

THE PRACTICAL GUIDE TO

ERGONOMIC LIQUID HANDLING

IMPROVE PIPETTING COMFORT, ACCURACY AND THROUGHPUT IN YOUR LAB

INTEGRA

FOREWORD

Pipetting may appear simple, but it demands more physical effort than many realize, and places significant strain on the operator's thumb, wrist, shoulder and neck. In fact, pipetting involves constant thumb flexion and abduction, sustained muscle loading, awkward postures and joint stress which can lead to musculoskeletal disorders (MSDs) in the long term.[1] There is a significant increase in the risk of developing repetitive strain injuries (RSIs) – including tendonitis, carpal tunnel syndrome, and joint and muscle pain in the neck, shoulders, arms and hands – when pipetting for more than 300 hours a year[2], which equates to as little as just 1 or 2 hours a day. Studies have even reported that almost 90 % of people who use pipettes continuously for more than an hour a day experience hand and/or elbow disorders[3].

Repetitive lab work can not only lead to physical discomfort, but may also negatively impact mental wellbeing and morale, potentially leading users to take days off sick. Awkward postures, pain and fatigue can also slow workflows and increase the likelihood of pipetting mistakes, lowering lab productivity and liquid handling accuracy. Ergonomic pipetting should clearly be a priority for every lab, especially those frequently performing liquid handling manually.

In this eBook, we will delve into the key factors to consider when setting up a lab and choosing ergonomic liquid handling equipment. This practical guide aims to help lab managers and scientists to develop a more user-friendly workflow to prevent RSIs and improve overall lab performance and productivity.



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CHAPTER 1: The hidden drivers of pipetting strain

What causes RSIs during pipetting and how can you prevent them?

The likelihood of developing an RSI from pipetting is largely dependent on 3 main risk factors: posture, force and repetition.



Posture

Pipetting is usually performed at a lab bench or in a laminar flow air cabinet. Users may need to rest their elbows on the benchtop due to the weight of the pipette, or they may have difficulty reaching under the sash while sitting upright. This means scientists must often hunch over to perform their routine liquid handling tasks. In addition, many lab personnel instinctively bend towards their work to better see what they are doing, and must constantly lean forward to load and eject pipette tips.

And that's not all. A chair or stool may be too high or too low for a user's feet to naturally reach the floor, causing them to sit awkwardly, and uncomfortable personal protective equipment may also contribute to unnatural posture. Large sample volumes and tight time constraints can lead to scientists maintaining a poor posture for extended time periods. Repetitive hunching or leaning forward can restrict blood flow to the muscles, and sitting incorrectly for long periods of time can put extra strain on the joints, particularly the neck and shoulders.



Force

RSIs are often caused by repeated forceful movements. For example, during manual pipetting, the plunger is thumb operated, with additional force needed to ensure all the liquid is dispensed. The thumb force is further increased when pipetting liquids with higher viscosity. Force is also needed when lifting the pipette and holding it in an upright position for a long time. The thumb contributes to stabilizing the pipette, and holding the pipette too tightly for extended periods can lead to nerve damage and, potentially, carpal tunnel syndrome. The weight of the pipette and hammering on pipette tips can exacerbate the problem and lead to hand pain.

The role of muscle load and fatigue

Muscle fatigue during pipetting is closely linked to the amount of force applied over time. Research shows that sustained muscle activity should remain below approximately 15 % of a user's maximum voluntary force to avoid rapid fatigue.[4] Exceeding this threshold – particularly during repetitive tasks – can significantly increase the risk of strain and long-term injury. Both static load (holding the pipette in position) and dynamic load (repeated thumb movements during aspiration and dispensing) contribute to overall fatigue. Static load is especially demanding, as it restricts blood flow to the muscles, accelerating the onset of discomfort.



Repetition

Pipetting relies heavily on a combination of forearm muscles, which generate force, and intrinsic hand muscles, which enable precise control. Accurate pipetting involves numerous highly monotonous movements, for example to attach tips, depress the plunger, move between labware and eject tips. These repetitive movements, though not strenuous in isolation, are repeated over and over again for several hours a day over the course of a working week, placing stress on tendons, ligaments, muscles and joints. This constant accumulation of strain may lead to irritation or inflammation, increasing the risk of developing an RSI in the forearm and hand, in particular in the thumb and wrist, where fine motor control and repeated motion are concentrated.

CHAPTER 2:
How ergonomics affects pipetting efficiency and accuracy



Extensive manual pipetting with heavy handheld devices often translates into poor posture, muscle pain and fatigue over the long term, with workers needing **more frequent breaks due to discomfort.**



Adjusting volumes on many manual pipettes requires repetitive wrist rotations and fine motor effort, taking up valuable time and **slowing down liquid handling workflows.**

This can result in **lower productivity and slower throughput** overall in the lab.



Muscle fatigue and joint pain can **lower aspirating and dispensing precision**, affecting the **reproducibility and reliability of results.**



Poor ergonomics can result in lapses in concentration, **increasing the likelihood of errors.**

Increased plunger force also **reduces the level of precision and control** that is possible during pipetting.

When joints move into extreme positions – such as bending the wrist or overstretching the thumb – muscle effort increases and **fine motor control is reduced**. This not only raises the risk of injury, but can also **negatively affect pipetting precision**.



CHAPTER 3:
Practical steps for preventing RSIs

The length of time it takes to recover from an RSI varies from case to case and, sadly, once you have been severely affected by an injury, the risk of recurrence is high. In severe cases, it may even be necessary to take sick leave until the pain subsides. RSIs can be treated in various ways, from pain killers and steroid injections to physiotherapy, depending on the symptoms, and you shouldn't hesitate to talk to a medical professional as soon as an issue appears.

Of course, preventing an injury from developing in the first place is far more effective than treatment. In fact, in many countries, employers are legally obliged to undertake a risk assessment for each workspace to evaluate potential RSI risk and prevent injuries. As well as these formal measures, here are a few general points that you can employ in your daily pipetting workflows to improve ergonomics and safeguard your health in the lab.

Adjust your pipetting technique

Check whether you are holding the pipette in the most ergonomic way possible, with minimum strain on your fingers, hand and wrist. Force is needed to lift a pipette up, hold it in an upright position during use, aspirate and dispense liquids, and attach and eject tips. You should therefore reduce the force required to perform any of these tasks. Maintaining neutral joint positions is essential for both comfort and control during pipetting. The wrist should remain straight, the thumb relaxed, and the elbow slightly flexed.

