

Ergonomics Meets Lean & Six Sigma: Reducing Physical Injuries while Improving Your Lab's Staff Performance and Health



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Utilize Key Tools to Ensure Ongoing Success

- Goals for Today:
 - Understand why combining Lean & Six Sigma Methodologies with Ergonomics makes sense
 - Review “case studies” and perform situational analysis of “good, bad and ugly” laboratory environments
 - Combine and utilize Lean / Six Sigma & Ergonomic tools to ensure ongoing success
 - Ergonomic guidelines
 - Spaghetti mapping
 - Standard work



Making the Case: National Health Care Spending

- Health expenditures in the United States over \$2.6 trillion in 2011, over ten times the \$256 billion spent in 1980
- National health spending reached over \$2.5 trillion in 2011, accounting for ~18 percent of the gross domestic product (GDP)
 - By 2018, national health care expenditures are expected to reach \$4.4 trillion—nearly double of where we are now
 - National health expenditures are expected to increase faster than the growth in GDP
 - Between now and 2018, the average increase in national health expenditures is expected to be 6.2 percent per year, while the GDP is expected to increase only 4.1 percent per year



Factors Driving Healthcare Spending

- Technology and prescription drugs
 - Availability of more expensive, state-of-the-art medical technologies and drugs fuels health care spending for development costs
 - Generate demand for more intense, costly services even if they are not necessarily cost-effective
- Rise in chronic diseases
 - Longer life spans and greater prevalence of chronic illnesses has placed tremendous demands on the health care system
 - Estimated that health care costs for chronic disease treatment account for over 75% of national health expenditures
 - In particular, there has been tremendous focus on the rise in rates of overweight and obesity and their contribution to chronic illnesses and health care spending
- Administrative costs
 - At least 7% of health care expenditures are estimated to go toward for the administrative costs of government health care programs and the net cost of private insurance



Source: <http://www.kaiseredu.org/Issue-Modules/US-Health-Care-Costs/Background-Brief.aspx>

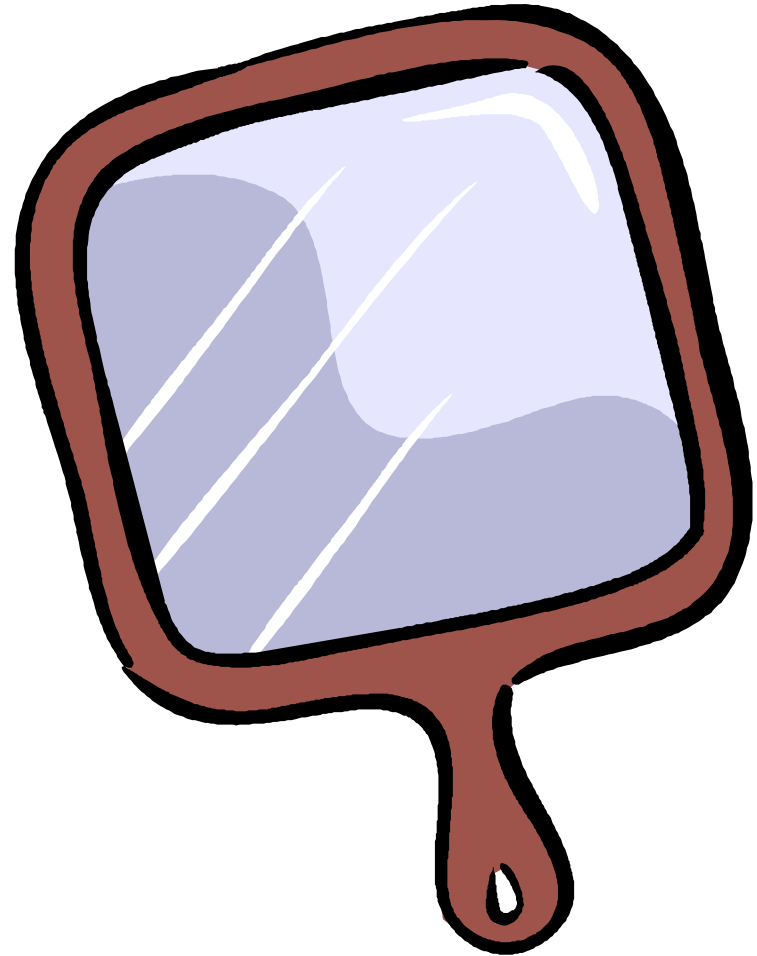
Employer and Employee Health Insurance Costs

- The cumulative increase in employer-sponsored health insurance premiums have risen at four times the rate of inflation and wage increases during last decade
 - This increase has made it much more difficult for businesses to continue to provide coverage to their employees and for those workers to afford coverage themselves
 - The average employer-sponsored premium for a family of four costs close to \$13,000 a year
 - Employee foots about 30 percent of this cost
 - Health insurance costs are the fastest growing expense for employers
 - Employer health insurance costs overtook profits in 2008, and the gap grows steadily
 - Over the last decade, employer-sponsored health insurance premiums have increased 119 %
 - Employees have seen their share of job-based coverage increase at nearly the same rate during this period jumping from \$1,543 to \$3,354



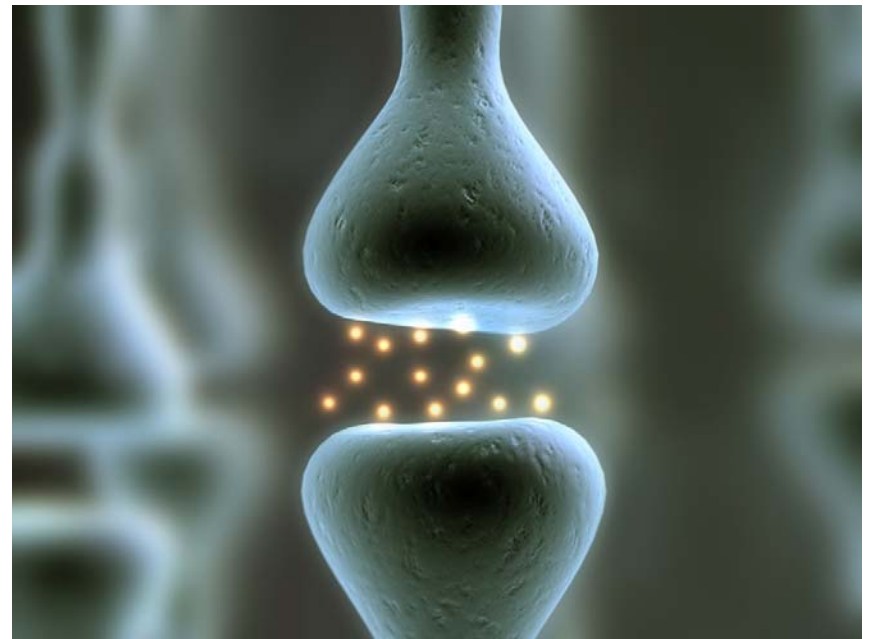
So What Does This Have To Do With Me...

