RESHAPE

APPLICATION NOTE

Evaluating OD Measurements for Microbial Growth Rates:

Comparing the Reshape Smart Incubator and Epoch 2 Plate Reader

APPLICATION

Comparison of Reshape Smart Incubator and traditional laser point plate reader for reliable OD readings.

Why is it a critical need?

Establishing a laboratory in the early stages of a biotech startup is often constrained by significant financial and logistical hurdles. The high cost of specialized analytical instruments, particularly those required for routine assays such as cell counting, can limit access to data-driven experimentation and slow down iterative development. Among these tools, cell quantification based on optical density at 600 nm (OD_{600}) is widely regarded as a gold standard due to its reliability and deep integration into microbiological workflows. Yet, achieving OD_{600} measurements typically depends on dedicated spectrophotometers, which come with substantial upfront costs and maintenance requirements, creating a steep barrier to entry for resource-constrained teams. Other than the cost, lab space and overall maintenance of multiple pieces of equipment can be cumbersome for management.

How does Reshape help?

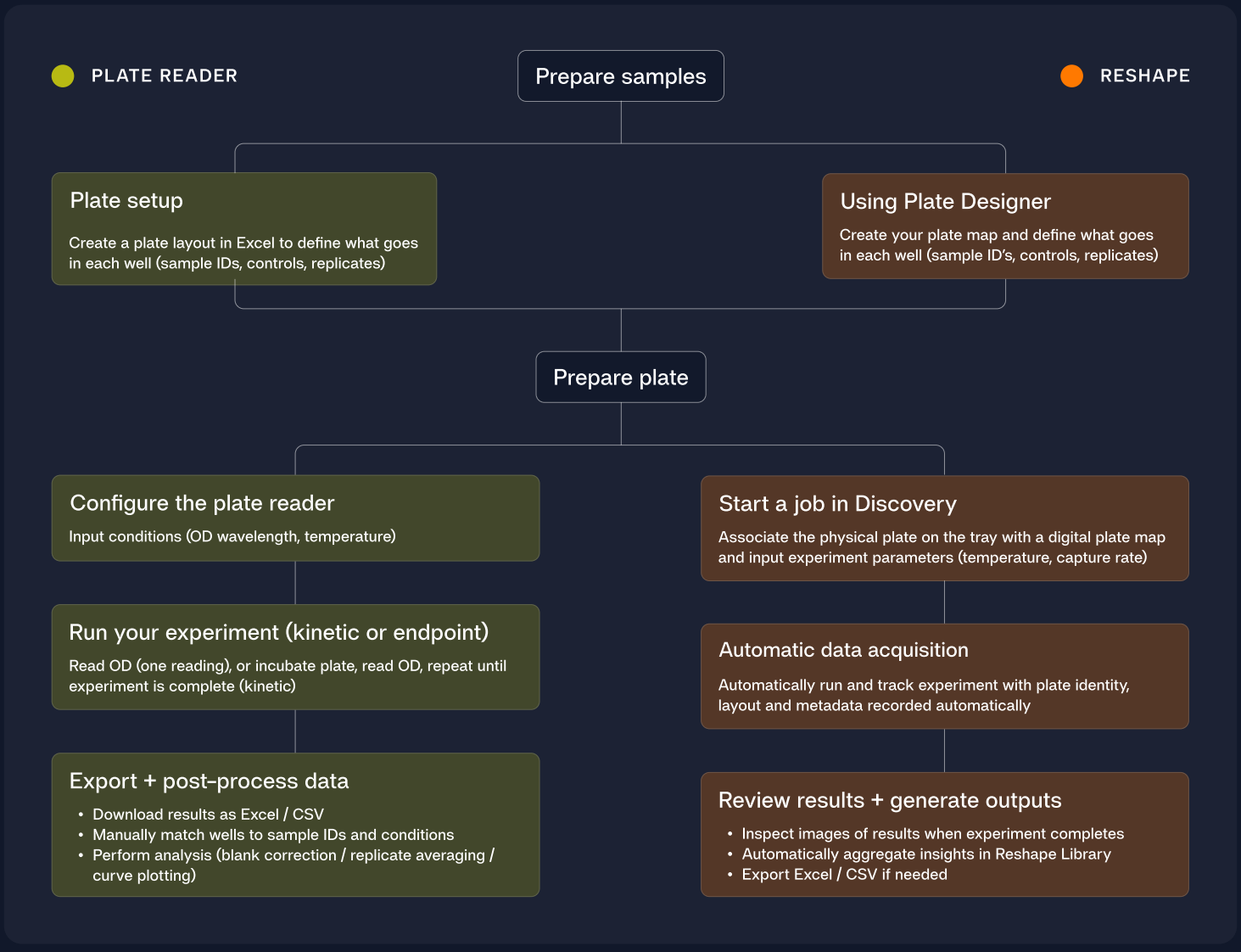
In this study, we compare two such systems, one based on turbidity imaging and the other using OD_{600}, to assess their accuracy and practicality in quantifying cell densities. By examining their performance side-by-side, we aim to evaluate whether lower-cost or usage-based alternatives can offer sufficient reliability to support early-stage research. This validation is not just a technical comparison, it represents a step toward reducing barriers to innovation, empowering emerging biotech companies, and ultimately, accelerating the development of technologies that could benefit biotechnology on a global scale.