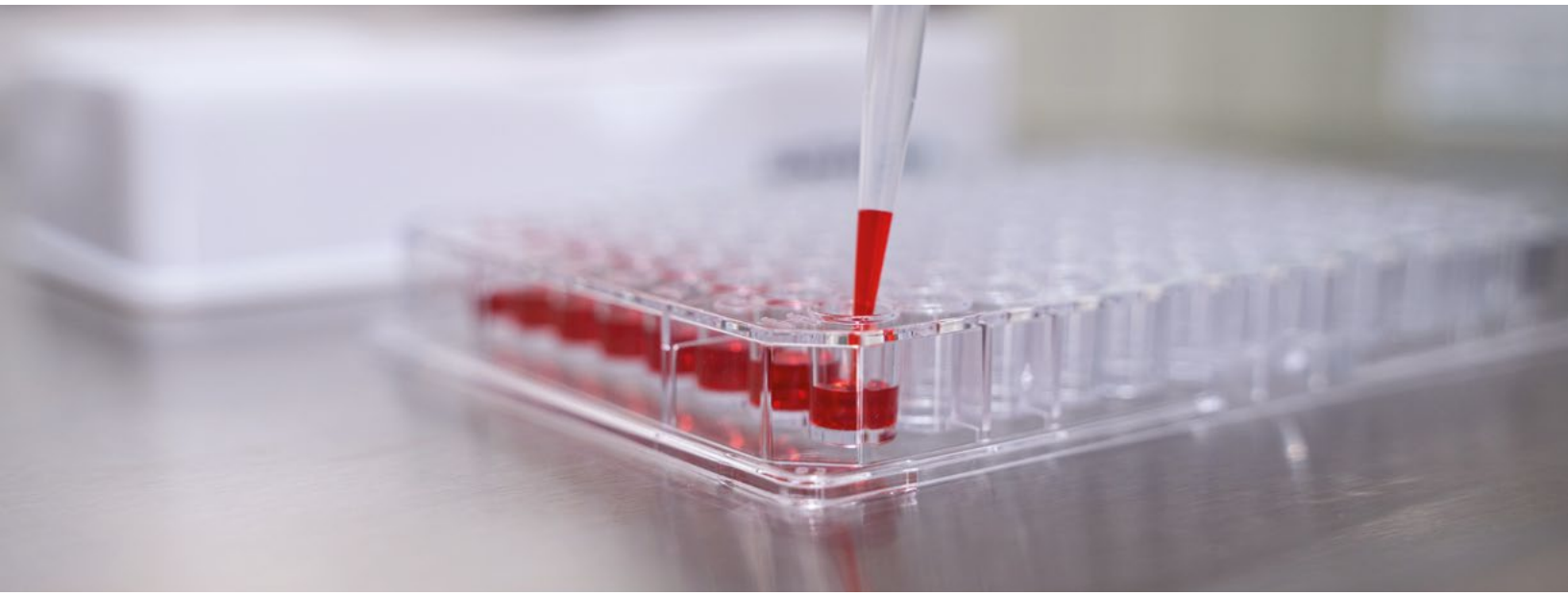
Pay attention to your posture

Sit in the middle of your chair or stool and keep your back straight as much as possible. Make sure your head and shoulders are aligned, with your head directly above the shoulders. You should also try to keep your shoulders relaxed and in line with your hips. Your legs should be placed beneath the lab bench or biosafety cabinet with feet flat on the floor or a footrest. Your arms should be kept close to your body, so it's important to organize your workplace to make sure that all reagents and labware are within easy reach, avoiding the need to stretch. Your arms should also not rest on the lab bench or sill of the laminar flow air cabinet, and you should avoid fully extending the elbow while pipetting.



Reduce repetitive motions

The initial symptoms of RSIs include pain, aching or tenderness, stiffness, throbbing, tingling, numbness, weakness and cramping of the hand, shoulder, neck, wrist or thumb. It's therefore important that once you notice any of these symptoms, you should identify the repetitive motion causing the pain and reduce its frequency if at all possible, or potentially avoid it completely while recovering.



CHAPTER 4:
Building in ergonomics with intelligent design features

Ergonomic liquid handling tools are clearly essential for reducing physical strain and improving pipetting efficiency and consistency, particularly during prolonged and repetitive tasks. There are several design aspects that can influence how comfortable a device is in the hand, how much force is required while pipetting, and how often a movement needs to be repeated.

Did you know?

Switching it up for enhanced ergonomics and workflow flexibility

INTEGRA Biosciences partnered with the Zurich University of Applied Sciences (ZHAW) to develop comprehensive ergonomic design guidelines for manual pipettes.[1] These guidelines were based on anatomical, biomechanical and task-specific criteria, including optimal grip dimensions, joint angles and muscle load tolerance. The SWITCH hybrid pipette was designed from the ground up in accordance with these expert recommendations, ensuring that it meets or exceeds the most critical ergonomic parameters. Internal benchmarking against leading manual and electronic pipettes then evaluated biomechanical factors such as plunger and ejector force, handle dimensions, weight and task efficiency. This helps to ensure that the SWITCH delivers superior ergonomic performance across a wide range of applications.

Lightweight, balanced instruments

The strain of lifting a pipette and keeping it in an upright position cannot be avoided completely without switching to benchtop or automated instruments. However, pipettes with a lightweight, well-balanced design and optimal dimensions are easier to hold and help to minimize static muscle load and reduce fatigue during prolonged use. Finger hooks, for example, ensure that some of the pipette's weight rests on the index finger, and that the hand and fingers can loosen their grip. Moreover, pipettes with handles that can be rotated help to keep the wrist in a neutral position, allowing each user to choose their ideal position. Pipette handles that can be rotated help with this as they enable the user to choose whatever they find most comfortable.

Effective grip design should distribute pressure evenly across the hand, avoid sharp edges or pressure points, use rounded or slightly cylindrical shapes, and allow flexibility for different hand sizes, rather than enforcing fixed finger positions. For precision tasks such as pipetting, an optimal grip diameter typically falls within the range of 3 to 4 cm,[5] allowing for controlled finger movement without excessive muscle activation. Longer instruments increase the distance between the hand and the working area, requiring greater arm elevation and increasing strain on the shoulders and neck. Shorter designs allow users to work closer to the body, improving control and reducing unnecessary muscle effort.





The **SWITCH** combines the tactile feedback of a manual instrument with the speed of an electronic system, enabling users to switch seamlessly between manual pipetting and electronic repeat dispensing. It was built to fit comfortably in the palm across a broad range of sizes, providing a grip that is molded to suit the natural biomechanics of the hand. The pipette also features a tapered, cylindrical shape that reduces pressure on the little finger and allows neutral wrist alignment. The SWITCH weighs only 128-132 g – well below the grip force capabilities of both men and women, according to normative strength studies.[6] It is significantly lighter than typical electronic models, enabling users to maintain better posture and take fewer breaks due to discomfort, and reducing their risk of chronic fatigue.[1]



Set-up for manual pipetting, with the mode switch and plunger in the upper position for optimal liquid control

Repeat dispense mode, with the mode switch and plunger in the low position for fast dispensing

The **SWITCH** handle has diameters of 3 cm along its short axis (A-axis) and 3.7 cm along its long axis (B-axis) (**Figure 1**), comfortably within the ergonomically optimal range of 3 to 4 cm for tasks involving precision finger control.[5] This means it provides a grip that supports the natural biomechanics of the hand. This alignment validates the pipette's suitability for manual pipetting tasks that demand both control and comfort. In contrast, nearly all competitor pipettes fall significantly below this optimal range, particularly along the A-axis (**Table 1**).

