Automated Cell Counting Shouldn't Cost the Earth

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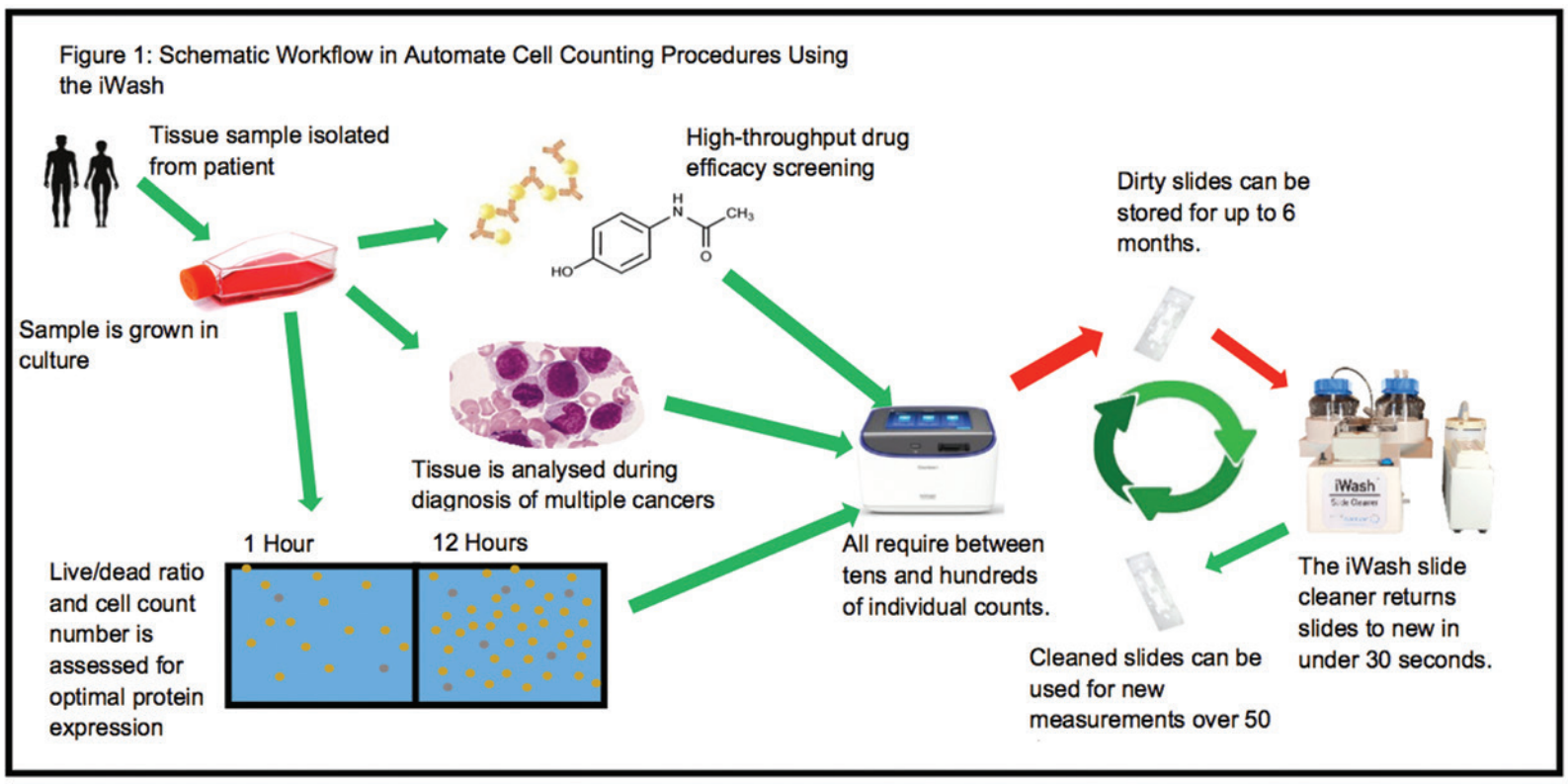
Scientific Laboratory supplies (SLS) are adding to their environmentally friendly portfolio as they recognise that sustainability is now a major driving force in most laboratories and all scientists are looking for ways to minimise their environmental impact as well as reducing cost per analysis. One area where this is particularly pertinent is automated cell counting, where the need to reduce wastage of single-use plastic slides is of significant economic and environmental concern.

Over the last 20 years the scale of global scientific research has increased exponentially, leading to massive increases in cost, both financial and environmental [1,2]. This has stretched budgets and limited the scope of countless studies and so it is becoming increasingly important to streamline high-throughput procedures to minimise waste and reduce expenditure.

