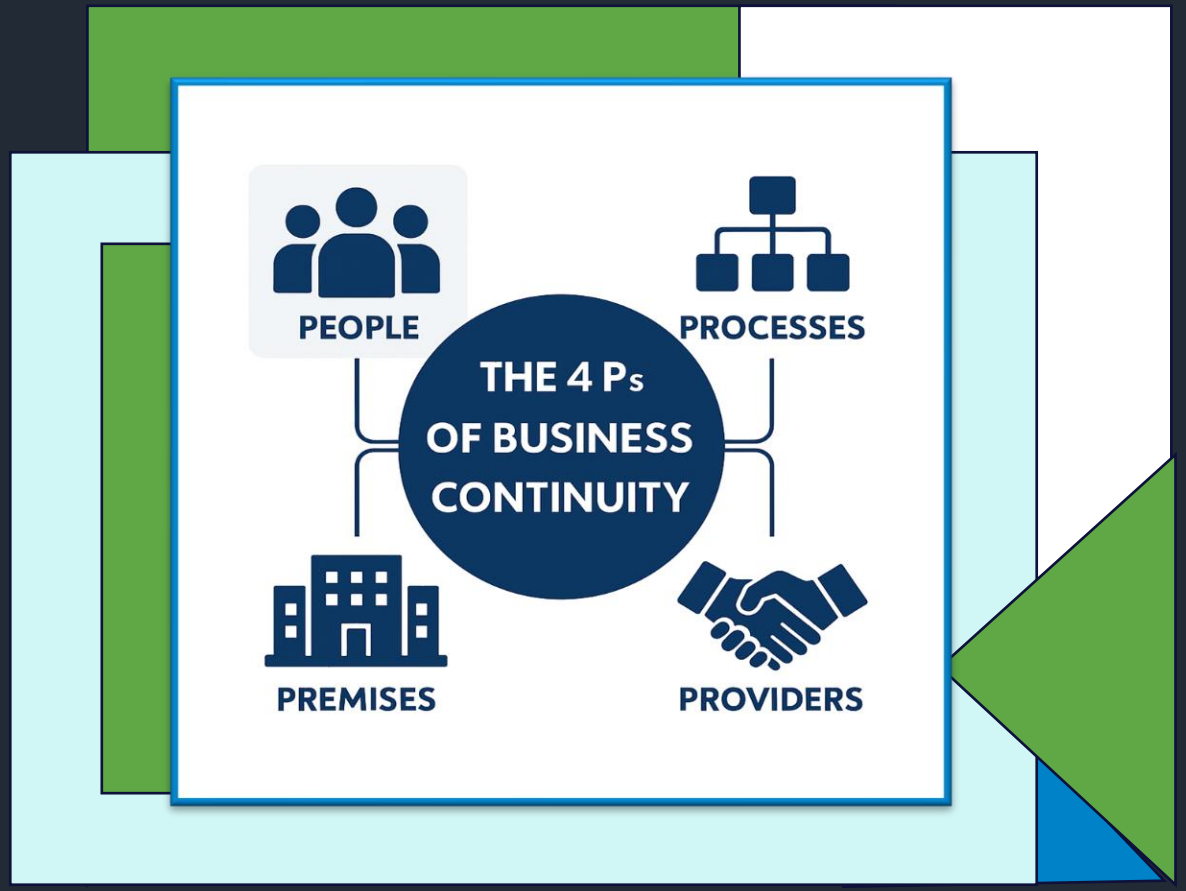
The Beginning…

- The 4 P's of Business Continuity
  - Scope
  - Objectives
  - Cross-Functional Team
  - Resources



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Critical Functions in an Environmental Lab

Functions that must continue or resume after a disruption.

Critical Functions in an Environmental Lab

- **Examples of Critical Functions:**
  - Critical Lab Testing
  - Sample Collection
  - Sample Receiving
  - Data Review and Reporting
  - QA/QC Review
  - Managing Laboratory Data & Records
  - Regulatory Reporting

Critical Functions in an Environmental Lab

- **Methodology:**
  - Stakeholder Reviews
  - Questionnaires
  - Staff Interviews
  - Cross-Functional Review
  - Expert Advice
  - Industry Standards

Critical Functions: Operational Priority

Rank essential functions in order of operational priority

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Critical Functions: Ranking Review

Function: Testing of Total Coliforms and E.coli

1. How quickly does the function need to be restored?
   Example: 12-24 Hours.

Critical Functions: Ranking Review

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   Example: Testing of drinking water.