Product	Company	A (mm)	B (mm)
SWITCH	INTEGRA	30.4	37
Product 1	A	27.1	36.1
Product 2	B	24	40.4
Product 3	C	26	30.3
Product 4	D	22.2	32
Product 5	E	23.6	35.6
Product 6	F	31	27.1

Table 1: A comparison of the dimensions (A-axis and B-axis) of different pipettes.

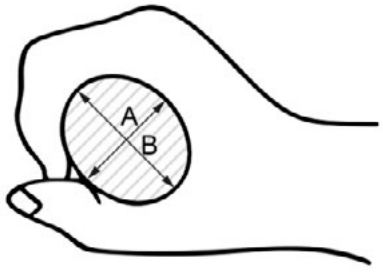


Figure 1: Image demonstrating the 2 key axes of a pipette (A-axis and B-axis).

VIAFLO electronic pipettes are comfortable to hold thanks to their lightweight, well-balanced design and finger hook, even during prolonged pipetting sessions. Multichannel **VIAFLO** pipettes also feature a handle that can be rotated so that every user can find their ideal pipetting position.



Low plunger forces

Manual pipettes only aspirate and dispense liquids when a plunger is moved up and down and, when using those pipettes, the plunger needs to be depressed and released with the thumb. Choosing pipettes with a minimal plunger force and stroke distance keeps the risk of problems such as thumb tenosynovitis as low as possible. Using electronic pipettes is an alternative solution that minimizes the strain placed on the thumb even more, as liquid displacement is controlled by a microprocessor.

The **SWITCH** combines the advantages of manual and electronic pipetting in one instrument, and has a low total plunger force across various volumes, requiring just 8.4 N of total force (the force to start, move and blowout the plunger) for 200 µl, and 8.2 N of total force for 1,000 µl – both values being half of that required by products from other manufacturers.[1] It also maintains a consistent plunger height across all volumes, keeping the thumb in a neutral, relaxed position. This allows the user to maintain complete control of the liquid at all volumes while avoiding overuse injuries in the thumb, making the pipette ideal for high throughput applications where the risk of RSIs is particularly high.

Our **EVOLVE** manual pipettes also offer low plunger forces, are lightweight and have a finger hook to minimize the risk of developing an RSI.



Reducing pipetting time

Multichannel and electronic pipettes can also help you to minimize the time you spend pipetting. For example, to fill all the wells of a 96 well plate with a specific amount of reagent using a manual single channel pipette, you would need to go back and forth between the reservoir and the plate 96 times. However, a multichannel pipette or electronic pipette with repeat dispense mode can aspirate a large amount of reagent from the reservoir, then aliquot the right amount into several wells from that single aspiration.

The **MINI 96** benchtop multichannel pipette transfers 96 samples in a single step, making plate filling faster and more reproducible. Individual columns of a plate can also be filled if needed. Up to 2 positions for labware can be used at one time, for example when performing serial dilutions. This avoids excessive plate handling, streamlining protocols and providing flexibility to find the most efficient set-up.

The **VIAFLO 96** and **VIAFLO 384** benchtop pipettes significantly increase laboratory efficiency by enabling the simultaneous transfer of 24, 96 or 384 samples in a single step, delivering fast, reproducible pipetting. Interchangeable pipetting heads can be swapped in less than a minute, allowing one compact instrument to handle a wide range of applications and volume requirements. Servo-assisted steering and an optional hands-free automatic mode eliminate the need for position programming, reducing hands-on time and ensuring consistent results. 3 deck positions further increase device flexibility for more efficient, high throughput liquid handling.

The **SWITCH** features an integrated repeat dispense function that eliminates the need to aspirate again before each individual dispense cycle. This dramatically reduces the total number of movements per task, and can reduce dispensing time by up to 50 %, compared to a traditional single channel pipette.[1]

The **VIAFLO** includes 10 intuitive, preset pipetting programs for common applications, and custom programs are also available for more complex assays, reducing the time spent pipetting and lowering the risk of RSIs. The **VIAFLO** can be mounted onto the **ASSIST PLUS** pipetting robot to automate liquid handling steps and allow less hands-on time. Simply choose a pipetting protocol, add a tip rack and your labware, press RUN and the **ASSIST PLUS** will automatically carry out the full workflow, removing the need to perform many manual steps for greater user comfort.



Wrist-friendly volume changes

Traditional manual pipettes use a single rotating dial or plunger to set the volumes, and the user must frequently twist and turn their wrist. This approach is particularly strenuous for the joints and muscles when switching from lower to higher volumes. Bending the wrist is especially problematic, placing it in an unnatural position. However, there are pipettes with alternative mechanisms for changing volumes that are easier and keep the wrist in a neutral position, for example, those featuring dials similar to combination locks. These mechanisms can reduce the degree of rotation required and minimize the risk of RSIs.

Volume adjustments on the **SWITCH** are fast and easy, resulting in faster set-up, significantly less strain during repetitive workflows, and a more comfortable pipetting experience for users. This makes it ideal for high throughput facilities performing repetitive workflows such as ELISAs, PCR preparation or cell culture. **Tables 2** to **4** show the time and number of wrist turns required to set the volume of the **SWITCH** compared to competitor manual products, with one turn representing a 45° turn of the wrist.



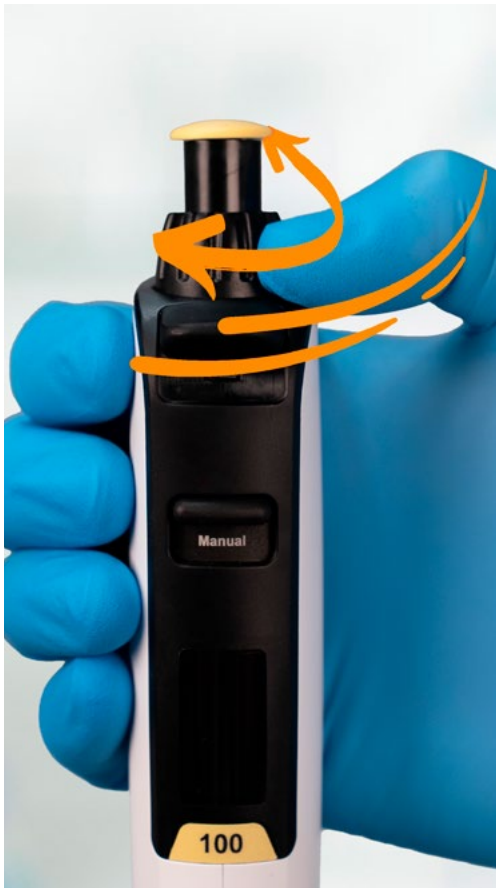


Table 2: Setting the dispense volume from 100 % to 50 %

Product	SWITCH	Product A	Product B	Product C	Product D
Company	INTEGRA	A	B	C	D
Time (s)	8	9	12	10	13
Wrist turns	10	15	15	13	18

Table 3: Setting the dispense volume from 10 % to 100 %.