Introduction

The purpose of this study was to compare the turbidity measurements generated by the Reshape Smart Incubator to conventional OD_{600} measurements performed using a plate reader.

The Reshape platform uses high-resolution imaging to visually inspect individual wells. Combined with turbidity-based OD measurements, this provides richer characterization than a conventional plate reader, which typically generates OD readouts only.

This application note summarizes the Reshape platform's OD measurement method and compares it to a conventional plate reader approach, with a particular focus on sensitivity and throughput.



- Measuring cell growth in liquid culture is standard practice in microbiology workflows and involves either turbidity reading or more traditionally, optical density (OD) measurements.

EXAMPLE

Turbidity measurement vs. OD reading

Establishing a laboratory in the early stages of a biotech startup is often constrained by significant financial and logistical hurdles. The high cost of specialized analytical instruments, particularly those required for routine assays such as cell counting, can limit access to data-driven experimentation and slow down iterative development. Among these tools, cell quantification based on optical density at 600 nm (OD_{600}) is widely regarded as a gold standard due to its reliability and deep integration into microbiological workflows. Yet, achieving OD_{600} measurements typically depends on dedicated spectrophotometers, which come with substantial upfront costs and maintenance requirements, creating a steep barrier to entry for resource-constrained teams. Other than the cost, lab space and overall maintenance of multiple pieces of equipment can be cumbersome for management.

Here we argue that turbidity-based imaging systems have emerged as a more accessible alternative, often available as part of pay-per-use platforms or lower-cost hardware solutions validating these systems against OD_{600} based methods could democratize early-stage experimental workflows, enabling broader access to reliable biological measurements without prohibitive upfront investments.

In this study, we compare two such systems, one based on turbidity imaging and the other using OD_{600}, to assess their accuracy and practicality in quantifying cell densities. By examining their performance side-by-side, we aim to evaluate whether lower-cost or usage-based alternatives can offer sufficient reliability to support early-stage research. This validation is not just a technical comparison, it represents a step toward reducing barriers to innovation, empowering emerging biotech companies, and ultimately, accelerating the development of technologies that could benefit biotechnology on a global scale.