- It means that if you (or anyone on your team) lose your ability to do work in the laboratory for a healthcare reason, then:
 - It may not only cost you personally in terms of healthcare costs
 - It may also cost you professionally because you may not be able to do your job
 - Think about it: if you can not use your hands, if your neck or back hurts, if your legs and feet are tired, you may be distracted by pain, weakness, and numbness in your body and this will compromise your ability to perform your work at your best, if at all



Definition of Musculoskeletal Disorders

- Musculoskeletal disorders can affect the body's muscles, joints, tendons, ligaments and nerves
 - Most work-related MSDs develop over time and are caused either by the work itself or by the employees' working environment
 - MSD's can also occur in the patients life outside work either through sport - tennis (elbow); music - guitar playing or a hobby - on-line tracing of a family tree
 - These external work events can be exacerbated by their daily profession.
 - They can also result from fractures sustained in an accident.
 - Typically, MSDs affect the back, neck, shoulders and upper limbs; less often they affect the lower limbs

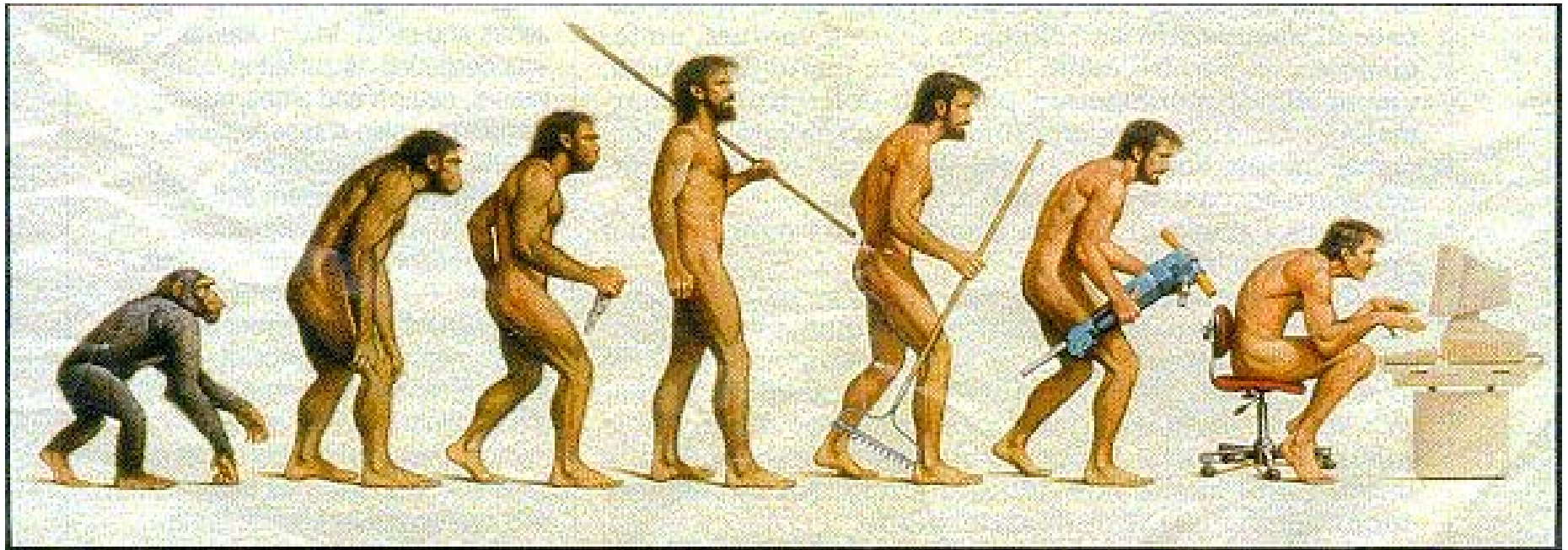


Factoid on Musculoskeletal Disorders

- In the United States alone, the annual cost associated with the diagnosis and care of musculoskeletal trauma amounts to tens of billions of dollars
 - In the United States today, occupational musculoskeletal disorders are the leading causes of work disability
 - Changes in health care policy and demand for improved allocation of health care resources by the Federal government have also recently placed greater pressure on health care professionals to provide the most cost-effective treatment for these disorders, as well as to validate treatment effectiveness