Product	SWITCH	Product A	Product B	Product C	Product D
Company	INTEGRA	A	B	C	D
Time (s)	1	16	27	18	15
Wrist turns	1	24	44	27	21

Table 4: Setting the dispense volume to 25 % from 50 %.

Product	SWITCH	Product A	Product B	Product C	Product D
Company	INTEGRA	A	B	C	D
Time (s)	8	6	9	8	6
Wrist turns	4	6	11	8	6

In contrast to using a single rotating plunger or dial to adjust volumes, the **EVOLVE** features 3 separate quick set dials. This enables users to set volumes more than 10 times faster than with other volume changing mechanisms, and reduces the number of rotational movements needed.

On the **VIAFLO**, pipetting parameters can be adjusted using an ergonomic thumbwheel interface. This avoids the need to repeatedly push buttons to change settings, easing the strain on fingers and hands.





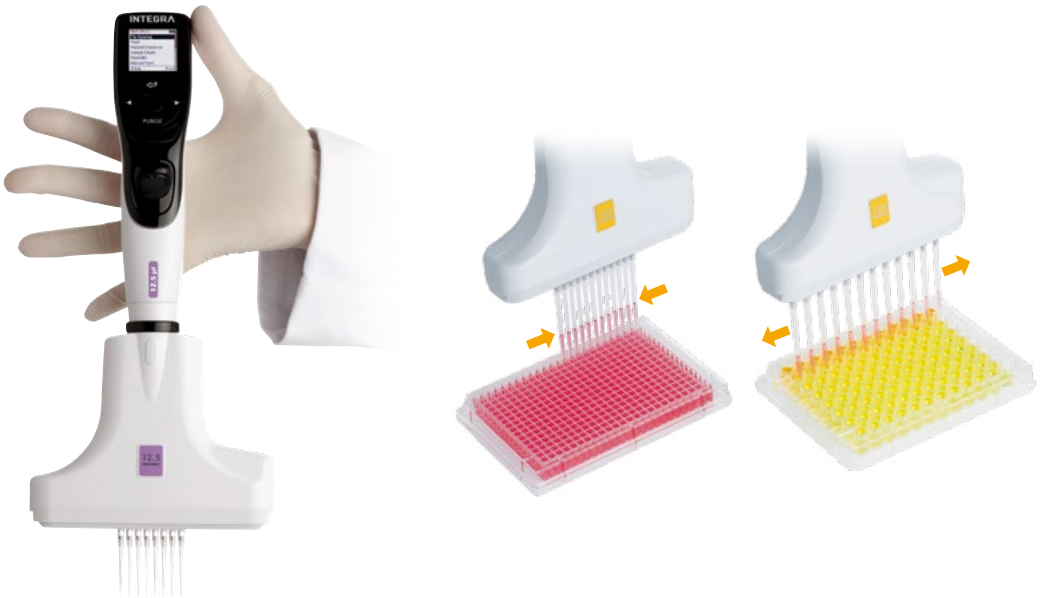
Fewer motion-intensive transfers

Performing the same movements over and over again always increases the risk of developing or aggravating an RSI, so you should look for pipettes designed to reduce the number of pipetting steps and increase your efficiency. Multichannel, adjustable tip spacing and electronic pipettes can all help to cut the number of physical steps required during liquid handling, streamlining tasks including transferring reagents from a reservoir to a microwell plate. For example, instead of performing 96 transfers from the reservoir to a 96 well plate with a single channel pipette, an 8 channel pipette will reduce the number of transfers to just 12.

The **EVOLVE** is available in single, 8, 12 and 16 channel options with a rotating handle on all multichannel options, minimizing the number of pipetting steps for a more ergonomic workflow.

Adjustable tip spacing pipettes can transfer several samples between labware formats in parallel, such as between tubes and 384 well plates, which is far easier than using a single channel pipette many times to transfer reagents or samples from one vessel to another.

VOYAGER adjustable tip spacing pipettes are ergonomically designed with a finger hook and rotating handle, and they feature a thumbwheel interface and various pipetting modes to speed up workflows. With their automatic adjustable tip spacing functionality, users can expand or reduce tip spacing at the push of a button and effortlessly transfer multiple samples from one labware format to another, which is much more convenient than using a single channel pipette. This drastically cuts the time spent pipetting and, at the same time, reduces the risk of RSIs.



Easy pipette tip attachment and ejection

Pipette tips are made from polypropylene, which has a memory effect and wants to move back to its original shape. This is why universal tips eventually loosen, leak or fall off, and why operators using them must hammer their pipettes into the tips to make sure they are secure for the duration of the pipetting step. This leads to high attachment forces and increases the ejection force needed to remove the tips. In contrast, pipettes designed to work with proprietary tips that snap onto the tip fittings have significantly lower attachment and ejection forces, reducing hand and thumb strain.

INTEGRA designed GRIPTIPS® pipette tips for use with our pipettes. The tips snap effortlessly onto tip fittings with minimal force to prevent users from having to hammer them on. This also avoids over-tightening, so ejection forces are reduced, minimizing the strain on the user's hand and thumb for a more comfortable experience.

ECO racks GRIPTIPS pipette tips contain 60 % less plastic than alternative racks, significantly reducing plastic consumption in the lab for greater sustainability. **ECO racks** are designed to be used in combination with an **ECO** or **POPTOP** base, and are compatible with all single- and multichannel INTEGRA handheld pipettes. For an even more sustainable option, the **POPTOP** base is compatible with INTEGRA's **GREEN CHOICE** refill inserts, helping to further reduce plastic waste. **ECO racks** are available in 300 µl long, 1,250 µl short and wide bore formats, as well as with low retention **GRIPTIPS** for improved pipetting performance with certain liquids.

GRIPTIPS



CHAPTER 5:
Reducing repetition through automation

An ergonomic workflow is a smarter workflow. High throughput multichannel pipettes and automation are the best ergonomic interventions for repetitive and time-consuming protocols, such as:

- plate filling and reagent addition
- serial dilutions
- plate reformatting
- NGS sample preparation





INTEGRA's 96 and 384 channel electronic benchtop pipettes eliminate the need to lift and stabilize pipettes in an upright position, as a servo motor assists movements to make pipetting effortless. The **MINI 96** portable pipette and **VIAFLO 96** and **VIAFLO 384** handheld pipettes feature intuitive thumbwheel interfaces, computer-controlled plungers and electronic tip loading and ejection mechanisms, which reduce the strain placed on the hand and wrist. On top of this, the pipettes can fill entire 96 or 384 well plates in one pipetting step, greatly increasing efficiency to minimize the time spent at the bench. The VIAFLO 96 and 384 pipettes can be operated in automatic mode, further reducing hands-on time. These ergonomic features enable operators to avoid unnecessary uncomfortable wrist movements and awkward neck and shoulder positions during the pipetting process.