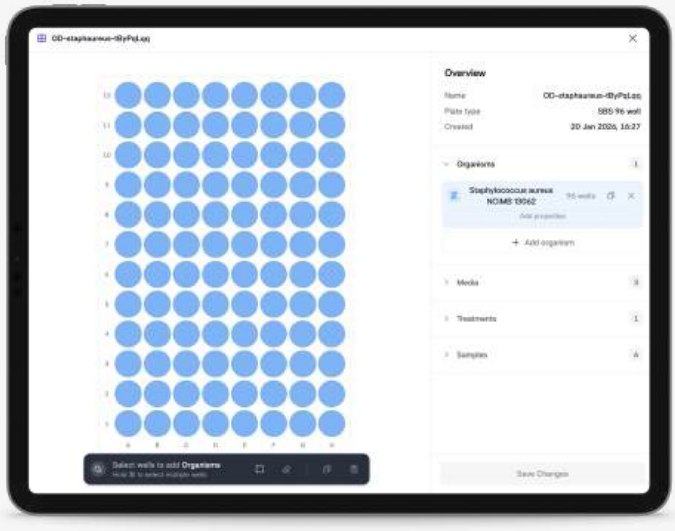
Method condensed

A single colony of *Staphylococcus aureus* NCIMB 13062 was inoculated into 1 mL of brain heart infusion agar and grown overnight. For comparative purposes, *Escherichia coli* NCIMB 12805 was included as well. Approximately 10µL of the overnight *S. aureus* culture was inoculated into each well of a 96-well microtiter plate (not including the negative media controls), and subjugated to different nutrient concentrations at (19%, 15%, 10%, 5%, 2.5%, and 0% w/w).

This was performed for 3 different media, namely Tryptic soy broth (TSB, Neogen, NCM0019A), potato dextrose broth (PDB, Neogen, NCM0157A) and brain heart infusion broth (BHI, Millipore, 53286).

Each 96-well plate was run either in the Reshape Smart Incubator or a plate reader (OD600 (λ=600) Epoch 2, SN 16121910). Assays were run at 25°C, 32°C, 37°C, and 40°C with hourly measurements for 48 h, and for 14 h for *S. aureus* and *E. coli*, respectively.

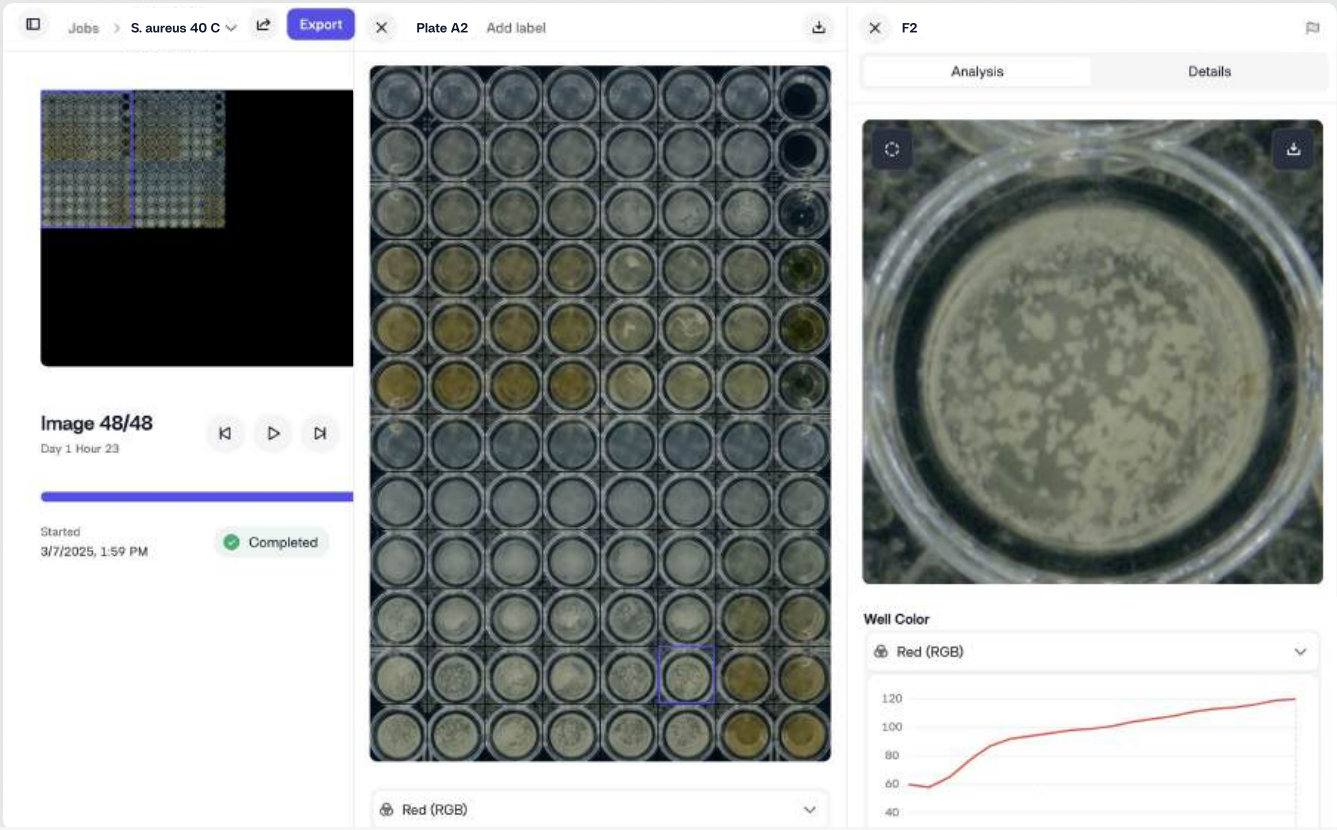
Biological triplicates as well as technical duplicates were made to allow for statistical analysis.