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3. Does the unavailability of this function result in damage (property/environment)?
   Example: Equipment must continue to be maintained for operational needs.

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2. What is the impact on life safety (public and staff)?
   Example: Testing of drinking water.

3. Does the unavailability of this function result in damage (property/environment)?
   Example: Equipment must continue to be maintained for operational needs.

4. What is the impact on operations and services provided by the lab?
   Example: Accreditation requirements are ongoing and still need to be met.

Critical Functions: Ranking Review

Function: Testing of Total Coliforms and E.coli

5. Impact on compliance requirements (Contracts, Policies, etc.)?
   Example: Unmet objectives, Sampling and Analysis Plans, Contractual obligations

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6. Effect on organizational reputation?
   Example: Missed compliance requirements, Public trust

Critical Functions: Ranking Review

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5. Impact on compliance requirements (Contracts, Policies, etc.)?
   Example: Unmet objectives, Sampling and Analysis Plans, Contractual obligations

6. Effect on organizational reputation?
   Example: Missed compliance requirements, Public trust

7. Financial impact (Revenue, Legal Fees, Fines, Penalties)?
   Example: Cost of outsourcing, Fines if monitoring is missed

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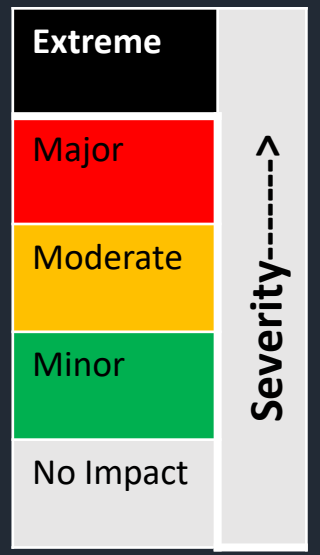
Business Impact Analysis

Function: Testing of Total Coliforms and E.coli

Time to return to normal operation	Life Safety (Public & Staff)	Damage to Property or Environment	Operations/ Service	Compliance Impacts	Organizational Reputation	Financial Impacts
0-12 Hours	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
12-24 Hours	Moderate	No Impact	Moderate	Minor	Minor	Minor
1-3 Days	Extreme	Minor	Moderate	Minor	Major	Minor
4-7 Days	Extreme	Minor	Moderate	Moderate	Major	Minor
1-2 Weeks	Extreme	Minor	Moderate	Major	Extreme	Minor
2-4 Weeks	Extreme	Minor	Moderate	Major	Extreme	Minor
>Month	Extreme	Minor	Moderate	Extreme	Extreme	Minor



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Disruptions in an Environmental Lab

Smoke, Flooding, Earthquakes, Fires

Environmental/ Natural Disasters

Safety, Evacuations, Chemical Spills, Facility Damage

Incidents/ Mishaps

Malfunction, Data Loss, Network Cybersecurity

Equipment/ Technology

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Equipment/ Technology

Power Outage, HVAC, Roof Leak, Water Supply

Utilities/ Facilities

Design Change, Occupancy issues, Construction

Design/ Construction

Audit Findings, New Regulations, Errors/Omissions

Regulatory/ Compliance

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Disruptions in an Environmental Lab

Illness Outbreaks, Shortage, Training, Loss, Emergencies

Personnel

Shortage, Vendor Issues, Shipping, Cost Change

Supply Chain

Emerging Contaminants, Changes to Monitoring, Contamination Incidents

Operational

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Disruptions in an Environmental Lab

- Illness Outbreaks, Shortage, Training, Loss, Emergencies — Personnel
- Shortage, Vendor Issues, Shipping, Cost Change — Supply Chain
- Emerging Contaminants, Changes to Monitoring, Contamination Incidents — Operational
- Contamination, Documentation, Transportation — Field Sampling
- Breakdown, Tech Limits, Stakeholder Updates — Communications
- Invalid Results, PT Not Passing, Data Integrity Issues — QA/QC

