UNDERSTANDING CURRENT LABORATORY BIOSAFETY AND BIOSECURITY PRACTICES AROUND THE WORLD

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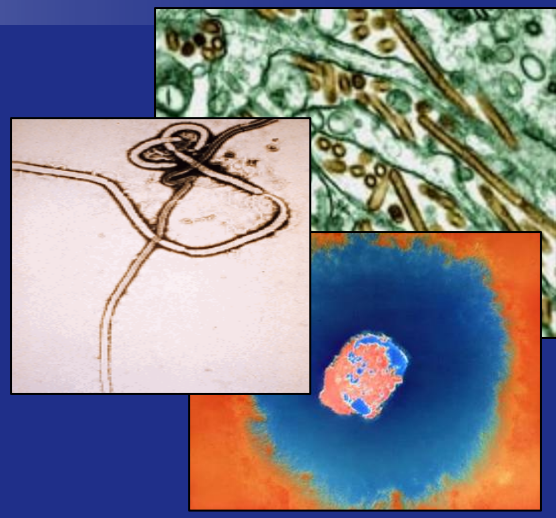
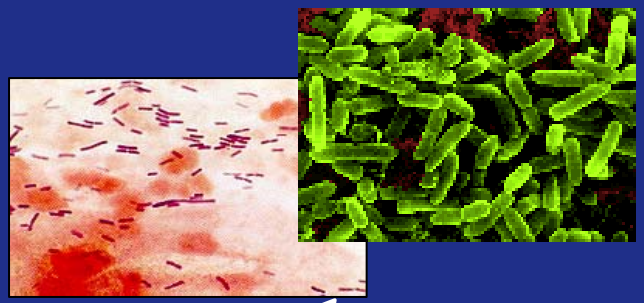
Surveys of Life Scientists



- **Survey focus areas:**
  - Types of pathogens and toxins used in research
  - Research objectives for those agents
  - Laboratory capacity
    - **Available tools and techniques**
    - **Personnel**
  - Status quo for biosafety and biosecurity policies and procedures
  - Perceptions of risk
- **765 respondents from primarily developing countries across 4 regions**
  - Asia: n=300
  - Middle East and Caspian Basin: n=154
  - Latin America: n=165
  - Eastern Europe: n=146



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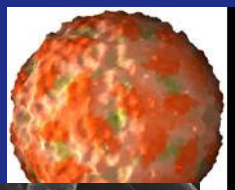
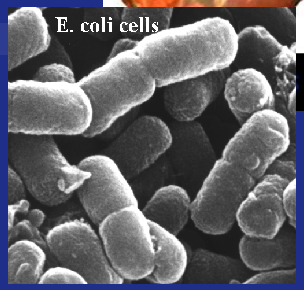
Surveyed Countries

- **Asia**
  - Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam
- **Middle East and Caspian Basin**
  - Algeria, Azerbaijan, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, Yemen
- **Latin America**
  - Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, Venezuela
- **Eastern Europe**
  - Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia, Ukraine

Mt. Merapi, Yogyakarta, Indonesia

Bio Agents Studied





- **Overall**
  - 53.4% studied bacteria; 43.6% studied viruses;
  - 28.4% studied toxins and 17.9% studied parasites
- **Most commonly studied bacteria**
  - Across all regions: *Salmonella typhi* (38-57%), *E. coli* O157:H7 (44-55%), *Shigella dysenteriae* (14-33%)
  - *Mycobacterium tuberculosis* (22-45%) one of most common in Eastern Europe, Middle East, and Latin America but only studied by 14% of respondents in Asia
- **Most commonly studied viruses**
  - Blood borne pathogens: HIV (29-45%), Hepatitis (35-70%) but not commonly studied in Asia
  - Asia: Dengue (41%) and Japanese encephalitis (30%)
  - Emerging viruses:
    - **HPAI: 8 - 23%; Latin America is least active and Asia is most**
    - **SARS: 4 - 23%; Latin America is least active and Asia is most**

Research Techniques

- **Across the regions:**
  - Basic research techniques dominate
  - Less utilization of newer tools