Reshape Discovery

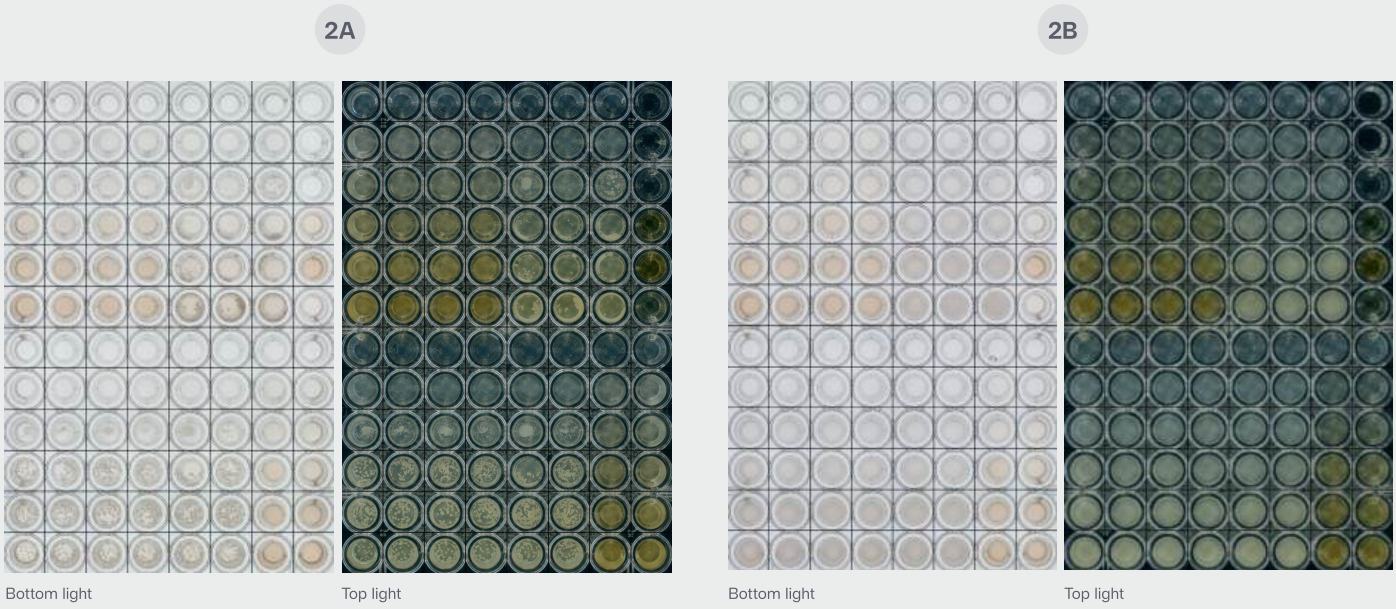
Results

Samples were normalized so that at T=0, all first measurement values were converted to 1. For ease of visualization, only data from the 40°C is reported further. All other data is available upon reasonable request.