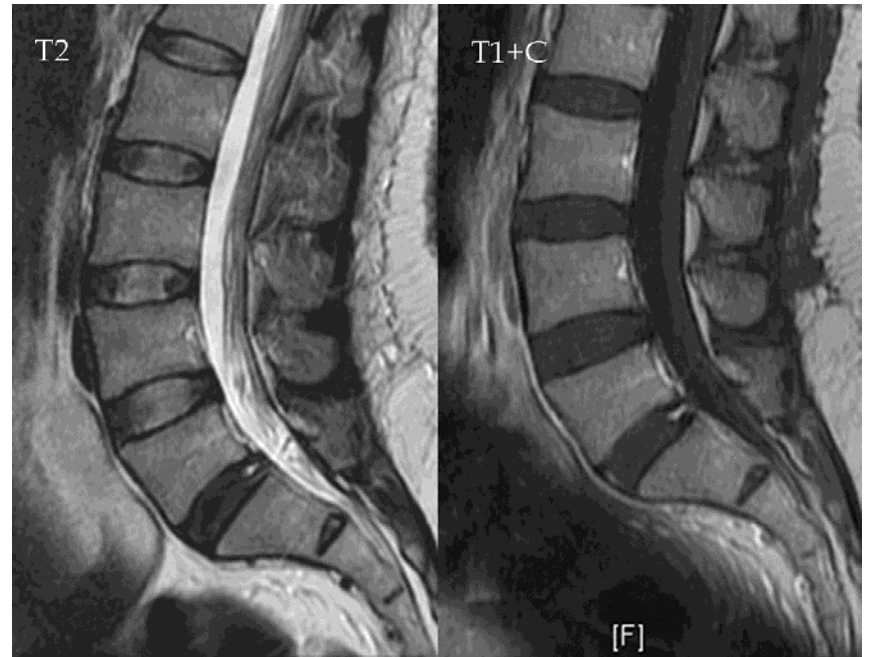


Back Injuries: We Pay a Price for Walking Upright



Low Back Injuries

- Low back injuries
 - Estimated total costs for low back pain is approximately \$16 billion annually in the US
 - Prevalence of back injuries is highest in the lower back (L5-S1)
 - Higher compression forces
 - Increased torque



Slip, Trip, or Fall: Definitions

- Slip
 - When there is too little friction or traction between your feet (footwear) and the walking or working surface, and you lose your balance
- Trip
 - When your foot (or lower leg) hits an object and your upper body continues moving, throwing you off balance
 - When you step down unexpectedly to a lower surface (Misstep) and lose your balance, e.g., stepping off a curb
- Fall
 - Occurs when you are too far off your center of balance



Injuries from Slips, Trips, and Falls

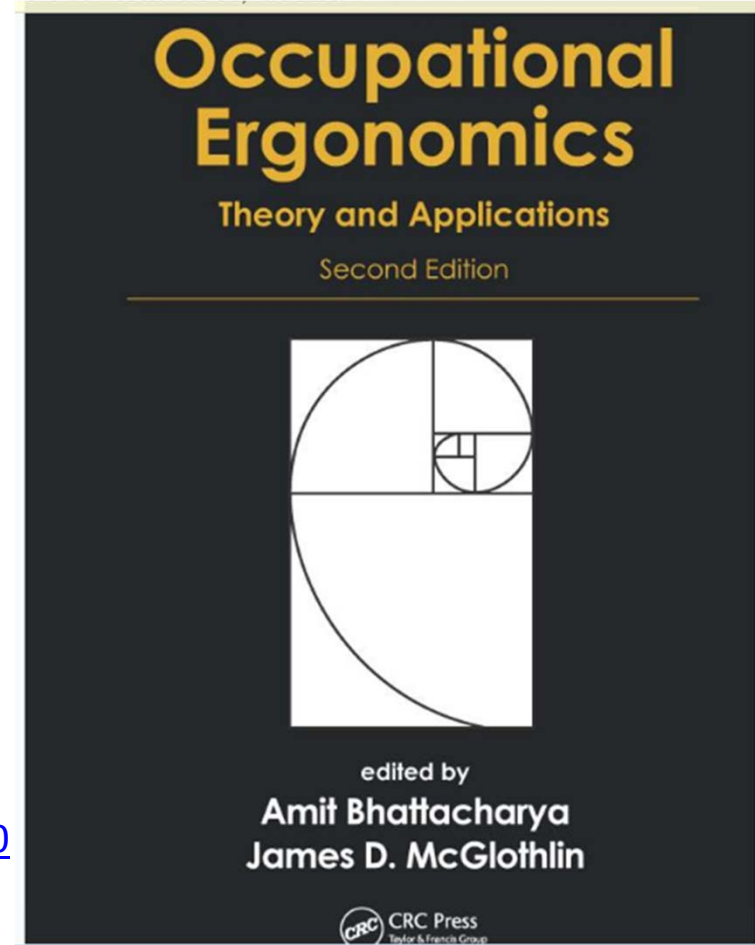
- Common types of injuries
 - Sprains, strains
 - Bruises, contusions
 - Fractures
 - Abrasions, lacerations
- Commonly affected body parts:
 - Knee, Ankle, Foot
 - Wrist, Elbow
 - Back
 - Shoulder
 - Hip
 - Head



What is Occupational Ergonomics

- The word ERGONOMICS is derived from the Greek language:
 - Nomos (meaning Laws of...)
 - Ergo (meaning Work)
- Literally translated Ergonomics means:
 - “The Laws of Work”

For further reading on this topic please link to:
<http://www.crcpress.com/product/isbn/9781439819340>



The Good, The Bad...and the Ugly



Again, what does all this have to do with me...and more importantly, what to look for in your laboratory

The Ugly Back and Neck Posture

- Challenge:
 - Work surface height for taller laboratory researchers results in them working in awkward postures resulting in prolonged static loading of the spine and neck
 - A shorter laboratory researcher may not have these challenges but may have to raise their arms causing static loading on their shoulders



The Ugly Force and Posture of the Hands

- Challenge:
 - High forces, static loading, and awkward postures of the hands can lead to musculoskeletal disorders



The Ugly

Extended Reach Static Loading of the Shoulders

- Challenge:
 - Extended forward reaches can lead to musculoskeletal disorders of the shoulders
 - Biomechanical loading of the shoulders and back can occur if the objects being lifted are heavy



The Ugly

Static Loading and Precision Work

- Challenge:
 - Injecting precise amounts of fluid into cartridge
 - Static loading of hands and shoulders



The Ugly Specimen Storage and Organization

- Challenge:
 - Forced awkward positioning while searching for specimens or materials



