EDITORIAL OPEN ACCESS

Phoning it in: Smartphone technology in the cancer research lab

Gail M. Seigel

INTRODUCTION

Smartphone technology has revolutionized communication and networking throughout the world. New apps appear daily, with the potential to streamline both information gathering and sharing. It was only a matter of time before these applications would be developed and adapted for use in basic science, including cancer research laboratories. The first basic apps were designed aslab timers (e.g., LabTimer by 0x0c) and laboratory calculators, (e.g., LabCalc by iSheepSoft). These have been followed by useful apps to aid in experimental design (e.g., Light Lab by Zeiss, Antibody Search by Biocompare). For the purpose of this brief note, we will focus on two recent smartphone developments that are particularly helpful for the cancer research lab-smartphone-based photomicrographs for cancer pathology as well as a new app developed for evaluating ELISA plates.

SMARTPHONE PHOTOMICROGRAPHS

The ability to capture microscopic images for cancer pathology typically involves a microscope equipped with a digital camera connected to a computer and controlled by proprietary software. These set-ups can be rather expensive, out of the financial reach of some laboratories. Core facilities may provide shared microscopes, but often involve waiting lists and down-time for maintenance, not to mention oil on the objective from a previous user. A novel way to capture microscopic images is by the use of a smartphone camera. To test the quality of smartphone microscopic images, I used my own phone (Apple: iPhone 5) to capture a sample image of a retinoblastoma tumor (Figure 1). I was able to capture the image without the use of a special adaptor, although it took some practice to line up the smartphone camera properly to capture the image through the microscope objective. As seen in Figure 1, this image is good enough for quick communications, consultations and teleconferences, although not the highest quality desired for publication. Others have gotten much better results [1]. Still, smartphone photomicrographs seem like an effective, quick way to share microscopic images with limited resources.

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Received: 10 June 2015
Published: 14 July 2015

SMARTPHONE ELISA IMAGING AND ANALYSIS

Enzyme-linked immunosorbent assays (ELISAs) generally involve 96 well microtiter plates containing enzyme-mediated colorimetric changes that are detected at the appropriate wavelength by a microplate reader. Microplate readers can cost thousands of dollars, so they often suffer the fate of most shared equipment—distant location, long sign-up sheets and down-time for maintenance. Recently, apps have been created to offer a rapid way of evaluating ELISA experiments without the need for a microplate reader. I was intrigued by the ELISA Plate Reader app from ENZO Life Sciences [2]. To test this app, I serially diluted trypan blue into a 96 well plate, captured the image with my iPhone 5 camera (within the app) and aligned the edges of the plate with the crosshairs that appear for analysis. I used the app to analyze the plate at 595 nm (the app has options for 405, 450, 495, 562 and 595 nm). A Microsoft Excel spreadsheet was sent to my e-mail address that allowed me to generate a graph, as shown in Figure 2. The app claims a 90% correlation with a spectrophotometer, so it is good, but not quite publication quality. However, for routine tests,

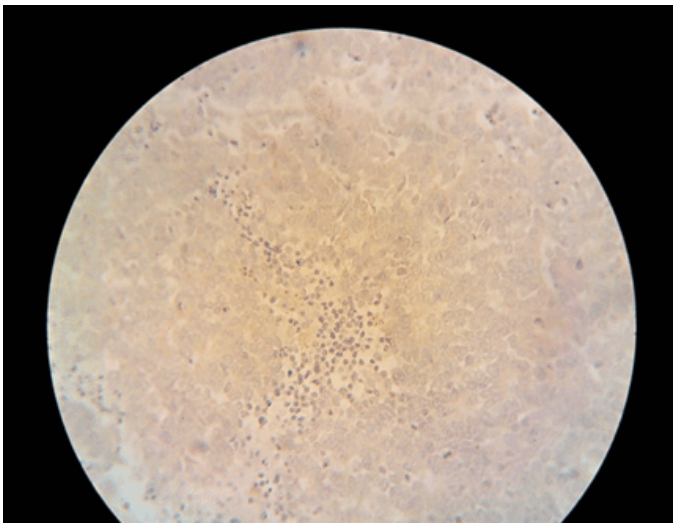

Figure 1: Smartphone image of a retinoblastoma tumor. The iPhone 5 camera was aligned with a bright-field microscope objective and the image was captured at x40.

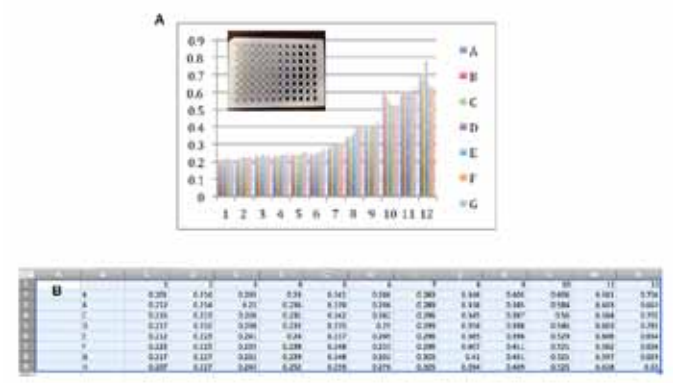

Figure 2: (A) Trypan blue diluted into a 96 well plate, read at 595 nm with the ENZO ELISA plate app, (B) Excel spreadsheet generated by the ENZO ELISA plate app and sent by e-mail from the app.

troubleshooting or non-publication purposes, this app has the potential to simplify basic experiments.

SUMMARY

The ability to capture images and analyze data with smartphones opens up new possibilities for those with limited access to high-end imaging equipment and microplate readers. Although the results are not quite publication quality, they are certainly good enough for troubleshooting experiments, exchanging information and discussion purposes. As the technology advances, more applications with higher quality results are sure to follow.

How to cite this article

Seigel GM. Phoning it in: Smartphone technology in the cancer research lab. Oncocytology 2015;5:14–16.

Article ID: 100008OCYGS2015

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doi:10.5348/OCY-2015-8-ED-2

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Acknowledgements

GMS is supported by the Cornell Center on the Microenvironment & Metastasis through Award Number U54CA143876 from the National Cancer Institute, as well as a grant from the SUNY Brain Network of Excellence.

Author Contributions

Gail M. Seigel – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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