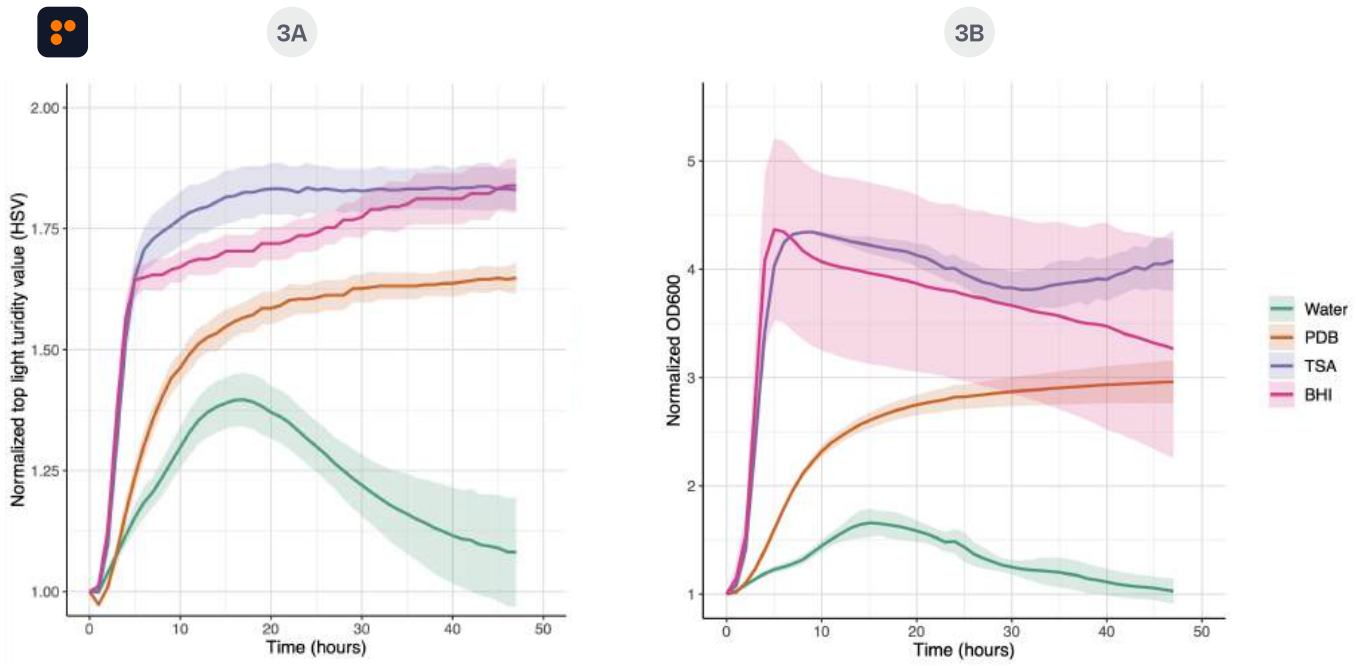


- **Figure 1.** Overview of the captured assay in the Reshape Discovery platform, highlighting the aggregating clumps of *S. aureus*