MINI 96

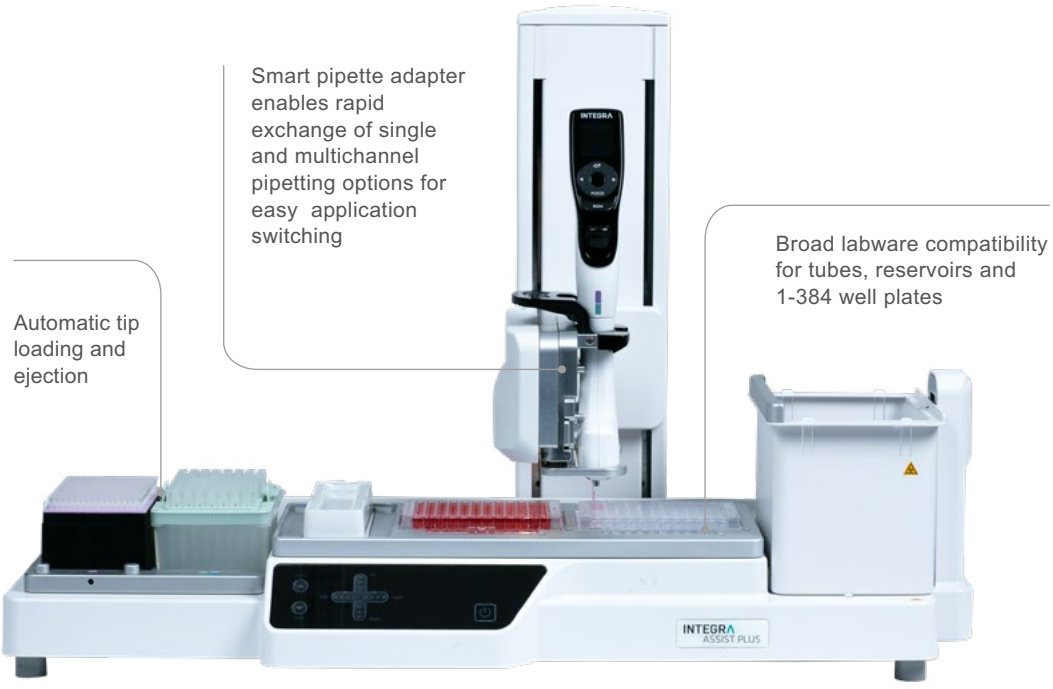


VIAFLO 96 AND VIAFLO 384



The **ASSIST PLUS** pipetting robot is an affordable solution for labs looking to fully automate workflows and repetitive tasks, eliminating physical strain. It can automate **VIAFLO** and **VOYAGER** electronic handheld pipettes, as well as the **D-ONE** single channel pipetting module, and is simple to program using **VIALAB** software. The **ASSIST PLUS** therefore eliminates repetitive manual tasks and completely solves posture issues for a higher throughput, smarter and more ergonomic workflow.







CHAPTER 6:
Streamlined serological pipetting

Serological pipetting requires the handling of large liquid volumes with precision, but holding on to bulky or heavy pipet controllers for long periods of time results in muscle fatigue, particularly during repetitive tasks. In addition, constantly having to monitor the graduations on the side of a pipet forces users into uncomfortable postures, especially when they are pipetting in a biosafety cabinet where space and access are limited. Users must either hold the pipet and labware at eye level – leading to arm, wrist and hand fatigue – or bend forward, giving them back and neck discomfort. Reading difficult-to-see graduations at weird angles can also strain the eyes, and awkward positions can make it difficult to maintain focus and precision, increasing the risk of errors and extending the time tasks take. On top of this, frequent filter changes due to overfilling and contamination can slow down productivity and reduce efficiency, making even simple tasks more tedious and physically strenuous.

The **PIPETBOY GENIUS** serological pipet controller helps to address common challenges faced by lab technicians when performing serological pipetting, reducing the risk of RSIs with ergonomic features. The **PIPETBOY GENIUS** enables fast and consistent repeat dispensing of multiple aliquots from 0.1 to 100ml at the press of a button, from a single aspiration when used with INTEGRA's serological pipets. This function eliminates the need to monitor graduations, relieving strain on the body and reducing eye fatigue. It also helps improve pipetting reproducibility by reducing manual errors and variability.

PIPETBOY GENIUS



The controller's ergonomic design naturally aligns with your posture, reducing neck and arm strain during prolonged use. The device is also lightweight and features a short sterile module nose piece, reducing arm lift height, making it feel like an extension of your arm. The **PIPETBOY GENIUS** features overfill protection to minimize filter changes when used with our serological pipets, avoiding additional manual tasks and muscle fatigue. This innovative liquid handling tool not only supports user health and wellbeing, but also enhances pipetting precision and efficiency for greater lab productivity.



CHAPTER 7:
How ergonomic is your lab?

By now it will be obvious just how important it is to choose liquid handling tools that support comfort and performance when designing your lab and pipetting station. You should also routinely assess your existing liquid handling workflow and make adjustments where necessary to ensure the wellbeing of users, as well as to maximize efficiency. A user-friendly work space is extremely beneficial to lab users, lessening physical strain and boosting worker morale. Making ergonomic choices also increases overall lab performance, improving pipetting accuracy and precision, speeding up processing and sample throughput, and opening workflows up to better scalability.

For optimal ergonomics the working height should be approximately at elbow level, frequently used items should be positioned within easy reach, and the arms should be supported where possible to reduce static load. Visual demands should also be taken into account; precision tasks such as pipetting require close visual attention, so it is important to maintain a comfortable viewing distance of around 20-40 cm, with a natural downward viewing angle of 15-45°. Excessive forward bending of the head should be avoided, as this can place additional strain on the neck and shoulders over time.

CHAPTER 8: Accelerating vaccine development with reliable liquid handling

There are many viral infections for which no suitable vaccines currently exist. The Wagner group, based at the Institute of Medical Microbiology and Hygiene, University of Regensburg, Germany, aims to apply its molecular virology expertise to the development of new immunizations for such diseases. The group relies heavily on products from INTEGRA Biosciences to streamline its research breakthroughs, improving reliability, speed and ergonomics in the laboratory.

Developing vaccines to improve global health

The Wagner research group aims to improve the quality of life and health across the world by focusing on the development of vaccines for a wide range of conditions. These include viruses for which no vaccines currently exist, such as HIV, diseases endemic in lower-income countries – including Ebola, Marburg, Lassa and Crimean-Congo hemorrhagic fever – potential future pandemic-causing agents, and viruses associated with malignancies.