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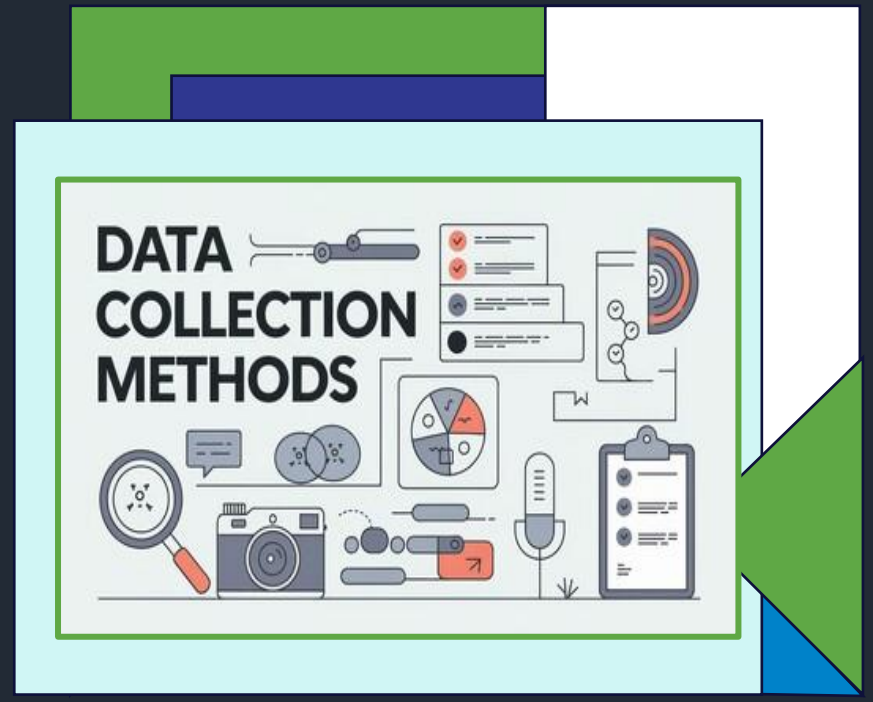
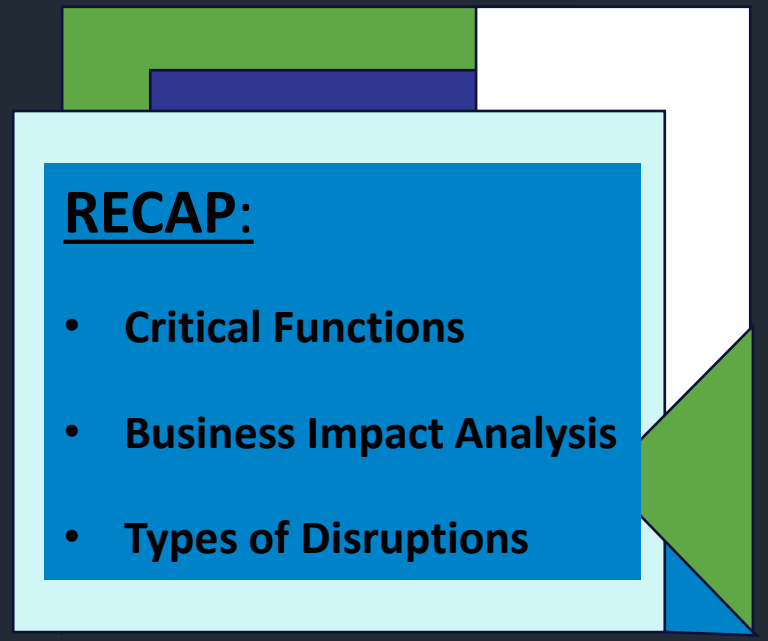
Research Other Disruptions

- Methods to find out if other likely disruptions may impact your lab:
  - Surveys
  - Interviews
  - Observations
  - Focus Groups
  - Incident Records
  - Reliable Data
  - Inspections
  - Case Studies
- Maintain these records to incorporate into the BCP



Risk Assessment



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Risk Assessment

- Identify disruptions that may impact the core functions
- Evaluate:
  1. Likelihood
  2. Impact

Likelihood:
1. Rare
2. Unlikely
3. Possible
4. Likely
5. Almost Certain

Impact:
1. No Impact
2. Minor
3. Moderate
4. Major
5. Extreme

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Risk Assessment

- Identify disruptions that may impact the core functions
- Evaluate:
  1. Likelihood
  2. Impact
- Evaluate Risk Score

  Risk Score = Likelihood x Impact

Likelihood:
1. Rare
2. Unlikely
3. Possible
4. Likely
5. Almost Certain

Impact:
1. No Impact
2. Minor
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Risk Assessment