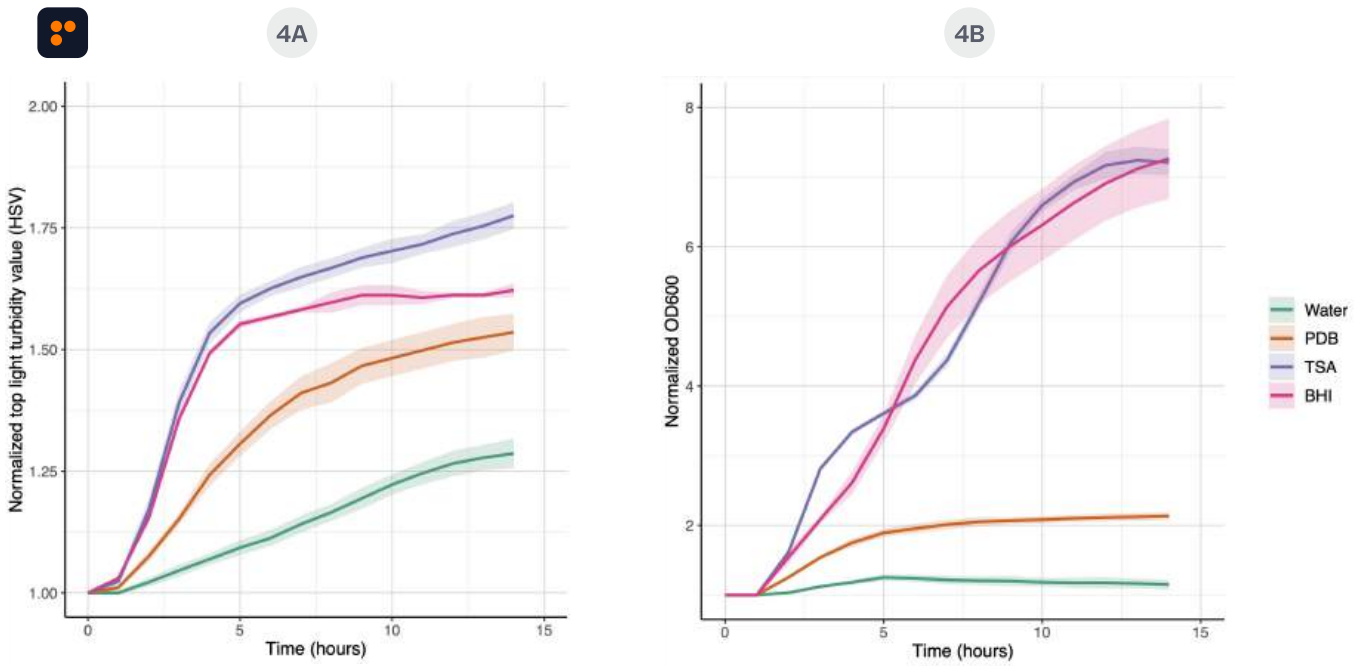
The following curves were obtained for the assessment of growth of *S. aureus* NCIMB 13062.



- **Figure 2.** Images of growth rates for **2A.** *S. aureus* NCIMB 13062 after 48h (left) and **2B.** *E. coli* NCIMB 12805 (right) after 14h. The growth of *S. aureus* shows very visible aggregates.



- **Figure 3:** The growth of *S. aureus* NCIMB 13062 measured in **3A**, the Reshape Smart Incubator (normalized turbidity value), and **3B**, an Epoch plate reader (normalized OD_{600} measurements). Growth measurements were recorded over 48 hours at 40°C across three different media—Potato Dextrose broth (PDB), Tryptic Soy broth (TSA), Brain-Heart Infusion broth (BHI)—and water. Standard deviation was calculated from the technical duplicates and biological triplicates.



- **Figure 4:** The growth of *E. coli* NCIMB 12805 measured in **4A**, the Reshape Smart Incubator (normalized turbidity value), and **4B**, an Epoch plate reader (normalized OD_{600} measurements). Growth measurements were recorded over 14 hours at 40°C across three different media—Potato Dextrose broth (PDB), Tryptic Soy broth (TSA), Brain-Heart Infusion broth (BHI)—and water. Standard deviation was calculated from the technical duplicates and biological triplicates.

DISCUSSION

Comparative analysis

Performance on low-value measurements

One notable area where the plate reader excels is in low-value measurements, such as those close to the baseline (e.g., water or very dilute cultures). In these cases, the plate reader consistently shows lower standard deviations between replicates, suggesting that it offers more reliable signal detection at the bottom end of the dynamic range. This is likely due to its finely tuned optical path and background correction algorithms optimized for low turbidity readings.