The group works across the full development pipeline, from epidemiological data analysis to in vitro vaccine design, immunogenicity analyses and human clinical trials. Anja Kalender, Laboratory Technician, explained: “Our work focuses on designing and testing new vaccine candidates against many different viral pathogens. This field of research is important for global health, as developing effective vaccines is essential to prevent dangerous viral outbreaks and fight infectious diseases. Thanks to developments in AI and machine learning – as well as next-generation RNA technologies and better delivery systems – the field is moving very quickly, allowing us to make vaccines more stable and effective against new mutations.”

Improving workflows in the lab

The group uses many different techniques, meaning flexibility is a key consideration for any laboratory equipment. “Our tasks change every day depending on the current projects. We do a lot of cell culture, DNA and mRNA preparation, as well as serological analysis including high throughput ELISAs and virus neutralization assays. The work also involves a lot of assay standardization, where precision and reproducibility is critical” said Anja.



Photo courtesy of University Hospital Regensburg

The sensitive nature of the assays performed means the group needs to use equipment it can rely on. The lab has used products from INTEGRA for more than 10 years, and now uses PIPETBOY acu 2 serological pipet controllers, VIAFLO electronic pipettes, VOYAGER adjustable tip spacing pipettes and SWITCH hybrid pipettes. The SWITCH has been a new addition to the lab, as Anja explained: “We recently bought 3 of them, including the charging stands, to replace a model from a competitor that broke after only 5 years. We have used many INTEGRA products over the years, and really appreciate their great durability and functionality, so we decided to try the SWITCH too.”



Photo courtesy of University Hospital Regensburg

Enhancing ergonomics in the lab

The electronic repeat dispense mode of the SWITCH is ideal for sample and reagent aliquoting, cutting down on the number of repetitive movements required. The team has also found the improved ergonomics to be a real benefit, as the SWITCH is specifically designed with user comfort in mind, featuring a larger diameter body that promotes a good grip. “Before we started using the SWITCH, the repetitive nature of many assays was the biggest workflow challenge. Pipetting large volumes and distributing master mixes for many samples was really tiring on our hands,” Anja explained. “We mainly use the electronic dispensing feature on the SWITCH, which saves us a lot of time when aliquoting reagents and distributing master mixes. In particular, the SWITCH shortens our turnaround times, as preparing PCRs is much faster, which saves us a lot of time every week and improves the stability and reproducibility of our results.” Anja added.

Reliable tools and service for faster, more ergonomic workflows

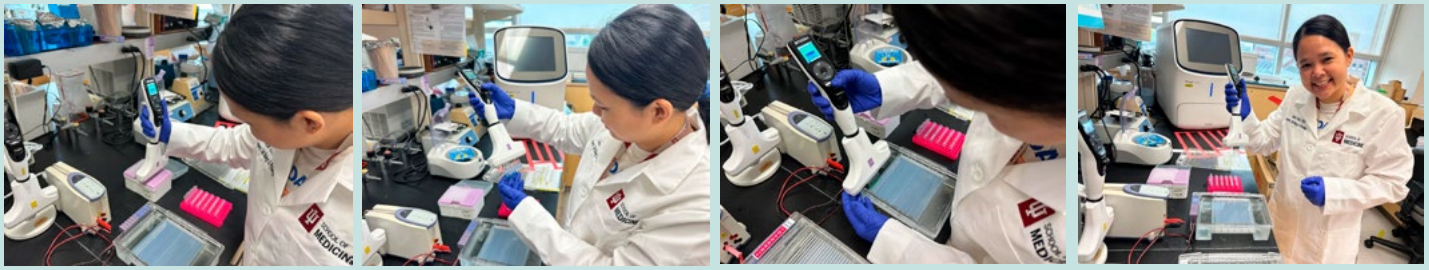
INTEGRA’s pipetting solutions have become an integral part of the Wagner group’s daily laboratory work, helping to improve workflow efficiency, reproducibility and user comfort as the group tackles its varied molecular biology tasks. The team has benefited from many INTEGRA products – from its long-lasting PIPETBOY serological pipet controllers to VIAFLO and VOYAGER pipettes, and now the SWITCH hybrid pipettes – allowing them to carry out vital research unimpeded. “We save a lot of time every week using INTEGRA products, and the company’s customer service is also very good. Our local sales representative is always helpful and friendly; she is quick to reply whenever we need information or a quote, or want to test a new product. She has saved us a lot of time and effort by introducing us to the VIAFLO and VOYAGER pipettes, as well as the new SWITCH. Thanks for making great products that help us with our daily lab work,” Anja concluded.

Advancing muscle–bone research with faster, more efficient genotyping workflows

Uncovering how muscles and bones communicate is essential for both understanding human development and advancing treatments for a range of musculoskeletal disorders. Dr Jean Kok, a postdoctoral researcher in the Robling Lab at Indiana University School of Medicine – and soon to establish her own laboratory at the Medical College of Georgia, USA – is investigating the molecular mechanisms underpinning muscle–bone crosstalk using mouse models. To manage the demands of high throughput genotyping and other molecular biology workflows, Jean and her colleagues rely heavily on VOYAGER adjustable tip spacing pipettes to improve efficiency and reduce hands-on time for their research.

Understanding the communication between muscle and bone

Musculoskeletal diseases are among the leading causes of disability worldwide, yet many questions remain about how different tissues communicate to maintain healthy movement and skeletal function. Fortunately, modern physiology is a fast-moving field of research, having evolved considerably over the last decade. Dr Jean Kok is investigating the molecular physiology underpinning muscle–bone crosstalk, and explained recent advances: “When I was doing my PhD, a lot of research focused on how different cell types communicate within a tissue, but the emphasis has now shifted to understanding how whole tissues communicate with one another. For example, a lot of research funding today is going towards looking at the whole-body effects of GLP-1 drugs, and the consequences of weight loss in relation to different organ systems and body states, like menopause. I am particularly interested in how the muscles and bones talk to each other, which brings together my PhD expertise in muscle physiology with my current work on bone biology.”



Improving mouse genetics experiments

Studying muscle–bone communication relies heavily on genetically-modified mouse models. Jean’s current laboratory maintains thousands of mice carrying different combinations of muscle- and bone-specific alleles, making genotyping one of the group’s largest routine workloads. The group uses two VOYAGER adjustable tip spacing pipettes for a variety of applications in its molecular biology workflows, including PCR set-up, gel loading and high density qPCR processing.

Jean performed these tasks entirely manually before joining her current laboratory: “I had to process samples one by one during my PhD. It often took me half a day or more just to get my genotyping done. In my current lab, genotyping is still a big task – we have over 5,000 mice at any one time – but having the VOYAGER has saved a lot of time. It’s so much easier now! We also have a graduate student in the lab who often performs qPCRs in 384 well plates. As with any qPCR, time is of the essence once reagents are added to the plate, so he uses the VOYAGER to load these plates much faster, ensuring reliability.”