The Ugly

Ejection of Pipette Tips Can Cause Musculoskeletal Disorders

- Challenge:
 - Significantly force required to eject pipette tips



The Ugly

Lack of Leg Space Below Vent Hood

- Challenge:
 - Awkward seating posture leads to back and neck pain



The Bad Reach to High Shelves

Opportunity for tall researchers and a
challenge for shorter researchers



The Bad

Fixed Counter Height Sight Lines and Machine Function

Opportunity for tall researchers and a challenge for shorter researchers



The Bad Specimen Storage: Deep Freeze



Inability to locate needed supply before opening freezer

The Bad Work Organization and Workflow

Workflow and organization must flow with
the specimen process



The Bad Pipettes Come In All Shapes and Sizes

There is no “one size fits all” pipettor



The Good Step Stool to Help with Reach and Sight Line



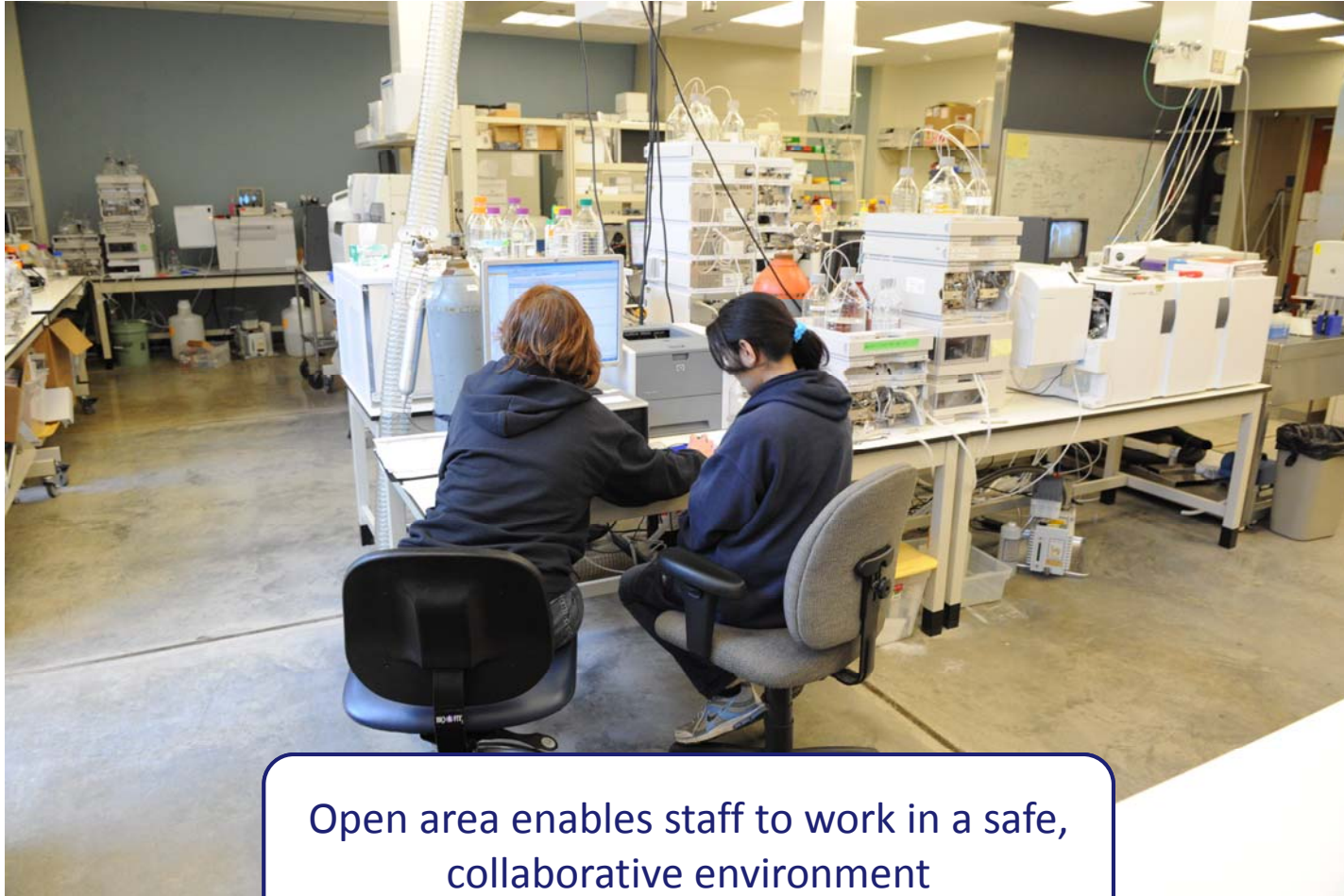
A stool enables entire staff to properly
utilize equipment

The Good See Through Cold Storage



See through storage enables the ability to search for a specimen before awkwardly positioning your body