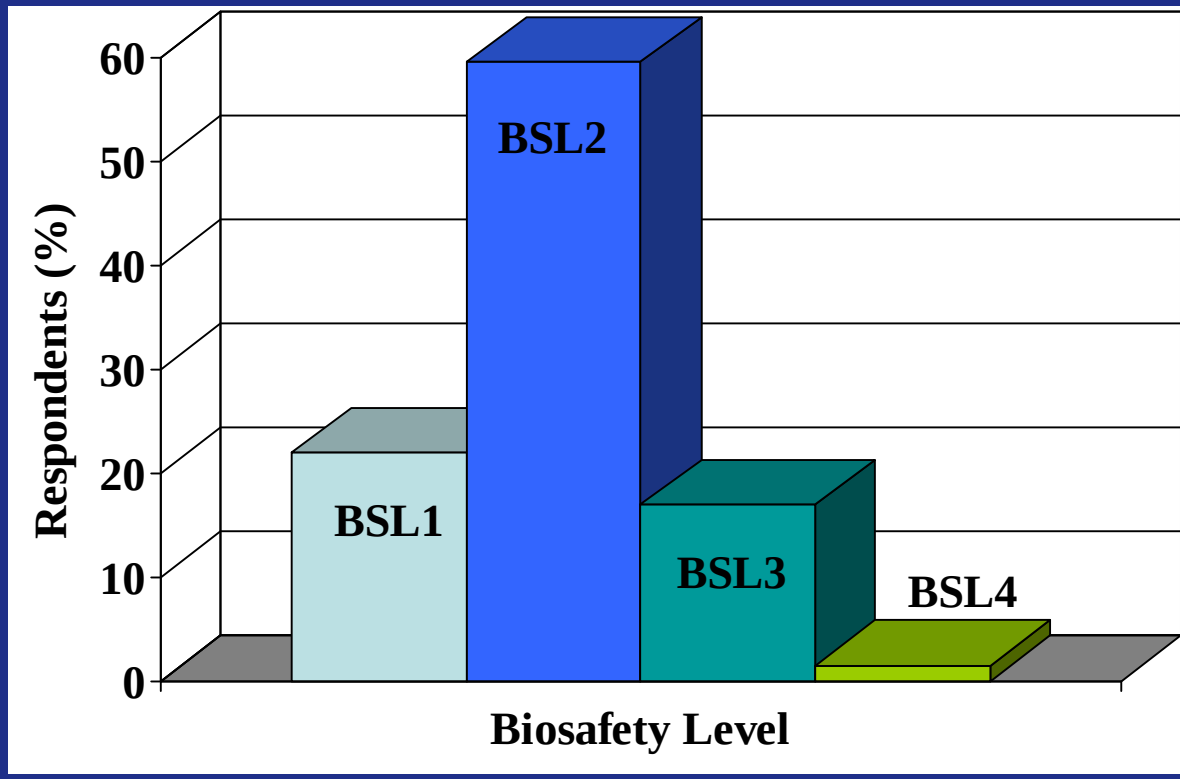
- **In general, Middle East lags adoption of newer techniques**
  - Sequencing: 19%
  - Microarrays: 3%
  - Chimeras: 1.3%

Research technique	% of all respondents using technique
Classical PCR	64%
ELISA	57%
Electrophoresis	56%
Sequencing	35%
RFLP	22%
SNP	8.4%
Microarrays	7.6%
RNAi	7.8%
Chimeras	5.3%
SAGE	1.8%

Reported Biosafety Levels

- **Most respondents work in basic biosafety labs**
- **Significantly fewer respondents work in containment labs**

- **Many do NOT know their biosafety level**
  - Latin America: 19%
  - Asia: 21%
  - Eastern Europe: 35%
  - Middle East: 44%



Often Inadequate Biosafety by US Standards

- **In Asia: ~2/3 of respondents studying Japanese encephalitis, HPAI, and SARS use BSL 2**
- **In the Middle East: most respondents studying Brucella, HPAI, and *Mycobacterium tuberculosis* use BSL2**
- **In Latin America: most respondents studying Hanta virus, Yellow fever virus, Dengue, and *Mycobacterium tuberculosis* use BSL2**
- **In Eastern Europe: *Mycobacterium tuberculosis* is evenly split between BSL2 and BSL3; the majority of HPAI, *Brucella*, and *Coxiella burnetti* work is done at BSL3 or BSL4**