Automated cell counting is a powerful tool used in cell biology, yet is very inefficient when it comes to sample handling. Some new, slide-free cell counting platforms have recently been developed, but these systems are substantially more expensive than slide-only systems, and still require manual cleaning of the sample pedestal or the re-useable glass slides. This new platform also exposes the user to biohazardous waste material during cleaning and generates solid biohazardous waste such as contaminated tissue paper as a result of manual cleaning. Switching to slide free technology is a costly option plus it is potentially disruptive as users adjust to the new system. Therefore, most laboratories would prefer to continue to use their present cell counters for consistency of operation and analysis while improving sustainability. As a direct result of market feedback the iWash™ slide cleaner has been developed so that slides which are normally disposed of after a single measurement may be reused time and time again without compromising data quality. It is also useful to note that a general consensus now exists amongst cell counter users that a certain percentage of new slides exhibit contamination which would render them inaccurate. For this reason, it is advisable to clean slides before use, making the iWash™ a crucial tool in minimising erroneous counts due to manufacturing contamination.

High-accuracy cell counting procedures underpin a huge variety of studies, both in academic and industrial settings. For example, all studies into cancer therapies require extensive culture-based efficacy tests, where the effectiveness of a drug is assessed by a live/dead cell count. This count is now carried out in an automated fashion by a range of cell counter systems. Most automated cell counters operate in a similar fashion; a sample is placed on a plastic slide before being inserted into the counting instrument, the samples are measured after which the slide is disposed of and incinerated. Whilst prices can vary, the usual cost per slide is £1 across all platforms. A statistically significant study capable of passing both academic and industrial scrutiny will require several hundred measurements, with individual labs performing dozens of studies a year. This highlights how the aggregate cost of slides may reach several thousand pounds a year before you include logistics and disposal costs.

In addition to the financial cost of single-use slides, the environmental cost of plastic slide manufacture, shipping, and disposal creates a significant carbon footprint together with potential micro plastic pollution [2,3]. As the public and government push all industries towards greener operational procedures, the recycling and re-use of previously disposable laboratory materials and equipment is a key consideration for a sustainable future [4].



The necessity for all labs to go greener is likely to become more pertinent in the near future as the single use plastics directive which led to the end of plastic straws will likely be extended to include consumable plastics in the scientific industry [5]. This will give legal weight to pressures to force all researchers to reduce single-use plastic consumption and those who have already made significant steps towards this will be best placed to meet the new regulations. The iWash™ was developed to meet this demand for improved sustainability whilst reducing cost per analysis.

The iWash™ slide cleaner uses an automated low-pressure liquid cleaning system to deep-clean the slide cavity, using a proprietary detergent wash solution. The wash procedure removes all of the culture sample out of the cavity, whilst simultaneously lysing all cells as well as deactivating any biohazardous organisms present, making the waste safe for disposal using standard drainage systems. After cleaning, the slide is dried using the attached vacuum based drying device resulting in all sample and cleaning fluid being removed in less than 15 seconds before the slide is ready for re-use. The 'soft' nature of the detergent used makes the cleaning process extremely gentle on the plastic slide and the drying process does not approach pressures or temperatures associated with plastic clouding or warping. This ensures that the refractive index as well as the cavity volume of the slide remains identical to the manufacturer's specification and that it does not become warped rendering it incompatible with the cell counting instrumentation.

Figure 2A: Labelled Image of iWash slide cleaner

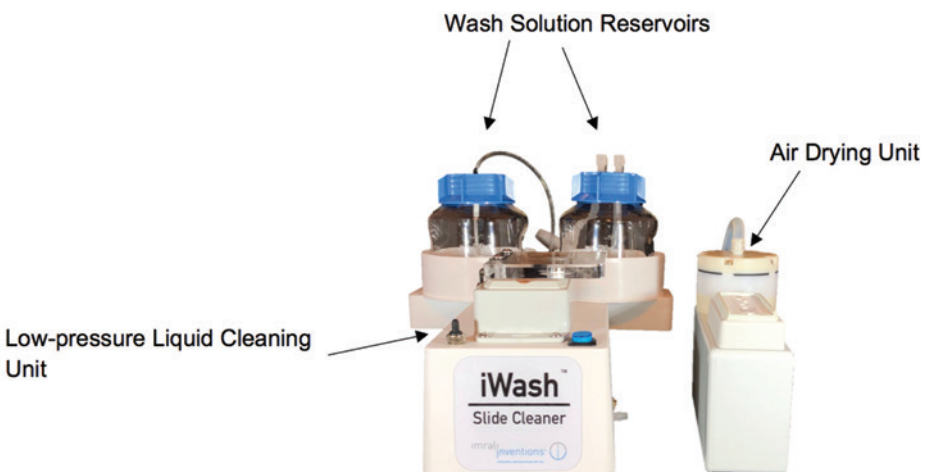
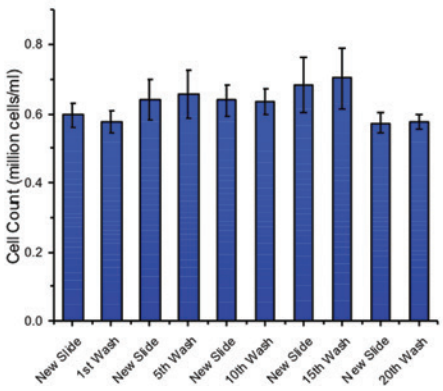