The Good Team Work: Analysis and Interpretation



Open area enables staff to work in a safe,
collaborative environment

The Good

Male vs. Female Hand Size and Pipette Diameter

Ensure to enable your staff to choose the best fit for their pipettor



The Good

Store Light and Non-Breakable Goods Overhead

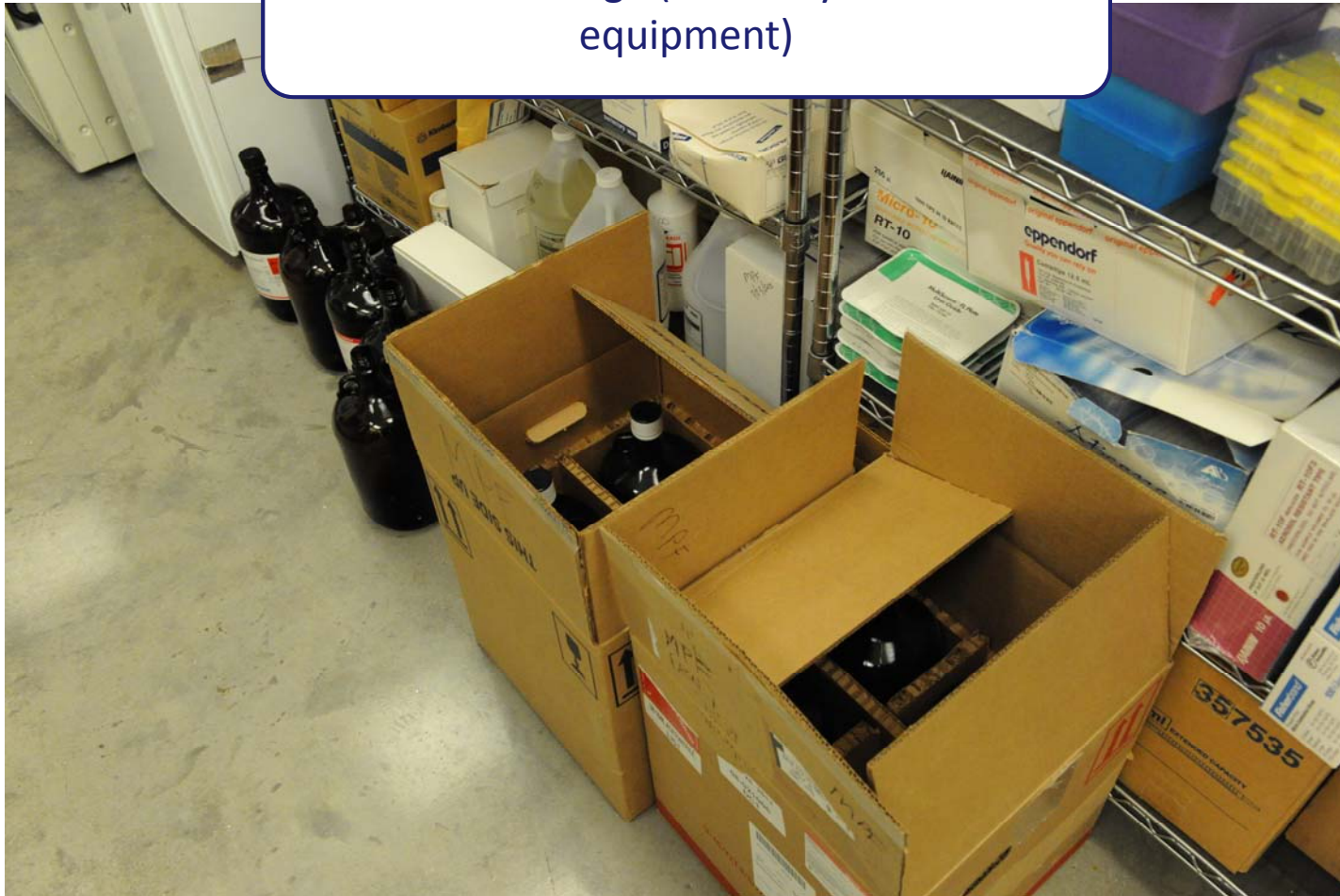
Easy to remove...nothing heavy falls on your head!



The Good

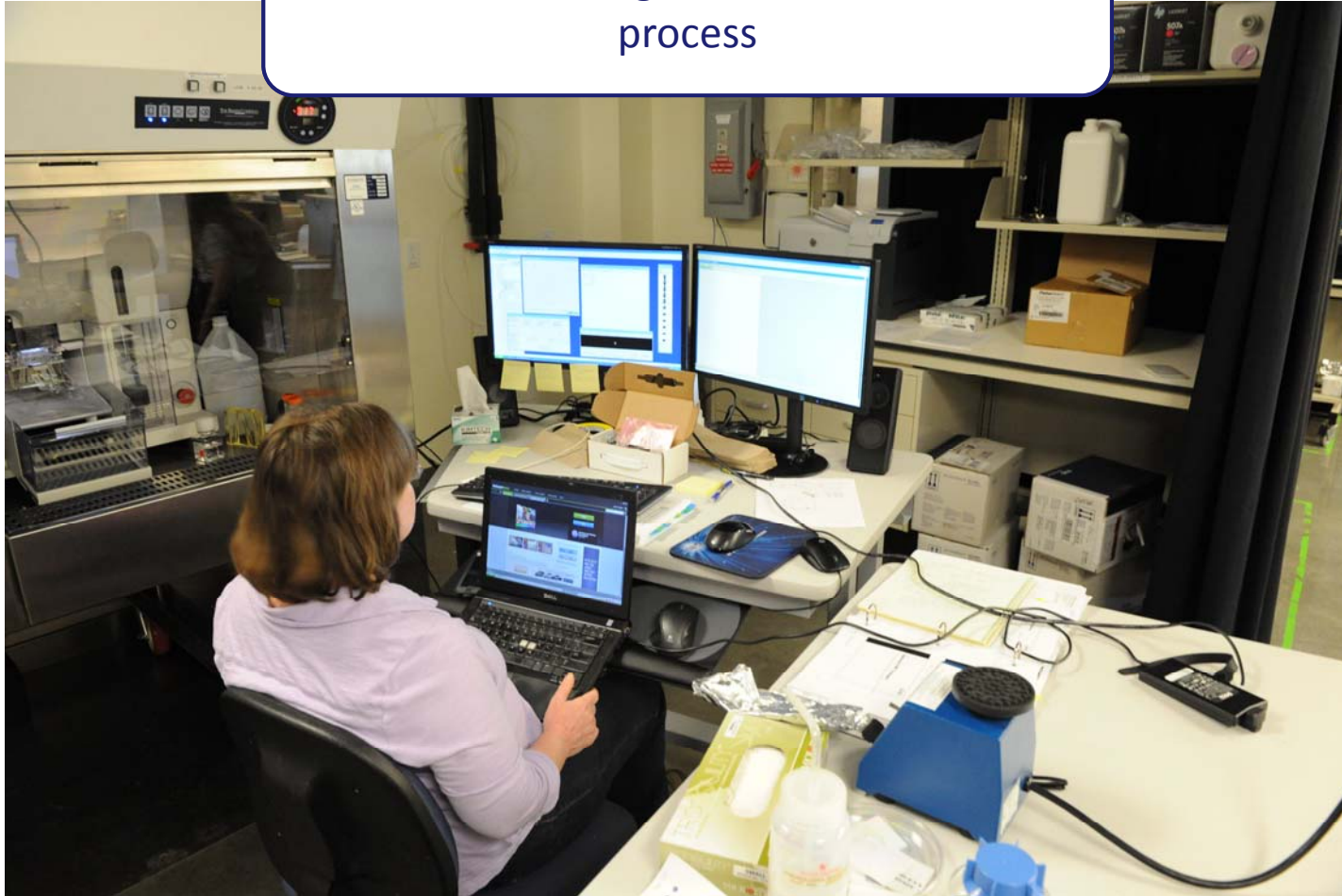
Heavy Breakable Objects Should Be Stored on Floor but Out of Walk Area to Avoid Trips/Falls