Risk Score	Risk Level	Response
1–4	Low	Monitor occasionally; minimal action needed
5–9	Medium	Address in planning; mitigation if resources allow
10–15	High	Prioritize in BCP; develop and test contingency plans
16–25	Critical	Immediate action; core BCP item; urgent mitigation

Risk Assessment – Examples

Risk	Likelihood (1–5)	Impact (1–5)	Risk Score	Risk Level
IT System Failure (LIMS, Servers)	3	5	15	High
Staff Shortage or Pandemic	4	3	12	High
Equipment Failure	3	3	9	Medium
Cyberattack / Data Breach	5	5	25	Critical
Flooding / Water Damage	2	4	8	Medium
Lab Software Update Delay	1	2	2	Low
Long-Term Building Outage	1	5	5	Medium
Unauthorized Entry Into Lab	4	4	16	Critical

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*Note: Data is for illustration purposes only

Risk Mitigation Measures

Risk	Risk Level	Mitigation Measure
IT System Failure (LIMS, Servers)	High	Offsite Backups, Cloud Access, Redundancies
Staff Shortage or Pandemic	High	Cross-training, Telework, Stagger Shifts
Equipment Failure	Medium	Maintenance, Vendor Support, Contracts
Cyberattack / Data Breach	Critical	Firewalls, Encryption, Cybersecurity Training
Flooding / Water Damage	Medium	Elevated Storage, Waterproofing, Insurance
Lab Software Update Delay	Low	Software Patching, Alert Scheduling
Long-Term Building Outage	Medium	Alternate Work Locations, Telework
Unauthorized Entry Into Lab	Critical	Access Controls, CCTV, Badge System

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Other Examples of Risks

- Assess other risks that may impact your lab
  - Power Outage
  - Fire or Chemical Explosion
  - Hazardous Material Spill
  - Supply Chain Disruption
  - Regulatory Non-Compliance
  - Ransomware Attack with No Backup
  - Emerging Contaminants
- Maintain these records to incorporate into the BCP

Mapping Risk and Quality Elements

- Link risk-based elements of the regulations and quality control to the BCP.

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Mapping Risk and Quality Elements

- Link risk-based elements of the regulations and quality control to the BCP.
- Incorporate the Business Continuity Plan and relevant documents within the lab's quality management system, where possible. Examples:
  - Equipment List
  - Vendor List and Evaluation
  - Master Document List and Backup Copies
  - Subcontract Lab Contracts and Accreditation Info

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Resource Mapping

Equipment: Examples			
Item	**Current Location**	**Backup (Yes/No); Location (If Yes)**	**Maintenance Schedule**
-20 ^{0}C Freezer	L-120	Yes (L-130)	Annual
GCMS-2	L-149	Yes (GCMS-5)	Annual
Turbidimeter	L-121	No	Quarterly

Resource Mapping

Personnel: Examples			
Role	**Name**	**Designee**	**Critical Tasks**
Lab Manager	S.Saini	M.Ellison	Lab Oversight, Budget Prep, Data Approval, Report Signatory, Training
Quality Manager	A.Lazzini	B.Sullivan	Management Review, Data Validation, Document Control, Quality Assurance
Microbiologist	K.Nguyen	K.Friedt	Microbial testing, Quality Control, Procurement, Reporting, Data Entry

Resource Mapping

Utilities: Examples			
Utility	**Provider**	**Backup?**	**Critical Systems Affected**
Electricity	PG&E	Generator	Fridges, Freezers, Incubators, Instruments
Water	Local Utility	Treatment Plant	Cleaning Glassware, Making Reagents

Resource Mapping

Technology/Systems: Examples			
System	**Purpose**	**Hosted Where?**	**Backup Method**
LIMS	Sample Tracking	On-Premise	Daily Sync and Backup by IT
Document Management System	Controlled Documents	Cloud	Cloud Backup

Resource Mapping

Supplies/Materials: Examples			
Item	**Use**	**Vendor**	**Minimum Stock**
Nitrate Standard	Drinking Water Testing	Fisher	3 weeks
Nitrile Gloves	Lab Safety	Grainger	3 boxes/person/month

Resource Mapping

Facilities/Space: Examples			
Room/Area	**Function**	**Critical Use**	**Alternate Location**
Microbiology Section	Microbial Testing	Drinking Water	Satellite Lab
Server Room	Data Storage	IT Operations	Cloud Replication

Resource Mapping

External Dependencies: Examples			
Partners	**Service**	**Risk if Lost?**	**Contingency**
Courier A	Sample Shipments	High	Switch to Courier B
Haz Waste Disposal Company	Chemical and Biohazard Removal	Medium	In-house storage for 2 weeks, then switch to another provider
Subcontract Lab	Backup Testing	High	Alternate Lab, Mutual-Aid Agreement with Partner Agencies.