- **Percentage of respondents who will do the experiment anyway if they do not have a particular item of safety equipment**
  - Nearly 50% in Asia
  - ~45% in the Middle East,
  - ~ 30% in Eastern Europe
  - Only 20% in Latin America

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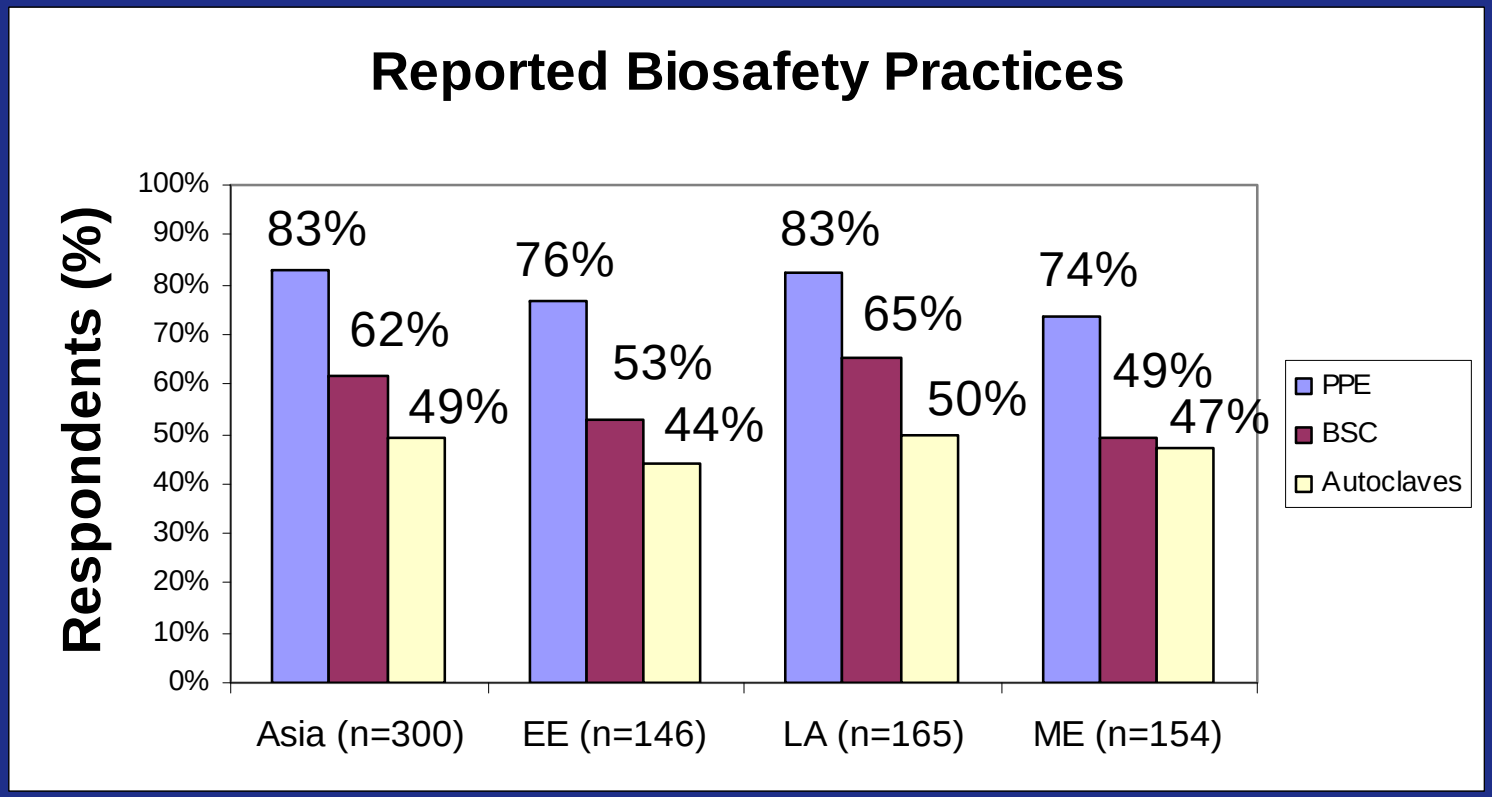
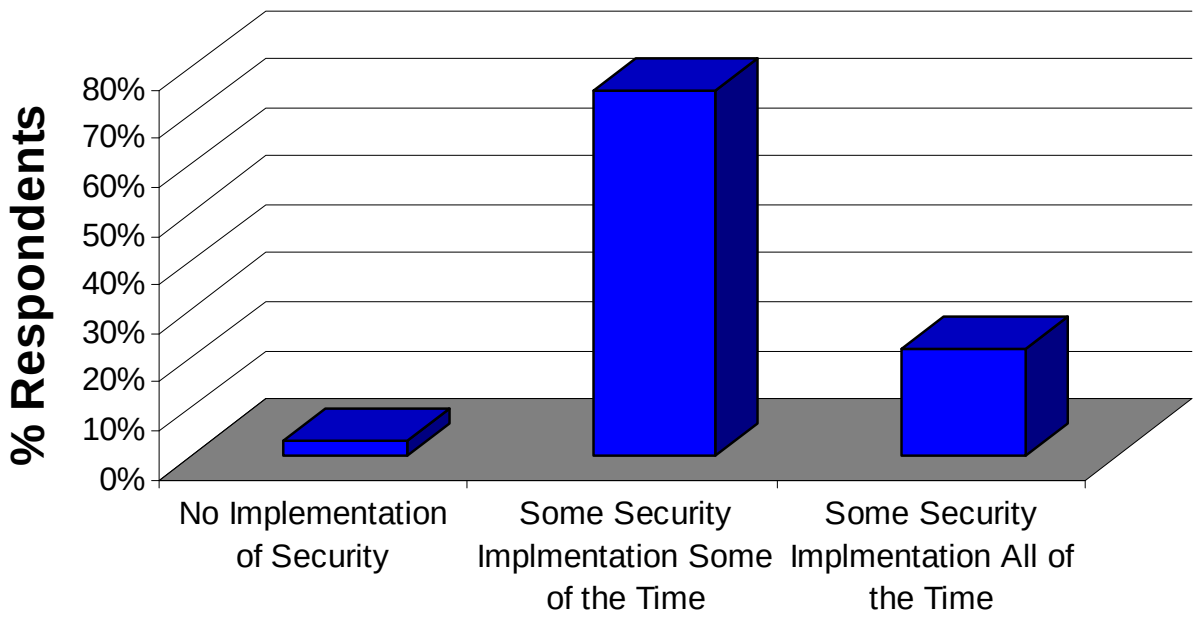
Reported Biosafety Practices