In contrast, the Reshape Smart Incubator, tends to show higher variance at these low values, possibly due to noise amplification or limited sensitivity near zero. For precision at extremely low cell densities, this can present a limitation. This generally indicates that the Reshape Smart Incubator has less resolution compared to the plate reader.

Superior consistency in higher ranges: Reshape's advantage

The Reshape Smart Incubator demonstrates significantly lower standard deviation in turbidity measurements. Across the range of cell concentrations tested (except water), Reshape's platform consistently outperforms the plate reader in terms of reproducibility and noise suppression. This suggests a strong case for using Reshape in mid-to-high turbidity applications, where robust data is crucial, and variability can skew biological interpretations.

Better instrumental fit for measuring biological performance

A notable biological factor is that *S. aureus* has a high tendency to aggregate during its growth, creating inconsistencies in optical-based systems due to uneven light scattering. This can artificially inflate or deflate readings, or increase standard deviation due to the clumping of the aggregates which can form in different orientations and size. As a comparison, *E. coli* does not coagulate to the same extent, offering a more stable reference curve.

Data analysis comparing the two organisms shows that the Reshape Smart Incubator remains more consistent even in the presence of aggregation, potentially due to how it integrates imaging data over a larger area or time window. Drawing this comparison highlights the Reshape Smart Incubator's resilience to biological noise – a major strength.

Importantly, despite absolute value differences, the overall shape and trajectory of the growth/turbidity curves remain consistent between the Reshape Smart Incubator and the plate reader. This means that biologically relevant trends (growth phases, inflection points) are preserved in both systems, reinforcing Reshape's potential as a high-throughput alternative.

Value in high-throughput measuring

To reinstate the value of bulk characterization of growth, especially where minute differences are less critical and trends over large sample sets matter, Reshapel offers massive advantages. The ability to process up to 10 plates simultaneously drastically reduces run time and enables higher experimental throughput, which is a game changer for screening pipelines or production QC environments.

Comparative overview

Both systems have their trade-offs. While plate readers are better for low-end sensitivity, the Reshape Smart Incubator provides consistency, scalability and robustness, especially to samples with a high aggregation tendency.

	Plate Reader	Reshape Smart Incubator
Low Value Sensitivity	✓ Better at detecting low resolution differences	✗ More variable at low signal
High Value Consistency	✗ More variable	✓ Lower standard deviation
Throughput	✗ Limited to 1 plate/run	✓ Can handle up to 10 plates/run
Aggregation Handling	✗ Impacted by clumping	✓ Better signal despite aggregation
Media Color Interference*	⚠ Can be affected, often corrected	⚠ Needs callibration testing for complex media

*Media color effects refers to color interference from growth media. Certain types of colored media could alter how light is absorbed or scattered, leading to false positives or skewed turbidity signals. While some plate readers compensate for this using dual-wavelength measurements or reference filters, the Reshape Smart Incubator could potentially implement similar reference-filter corrections for more complex media—though this would require additional validation and testing.

Conclusion

While plate readers retain an advantage in low-end sensitivity and established standardization, the Reshape Smart Incubator represents a compelling alternative, particularly for bulk and mid-range turbidity assays. The platform combines lower variance, higher throughput, and improved robustness to sample heterogeneity. With further validation and calibration, especially for sensitive applications such as MIC determination, Reshape has the potential to significantly streamline and enhance cell-based screening workflows.

Although this note focuses on a single application, the Reshape Smart Incubator supports a broad range of use cases, including colony detection and counting, microbial growth rate measurements, and halo zone analysis. This positions Reshape as a multi-purpose automated platform for data acquisition and analysis across diverse biological assays. Overall, the Reshape Smart Incubator offers a viable alternative to conventional plate readers, providing a lower-cost, higher-throughput approach without sacrificing assay versatility.