Minimizes damage (both to your staff and equipment)



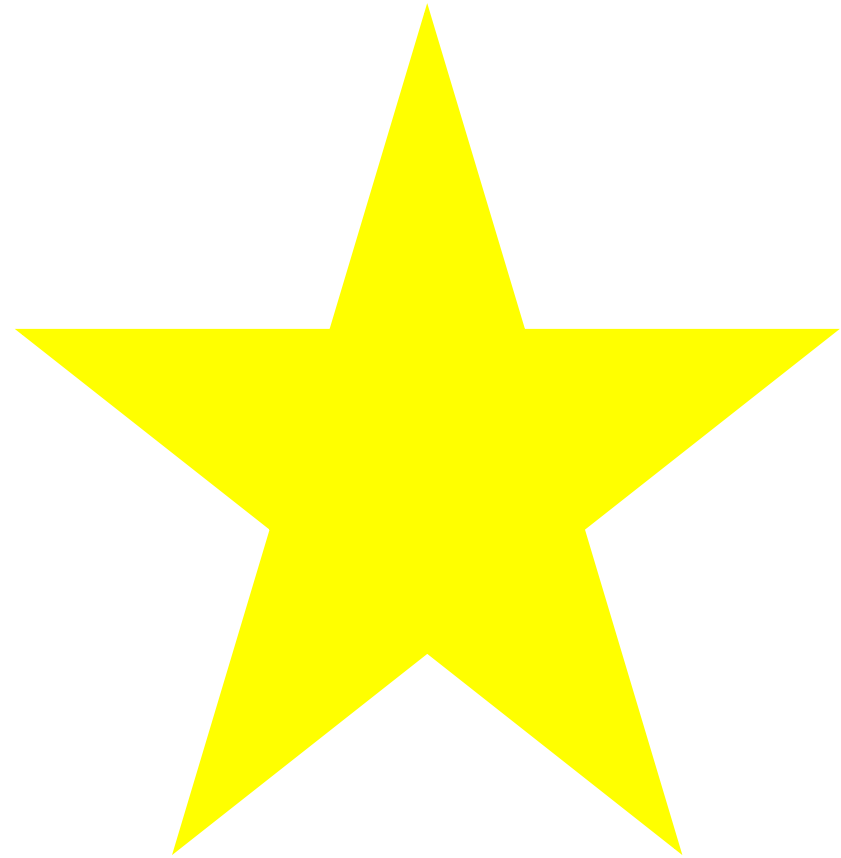
The Good Work Organization and Information Processing

Work follows organized, standardized process



Laboratory Design “Perfect State”

- Gold standard
 - Movable, variable height benches
 - Open doors, open shelving
 - Ability to move benches and redesign on moments notice
 - Ergonomically “friendly”
- Business Case
 - Life expectancy of lab equipment is 5 years...
 - Life expectancy of a laboratory is 20 years
 - Expect to change your lab 4 times!


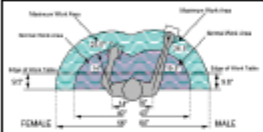





Laboratory Design & Layout Guidelines






- Steps to Success
 - Ensure physical layout is matched to processing workflow
 - Work benches should be laid out to direct the samples through the testing process
 - All work must be performed in the approved way
 - If changes are necessary, make small, cost-neutral changes before engaging in a major construction project
 - Utilize Ergonomic & Lean / Six Sigma tools to ensure ongoing success

Reference: CLSI Lab Design Guidelines (CLSI GP18)




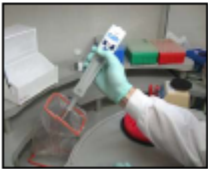
Utilize Key Tools to Ensure Ongoing Success Checklist

	Yes	No	Change/Modification	Comments
Standing Bench				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Adjustable height benches <input type="checkbox"/> Adjustable chair <input type="checkbox"/> Temporary standing platforms <input type="checkbox"/> Move the task to a seated bench with adjustable chair	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Reposition tools and supplies within 18" distance <input type="checkbox"/> Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Work at open bench cut outs <input type="checkbox"/> Remove supplies and equipment from bench cut out areas <input type="checkbox"/> Modify bench surface with clamp on cut out extensions to increase knee and foot clearance	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Install rails or foot props <input type="checkbox"/> Use footrest <input type="checkbox"/> If bench has undersurface cabinet, open or remove door and place foot on lower shelf	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide floor mats <input type="checkbox"/> Use cushioned shoes and in-soles	


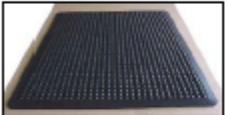


Utilize Key Tools to Ensure Ongoing Success Checklist

		Yes	No	Change/Modification	Comments
	6. Does the bench have rounded or padded edges to reduce contact stress?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Add edge rests and protectors to eliminate sharp edges <input type="checkbox"/> Use gel pads on surface to protect elbows <input type="checkbox"/> Wear custom padded sleeves under lab coat	
	7. Is standing bench available for tasks requiring frequent movement between workstations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Redesign work to reduce movement between stations to optimize workflow	
Seated Bench					
	8. Are bench cutouts available for seated workers? a. Minimum 15" depth b. Minimum 20" width	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Redesign benches to provide cutouts for seated work <input type="checkbox"/> Provide sit-stand chairs to improve knee clearance when working <input type="checkbox"/> Clear out cutouts if cluttered with supplies or equipment	
	9. Are work items within close reach? a. Maximum 24"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Reposition tools and supplies within 24" distance <input type="checkbox"/> Provide tool organizers, turntable workstations, turntables, storage bins, pipette holders and carousels	
	10. Is seated bench available for tasks requiring precision and close inspection?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide arm supports for stability if not available <input type="checkbox"/> Provide sit-stand stools <input type="checkbox"/> Provide adjustable work platforms to position work at optimal height	
Laboratory Chairs					