Easy liquid handling for busy labs

Jean found the VOYAGER remarkably intuitive to use, despite having no previous experience. “I saw the VOYAGER being used in the lab and was very interested in trying it out. Within 10 minutes, my lab manager had explained how it worked and taught me how to use it. It’s super easy to make changes to things like volumes or tip spacings, and it’s been very simple for the rest of the lab to learn how to use it too. It’s so straightforward.”

Adopting innovative liquid handling solutions is about more than simply reducing pipetting time. More automated approaches – such as the VOYAGER’s adjustable tip spacing at the touch of a button – are enabling increasingly high throughput molecular biology techniques, especially as funding priorities shift towards research that is less reliant on animal models. Jean continued: “New micro-physiological systems jointly developed by physiologists and biomedical engineers are allowing novel research approaches, enabling cells from different tissues to be co-cultured to investigate communication between them. As these technologies develop, with more tissue types added, they are allowing investigation of more complex problems. Innovations in liquid handling can really help to make things more efficient in these situations, as the amount of lab work is only going to grow.”

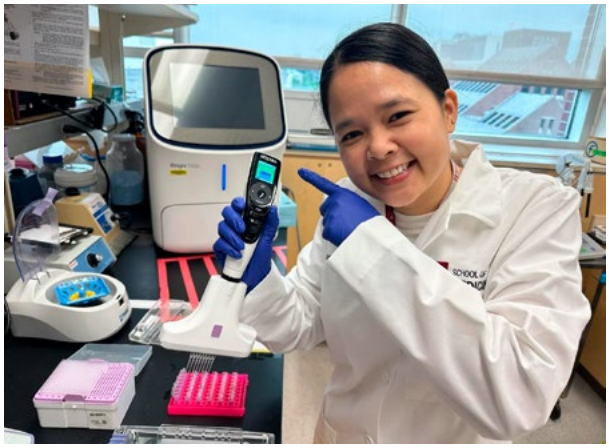


Photo courtesy of Indiana University School of Medicine

Investing in the laboratory of the future

Jean is currently preparing to establish her own research group, and is already thinking carefully about which technologies will help to build an efficient and productive laboratory from the outset. “I see the value in investing in INTEGRA pipettes, as the company makes really high quality, easy-to-use products. I see them as the ‘Apple’ of pipettes. I am certainly planning to buy a VOYAGER, and I’m very interested in other INTEGRA products too, such as the SWITCH hybrid pipette, which I expect I would use every day. I really like the innovations coming out of INTEGRA, and I’m keen to try more products as my lab grows.”

Streamlining hepatitis C vaccine research using VIAFLO pipettes

ELISAs represent a powerful analytical approach commonly used in molecular biology laboratories, but can be time consuming and require precise pipetting at specific timepoints across hundreds of wells to give reliable results. One immunology research group at an Ivy League university is using INTEGRA's VIAFLO 96 and VIAFLO 384 handheld electronic pipettes to maintain consistency while saving time for students and researchers.

Automating ELISA experiments

The group is currently working on a project that may lead to the development of new vaccines against the hepatitis C virus. As with many immunology projects, ELISAs are commonly used in the lab to assess immune and antibody responses. A PhD student working on the project explained: "We perform multiple ELISAs every day in our lab, and it would be impossible to manually pipette that many reagents and samples as quickly. We use the VIAFLO 96 and VIAFLO 384 electronic handheld pipette to carry out key liquid handling steps, including blocking and the addition of secondary antibodies, substrates and stop solutions."

These repetitive tasks are well suited to more automated approaches using the programmable protocols on the VIAFLO 96 and VIAFLO 384. "We've been exploring the programmable settings more recently to streamline our workflows. We have now set up the instruments to automatically add TMB substrate and HCl stop solution to the ELISA plate, meaning we can perform these steps more quickly and accurately."



Photo courtesy of the client (identity protected for privacy).

Saving time on repetitive ELISA steps

The introduction of the VIAFLO 96 and VIAFLO 384 has enabled the lab to perform experiments more quickly and ergonomically than with manual pipetting. "It still takes a long time to perform ELISAs, but there's a lot less stress on the individual, both in terms of the risk of errors creeping in from repetitive pipetting, and the manual strain; gone are the days where I would get pain in my

shoulder or tendons from repeated pipetting," they continued. "The repeat dispense mode really helps when we do protein purification and aliquoting. This task would normally take about an hour but, with the VIAFLO 96 or VIAFLO 384, we can finish in less than 30 minutes – it really does cut the time in half, meaning we can do other things in the lab." The time saved by using the VIAFLO 96 and VIAFLO 384 means that trainees in the lab can learn more techniques, as the student explained: "Now there's not hours and hours of mundane work to do, the undergrads who help out in the lab get to do more exciting tasks than just diluting proteins!"

Improving workflows across the lab

The lab also uses a range of other INTEGRA products to improve the efficiency of its protocols. "We really love INTEGRA in our lab; its products have become essential for all our workflows. We have many other products for different tasks, including several VOYAGER adjustable tip spacing pipettes, and PIPETBOY acu 2 serological pipet controllers, and use them for all dilutions, transfers and mixing of reagents to ensure consistency."

The wealth of INTEGRA products in the lab means high quality support is essential. "Our INTEGRA rep is really helpful. He's visited our lab several times to service our VIAFLO 96 and VIAFLO 384, provide demonstrations of other products and teach us how to program our devices, saving us hours of time. We've only had positive experiences with INTEGRA – I only have good things to say!"

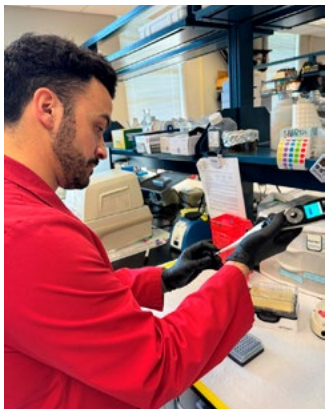
Advancing the efficiency of breast cancer research in Louisiana with efficient liquid handling

More than 4,000 women are diagnosed with breast cancer every year in Louisiana, making it the second most common cancer in the state. This mirrors trends across the US, however Louisiana women are dying of breast cancer at a rate 14 percent higher than the national average. Breast cancer is just one of the targets for the Tulane University School of Medicine in New Orleans – a member institution of the Louisiana Cancer Research Center – whose researchers aim to reduce the impact of all cancers throughout Louisiana and the Gulf region. One of the laboratories at Tulane is using the PIPETBOY GENIUS and VIAFLO electronic pipettes to ensure the accuracy and efficiency of its breast cancer research workflows.