Resource Mapping

Internal Dependencies: Examples			
Partners	**Service**	**Risk if Lost?**	**Contingency**
Facilities Staff	Building Maintenance	Critical	Contractors
IT Staff	Computer/Server Support, Backups	Critical	Contractors or Cross-trained Staff
Laboratory Staff	Sampling and Analysis	High	25%/50%/75% Staffing Plan, Telework, Cross-trained staff, Staggered Shifts

Recovery Plan

For all high-priority critical functions:

1. Prepare a Recovery Strategy to restore functions
2. Identify Roles and Responsibilities for Recovery Team
3. Outline Recovery Time Objectives (RTOs)
4. List Required Resources
5. List Required Coordination for a structured and efficient response

BCP: Development

- Key Elements
  - Critical Functions
  - Business Impact Analysis
  - Risk Assessment
  - Risk Mitigation Measures
  - Resource Mapping
  - Recovery Plan

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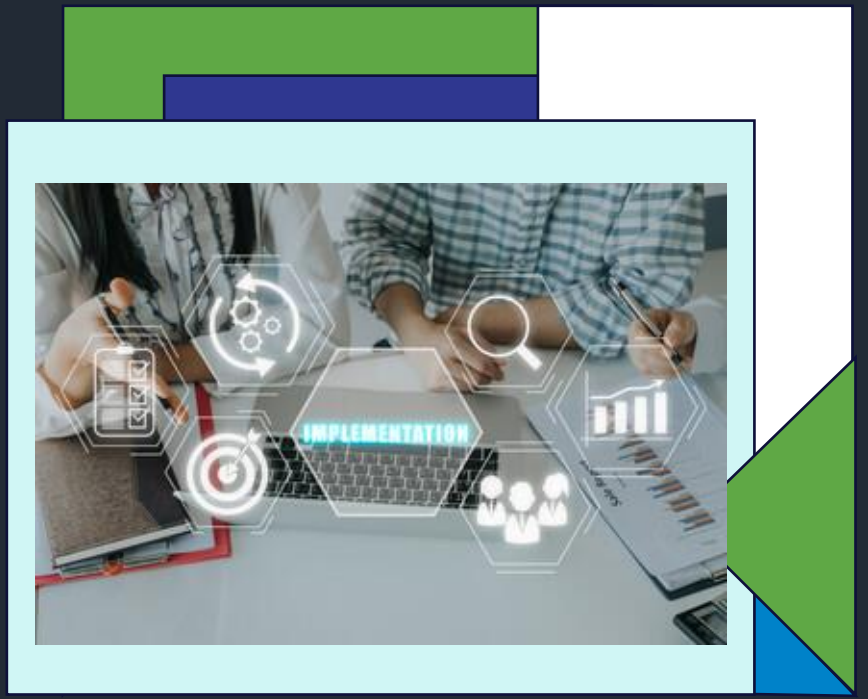
BCP: Development

- Other Supporting Elements:
  - Contact Lists
  - Vendor Lists
  - Evacuation Routes
  - SOPs (Electronic and Hardcopy)
  - Regulatory Documents and Plans
  - Site Plans
  - Sampling Plans
  - Maps and Manuals
  - Staffing Plan to address outbreak situations

BCP: Implementation

- Distribute the plan.
- Train staff. All staff must understand their roles.
- Training should be structured, periodic, and include practical examples or simulations.
- Validate the plan through tabletop simulations and real-life drills.
- Testing identifies gaps and increases confidence in the plan’s effectiveness.



BCP: Exercises

Types of Exercises:

- Tabletop
- Functional
- Full-Scale
- Notification Drill

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BCP: Continual Improvement

- Plans are living documents.
- Review and update regularly to reflect changes in personnel, equipment, procedures, or threats.
- Create a schedule to review plans annually or after major events.
- Involve managers and align updates with quality audits.
- Use feedback loops and performance data to fine-tune the plan.
- Use after-action reports and lessons-learned to lead policy and process refinements.