Utilize Key Tools to Ensure Ongoing Success Checklist

		Yes	No	Change/Modification	Comments
Cabinets					
	37. Is leg, knee clearance available to promote neutral sitting postures when using the hood or cabinet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Clear knee area under cabinet or hood <input type="checkbox"/> Use sit/stand stool	
	38. Can workers work with shoulders relaxed when sitting or standing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Consider height adjustable hood or cabinet <input type="checkbox"/> Use height adjustable stool/chair	
	39. Is padding available to reduce soft tissue compression (edge padding or arm pads)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Use elbow pads <input type="checkbox"/> Use edge padding <input type="checkbox"/> Use arm supports	
	40. Are materials inside the hoods and cabinets as close as possible to the worker to avoid over-reaching?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Position receptacles within close reach <input type="checkbox"/> Use turntables, rotating organizers, angled platforms	

Utilize Key Tools to Ensure Ongoing Success Checklist

	Yes	No	Change/Modification	Comments
 <p>41. Are vials, tubes and receptacles as low profile as possible?</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide low profile vials, tubes and receptacles <input type="checkbox"/> Angle receptacles to position within closer reach	
 <p>42. Are anti-fatigue mats used if employees stand for more than 4 hours per day?</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide anti-fatigue mats <input type="checkbox"/> Provide foam insoles for shoes <input type="checkbox"/> Provide supportive shoes	
Miscellaneous				
 <p>43. Are bottle dispensers and bottom dispensing carboys available to dispense liquids?</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide bottle dispensers <input type="checkbox"/> Provide bottom dispensing carboys <input type="checkbox"/> Provide bottles with handles	
 <p>44. Is there adequate and appropriate storage for supplies? a. Is sufficient space available for supplies? b. Are heavy bottles and boxes stored on low shelves?</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Provide storage for supplies <input type="checkbox"/> Place heavy items on shelves between knees and chest level	

Utilize Key Tools to Ensure Ongoing Success

- Lab Design Ergonomic Guidelines
 - Operators should have:
 - All needed equipment & materials located at the point of use or in sequence of use
 - Instrumentation / Equipment
 - Sinks
 - Computer keyboards
 - Computer mice
 - All needed consumables / disposables located at the point of use in adequate supply
 - Pipettes
 - Pipette tips
 - Loops
 - Pens



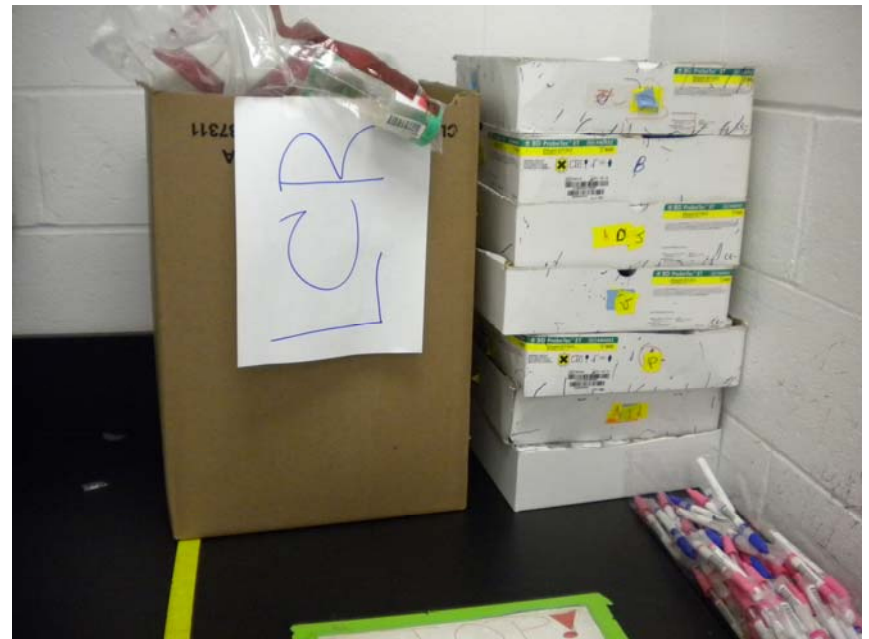
Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - Syringes located at the point of use in adequate supply



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - All needed equipment & materials located at the processing bench
 - Specimens
 - Specimen transport containers
 - Racks
 - Waste bin



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - All needed equipment & materials located at the processing bench
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Utilize Key Tools to Ensure Ongoing Success



- Lab Design Ergonomic Guidelines
 - Operators should not be:
 - Reaching
 - Bending
 - “Borrowing” supplies
 - Searching for adequate supplies
 - » Traveling for supplies
 - Transporting heavy / bulk solutions

Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Regular maintenance required
 - significant duration of time spent bending / reaching



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Analyzer required the regular transporting of heavy, bulk solutions across the laboratory to reagent storage



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Significant amount of reaching, bending & transporting necessary to maintaining daily molecular inventory
 - Required searching



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Inability to access inventory without bending & reaching
 - Inability to easily access inventory
 - Inventory not located in close proximity to testing area
 - Required transport of heavy materials



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Required transport of bulk solutions across laboratory to dispose into sink



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Opportunity for improvement
 - Daily searching & transport of supplies was necessary



Utilize Key Tools to Ensure Ongoing Success

- The focus of Lean in the facility design is to:
 - Remove wasteful practices
 - Create value-added steps to the process flow while eliminating non-value-added steps
 - Facilitate employee involvement



Utilize Key Tools to Ensure Ongoing Success

- The focus of Six Sigma in the facility design is to:
 - Identify & remove process variation
 - Achieve and maintain standardized laboratory design
 - Optimize testing protocols and work practices



Utilize Key Tools to Ensure Ongoing Success

- The blending of Lean / Six Sigma involves:
 - Standardizing work practices
 - All stations are set up identically
 - Everyone performs work identically
 - Maximizing the utilization of existing space
 - Storage cabinets and shelves are kept open and uncluttered
 - Reducing the amount of space that is needed
 - Drawers are virtually eliminated