Figure 2B: Left; Image of single slide at each stage of cell counting process. Right; cell count data demonstrating that cleaned slide counts are identical to new slides (average of 4 counts). Table below; percentage difference in cell count between new versus washed slides.



This data demonstrates that there is no statistically significant difference in the cell counts obtained using new slides and those washed up to 20 times. Furthermore the extremely low percentage difference between counts illustrates the low error and variability in count between new and washed slides.

The effectiveness of the iWash™ is demonstrated in Figure 2B; up to 20 washes there is no statistically significant difference between the cell count obtained from the same sample using a washed slide and a new slide. This is further highlighted by the tiny percentage difference between the total count of new versus washed slides (Table 1). This data validates the iWash™ as a system capable of using what were single-use plastic slides up to 20 times with no compromise in data quality, accuracy, or reliability. Further test have been performed with up to 50 wash cycles without any significant changes in performance.

Table 1:

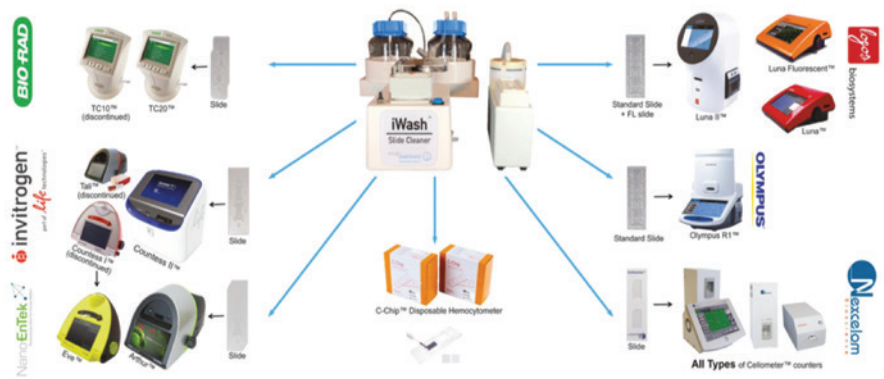
Number of Washes	% Average Cell Count Difference New v Washed Slides
1	2.9
5	2.8
10	0.9
15	3.0
20	0.7

The unique iWash™ wash solution in conjunction with a slide recovery solution is now capable of regenerating old or dried slides which have been stored for up to 6 months. This makes it possible to reuse old slides, with a cleaned slide indistinguishable from new after many wash cycles, with no detrimental effect on accuracy of cell count. Remembering also that new/unused slides should also be washed prior to use.

A typical, productive lab may be disposing of anywhere between 500-1000 slides per month. With each slide costing between £0.75-£1.20. This will equate to a monthly consumables spend of £375 to £1200. Therefore, a return on investment may be achieved in as little as 3 months, and will continue for the lifetime of the iWash™. Over a 10 year period this will equate to many thousands of pounds. By allowing the user to recycle slides up to 50 times, the iWash allows £50 of research to be performed for every £1 spent on plastic slides.

iWash™ is quick and simple to use and is compatible with current cell counting instrumentation to include; Nexcelom® cell counter, Biorad TC20®, Invitrogen Countess II®, NanoEntek's Eve® and Arthur®, Logos Biosystems Luna®, Luna II® and Luna® Fluorescent Cell Counters, and Olympus R1® cell counters.

iWash™ Slide Cleaner can clean the slides for the majority of image based cell counters in the market



In summary the iWash™ slide cleaner minimises the consumables cost of automated cell counting and enhances sustainability with a return on investment in months rather than years.

1. Gajović, Srećko, and Roland Pochet. "The cost of scientific excellence–could it be expensive and out of reach?" Croatian medical journal 57.5 (2016): 413.

2. Verma, Rinku, et al. 'Toxic pollutants from plastic waste-a review'. Procedia Environmental Sciences 35 (2016): 701-708.

3. Taylor, M. L., et al. 'Plastic microfibre ingestion by deep-sea organisms'. Scientific reports 6 (2016): 33997.

4. Life Scientists Cut Down on Plastic Waste, KATARINA ZIMMER, The Scientist, August 1st 2018

5. Circular Economy: Commission welcomes European Parliament adoption of new rules on single–use plastics to reduce marine litter- STATEMENT/19/1873