BCP: Summary of Benefits

- Prepares for Disruptions
- Preserves Sample Integrity and Data
- Promotes Cross-Functional Readiness
- Minimizes Downtime and Financial Loss
- Protects Public Health and the Environment
- Strengthens Regulatory Compliance
- Builds a Culture of Resilience

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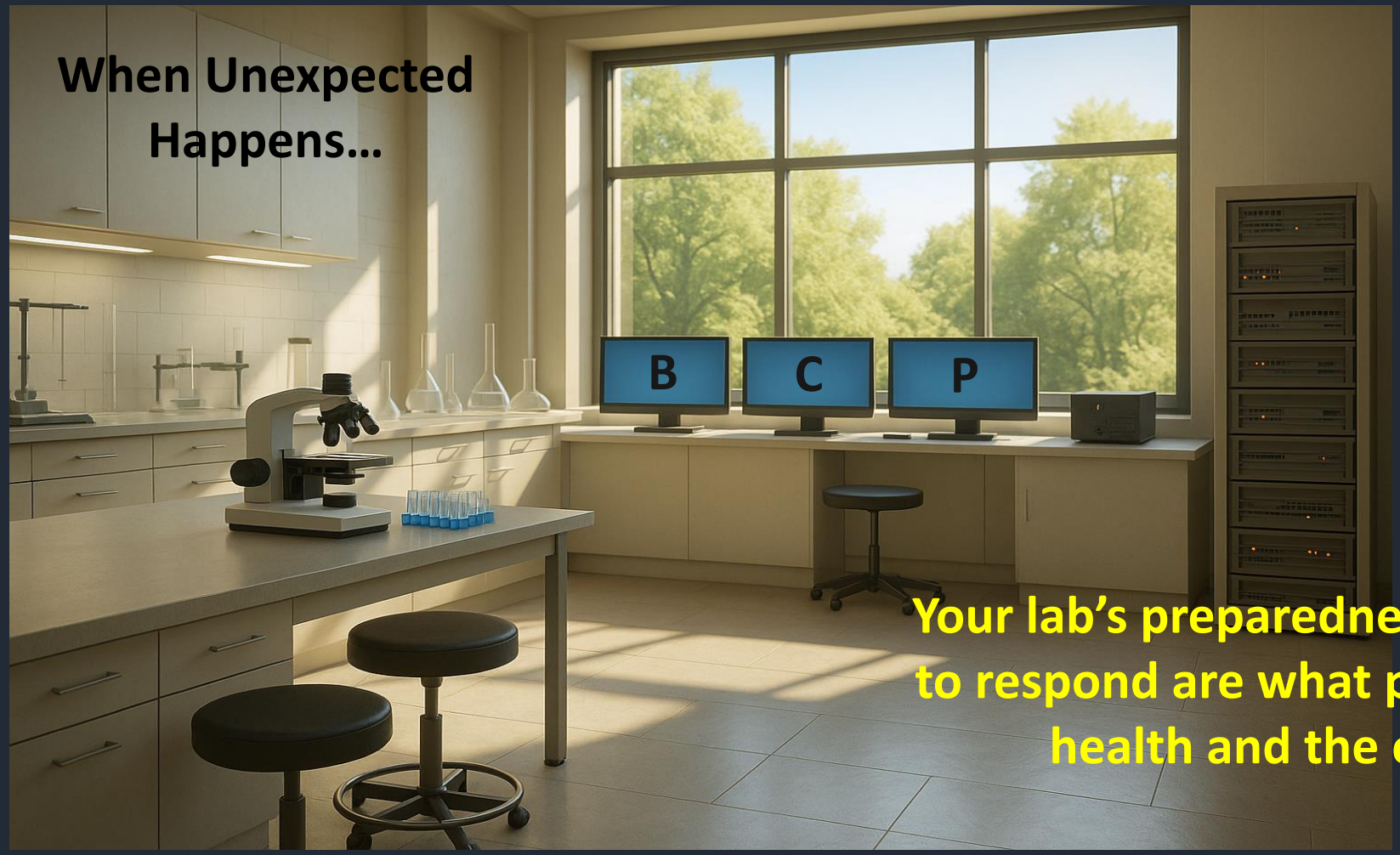
Call to Action

- Start today!
- Prepare a BCP for your lab.
- Establish mutual-aid agreements.
- Develop succession plans and delegation of authority.
- Implement alert notification systems.
- Test your emergency plans.
- Conduct annual TT&E programs to validate readiness.
- Build a resilient lab that’s ready for anything.

This Topic Is Important Because…



Your lab's preparedness and ability to respond are what protect public health and the environment.

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QUESTIONS