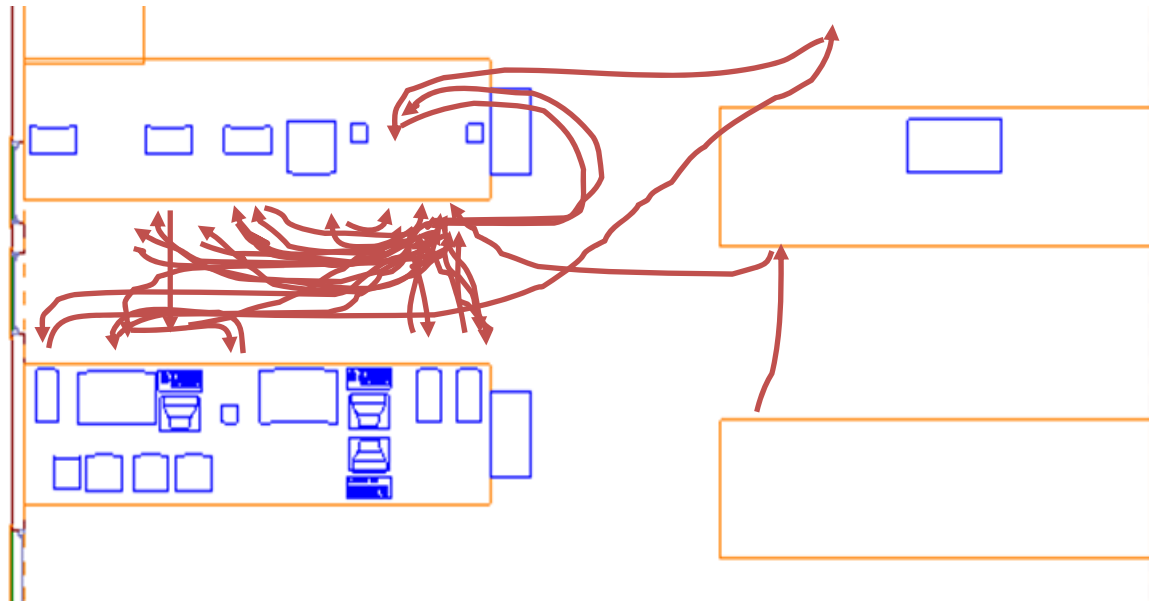
Utilize Key Tools to Ensure Ongoing Success

- Spaghetti Diagrams
 - A method of viewing data to visualize possible flows through systems
 - Can be used to quantify workflow and objectively analyze the physical laboratory layout
 - Visualizing flow in this manner can reduce inefficiency within the flow of a system



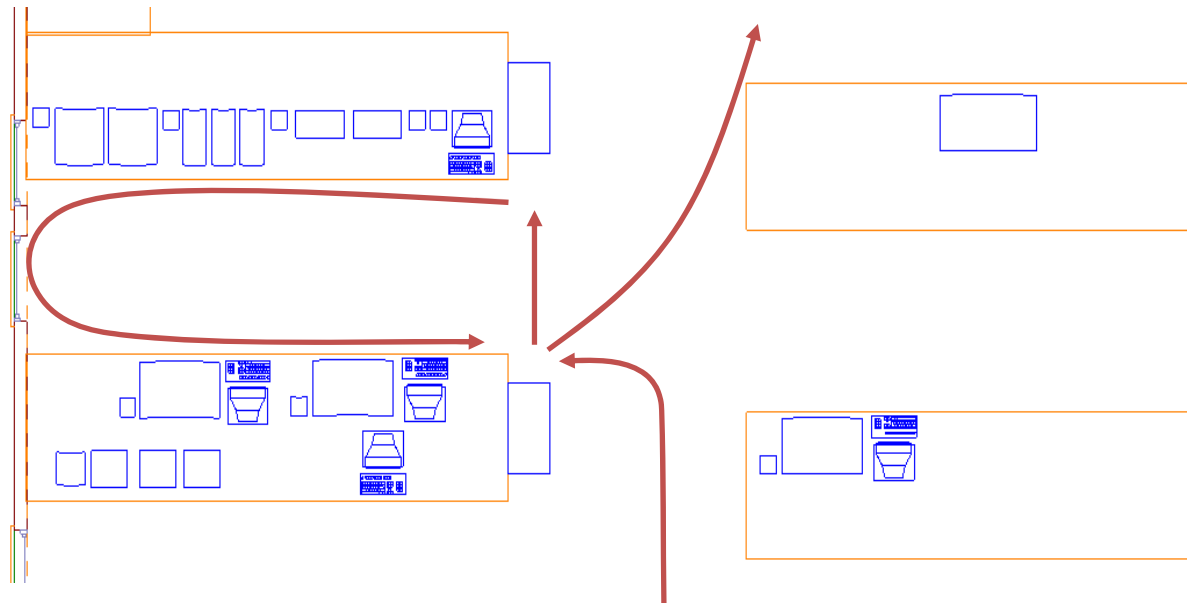
Utilize Key Tools to Ensure Ongoing Success

- To implement use of the Spaghetti Diagram tool:
 - Draw a rough sketch of the laboratory
 - Identify and label key pieces of instrumentation and furniture
 - Observe laboratorians performing work processes
 - For each step, draw an arrow depicting process movements
 - Identify wasted or unnecessary movements



Utilize Key Tools to Ensure Ongoing Success

- To implement use of the Spaghetti Diagram tool (cont.):
 - Implement changes to improve testing process
 - Observe laboratorians performing work processes
 - For each step, draw an arrow depicting process movements
 - Compare before and after to assess efficiency gains



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - Maximized used of space
 - Storage cabinets and shelves are kept open and uncluttered
 - Ability to see exactly what is in storage
 - Uni-directional processing flow



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - Maximized used of space
 - Storage cabinets and shelves are kept open and uncluttered
 - Ability to see volume of pending & completed specimens



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - Identical work cells enable staff to perform standardized processing at any station
 - Storage cabinets and shelves are kept open and uncluttered
 - Ability to see inventory at a glance
 - Uni-directional processing flow



Utilize Key Tools to Ensure Ongoing Success

- Benchmarked
 - Best Practice
 - Identical work cells enable staff to perform standardized processing at any station
 - Uni-directional processing flow



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