Jorge Belgodere is an instructor at the Tulane University School of Medicine in New Orleans, with a secondary appointment as an adjunct faculty member at Louisiana State University in Baton Rouge. He told us more about his team's research: "Breast cancer is one of the pillars of what we do at Tulane, and we are also fortunate to be embedded in the School of Medicine, which gives us access to actual patient samples. Our region has statistically some of the worst breast cancer cases in the US, particularly with triple negative cancer, which has little to no active receptors that can be targeted with traditional therapies. In my experience, some of the patient samples that we've dealt with have cancer cells that are really difficult to kill, and will even occasionally get angrier and start to proliferate when targeted with treatments. Tulane is therefore nestled in a very unique realm where we can hopefully have a more positive impact locally that will also give us better insight globally with information that can be disseminated."

Equipping a growing lab with smarter liquid handling solutions

In 2023, Jorge established his own laboratory group at Tulane, taking on undergraduate and graduate students, technicians and a postdoc to focus on developing tumor models. As the lab expanded, so did the workload. When his postdoc highlighted the need for more efficient liquid handling to support RNA extractions, high throughput PCR plates and western blots, Jorge began looking for a better solution, as he explained: "My post doc came to me and said 'My workload is going to be inefficient with the equipment we have. We need INTEGRA Biosciences systems so that we can set up assays, experiments and PCR plates in less than half the time it would normally take'. So we invested in a PIPETBOY GENIUS serological pipet controller and VIAFLO lightweight electronic pipettes."





Improving comfort and consistency

As well as speed, the physical demands and reproducibility challenges associated with repetitive laboratory tasks were also important. Jorge commented: “I was personally really interested in the PIPETBOY GENIUS for performing drug dilutions because, even though it’s a relatively easy task, it is very repetitive. It is monotonous, and you can experience a lot of fatigue as you have to prep lots of plates. The equipment from INTEGRA helps to reduce this and our researchers feel more comfortable. It was also important for reproducibility; previously I would be preparing 20 different dilutions at a time, for example, and I would see variability, but the PIPETBOY GENIUS has improved the accuracy of dilutions.”

Supporting training and accuracy

In a research facility, there is a high turnover of students, so it is incredibly important to have equipment that is not only easy for training, but is also accurate to ensure the integrity of the work. Jorge explained: “When I train an undergrad, it is far easier with INTEGRA instruments because of their reliability and accuracy. It means that they can do it right the first time. Plus, I can feel confident that any undergraduate can get the work done, and then they feel accomplished once the data comes out and the experiment was successful. This is especially important as the community helps us by providing samples; the cells came from someone in the community and we emphasize an ethos of not wasting the cells and the effort that was put in to acquiring them.”

The right liquid handling partner

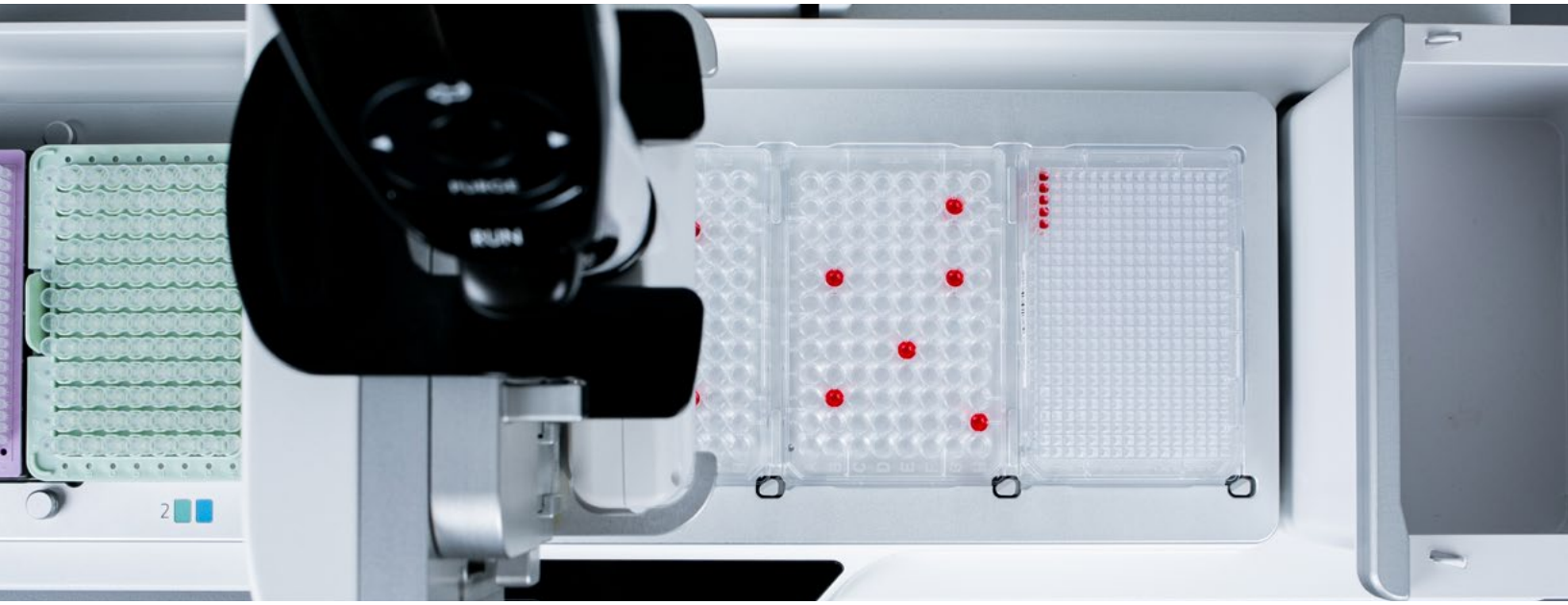
“It has been really positive working with INTEGRA. It is the first pipette brand that I’ve worked with extensively, and it seems to be the most active in our space. You might think pipettes are just about moving liquids, but in reality they have a big impact on consistency and efficiency – and that makes a real difference in how we work,” Jorge concluded.



Photo courtesy of Tulane University School of Medicine

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CHAPTER 9: Conclusion

We hope this eBook has given you lots of insight into the importance of ergonomics in the lab, and information on how to minimize user strain in liquid handling workflows. To recap, when building an ergonomic liquid handling set-up, there are several crucial factors that should be considered.

- Adjust your posture to prevent musculoskeletal issues
- Choose the right pipette for the task, such as manual or electronic pipettes
- Reduce repeated manual steps, for instance through automation
- Adopt a customized workbench layout and reach zones

Last but not least, another way to promote ergonomic liquid handling is to regularly provide instruction and hands-on training for lab users. If you are interested in learning more about ergonomic pipetting and lab set-up, book a free online or onsite training session with one of our liquid handling experts through the INTEGRA School of Pipetting. You can also request a demonstration of our electronic and automated solutions.

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