- **Most facilities have some form of PPE**
  - Primarily Gloves and Gowns
- **Only half the facilities have autoclaves within the laboratory or on-site**



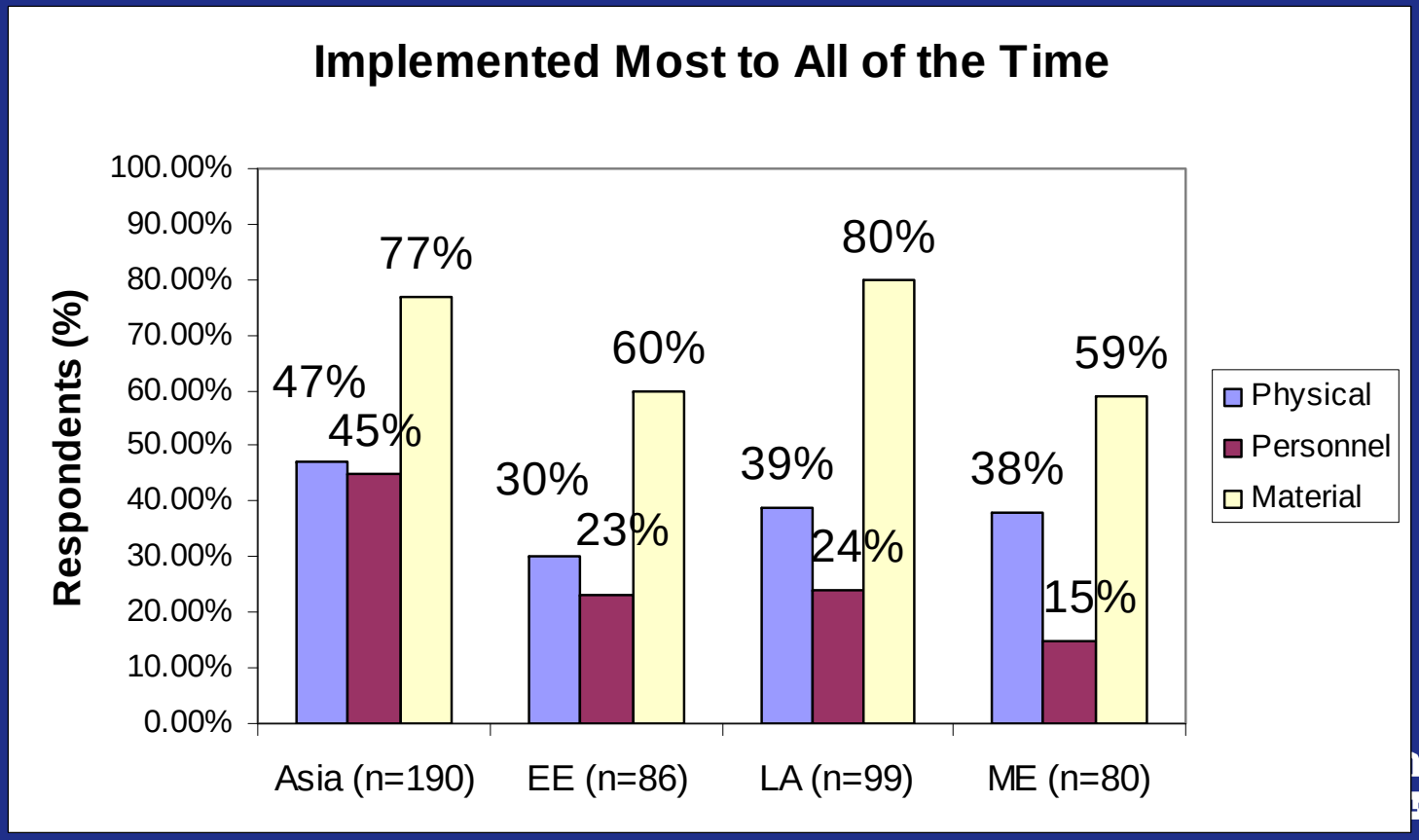
Reported Biosecurity

- **Biosecurity implementation was based upon practices of:**
  - Physical Security
  - Personnel Security
  - Material Control and Accountability
- **97% of the total respondents implement some level of biosecurity**
  - 27% implement some biosecurity all of the time
  - 70% implement some security at least some of the time



Reported Biosecurity Practices

- Most facilities implement some form of material control
- Less then half implement physical or personnel security
- Asia generally has the best implementation of biosecurity



Perceptions of Risk

- **Respondents very worried about lab-acquired infections**
  - Asia – 46%
  - Middle East – 46%
  - Latin America – 57%
  - Eastern Europe – 33%

- **Respondents very worried that the biological agent they study could be used to cause harm**
  - Asia – 44%
  - Middle East – 36%
  - Latin America – 42%
  - Eastern Europe – 24%

  - But, not from *their* lab….

- **Respondents who think it is likely or very likely that an employee would steal an agent with an intent to cause harm**
  - Asia – 15%
  - Middle East – 17%
  - Latin America – 9%
  - Eastern Europe – 7%

- **Respondents who think it is likely or very likely that an outsider would steal an agent with an intent to cause harm**
  - Asia – 14%
  - Middle East – 15%
  - Latin America – 7.5%
  - Eastern Europe – 8%

Challenges to Research

- **The cost of doing research was the biggest challenge in**
  - Asia and Eastern Europe
- **Delays in shipments of reagents and/or equipment was the biggest challenge in**
  - The Middle East and Latin America
- **Lack of necessary equipment is a significant challenge in all four regions**

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Key Conclusions and Opportunities

- **Biotechnology and bioscience is more advanced in Asia and Eastern Europe than Latin America; the Middle East lags behind**
- **Many commonalities across regions**
- **Cost is a significant factor**
  - Lower cost / lower technology solutions to managing biosafety and biosecurity risks must be made available

- **This study indicates possible avenues for providing education on biosafety and biosecurity**
  - Collaborations, including a strong reliance on Western scientists
  - For higher risk agents, respondents turn to WHO and CDC for guidance

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