CYTO Lab Hacks: A platform for the exchange of innovations in cytometry

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ABSTRACT

This article reports on a conference workshop conducted at CYTO 2019. This workshop centered on an online directory for non-commercial cytometry innovations called CYTO Lab Hacks. The CYTO Lab Hacks website is being developed to become a curated platform to collate and to promote cytometry related materials developed by the wider scientific community. The website will present brief summaries and links to repositories with experimental protocols, descriptions of hardware changes, document templates, software code, and other innovations. The workshop outcomes, summarized in this manuscript, cover the topics of the website functionality and user experience, organization of the volunteer task force, and understanding the needs of the cytometry community in respect to sharing innovations.

open science, free and open source software (FOSS), free and open source hardware (FOSH), network, cytometry, website

INTRODUCTION AND AIMS

Publishing in peer-reviewed journals and books or through meeting proceedings and presentations remain the main tools for disseminating scientific findings. These communication platforms have served the scientific community successfully for centuries. However, they introduce practical and administrative delays and barriers to the knowledge spread from the scientists to their peers and the wider public. These barriers intrinsically promote groundbreaking discoveries over incremental, unfounded, or poorly-communicated ones. Inadvertently, they also sustain a culture of scientific competition, confidentiality, and reticence to the disclosure of details. In the past decades, the emergence of rapid, low-cost, and content-rich communication over the Internet has started to challenge this traditional model and created opportunities to build on it and improve it Hausmann et al. (2016). Consequently, social media Editorial (2018) and preprint archives Berg et al. (2016) are increasingly used by scientists, funders, and publishers to improve and accelerate knowledge exchange and peer-review process. Beyond publishing; numerous scientific, political, and funding initiatives have emerged to improve transparency and rate of data, information and knowledge exchange. ISAC has contributed to this development in the area of cytometry by introducing the MIFlowCyt Lee et al. (2008) standard, FlowRepository Spidlen et al. (2012), and the FCS data file standard Murphy and Chused (1984); Spidlen et al. (2010).

The CYTO Lab Hacks website is being developed to become a directory of cytometry innovations. By innovations we mean: new or improved protocols, instruments, methods, procedures, teaching materials,

and/or software. These innovations are already being regularly shared by scientists through publications, content-sharing repositories, personal or institutional websites, forum entries, blogs, videos, social media, and their combinations. Distributing these innovations through this broad range of media creates a barrier to discovery and utilization by peers. Consequently, their impact tends to be diminished. CYTO Lab Hacks aims to solve this problem by providing a centralized directory and a database of cytometry-related innovations. These innovations could be published in any form anywhere across the Internet. The purpose of CYTO Lab Hacks is to bring them all into one clear, concise, categorized, and searchable directory pointing to the relevant repositories containing further details about the submitted innovations. CYTO Lab Hacks should deliver advantage to both the contributors and visitors. The contributors would gain a much larger audience for their innovations in exchange for a small amount of effort when submitting a summary and a link to the innovation. The visitors would have one place to look for a broad range of cytometry-related innovations without needing to trawl a range of online resources.

The concept of CYTO Lab Hacks was first presented at a workshop during CYTO 2018. We collected feedback from the participants, recruited volunteers, and collectively devised a development strategy for this initiative Czechowska et al. (2019). Subsequently, we organized a group of volunteers. The group agreed on priorities for the development of CYTO Lab Hacks. It started developing a prototype website to verify the concept. At the CYTO 2019 workshop, we introduced the website with example content to draw experience and feedback from the workshop participants. The conclusions are reported in this manuscript.

METHODS

The workshop was structured into three parts (Supplementary Presentation 1). We first introduced CYTO Lab Hacks and its prototype website (`http://bit.ly/CytoLabHacks`, Supplementary Figure 1). We presented the structure of the workshop and three examples of innovations submitted to the CYTO Lab Hacks website. We then introduced three questions to be discussed for 20 minutes in three separate break-out groups. The three discussion questions were:

What makes an innovation generate interest and enthusiasm in the cytometry community?
How to organize the CYTO Lab Hacks group to work efficiently towards its goals?
How should CYTO Lab Hacks website look like? What should each submission include?

Each group was led by one leader with the responsibility for moderating the discussion and recording the findings into written notes or audio recording. Finally, each leader briefly summarized the conclusion of their group discussion to all workshop participants. At the very end, volunteering participants came forward to briefly present their own innovations, which they could contribute to CYTO Lab Hacks. The workshop was highly interactive and rapidly paced. The choice of three topics and the small size of each breakout group (< 20) allowed all participants to get involved in their preferred subject and have their opinion heard.

OUTCOME

In the following paragraphs, we summarize the discussion outcomes from the workshop breakout groups. Each breakout group had one question to address.

What makes an innovation generate interest and enthusiasm in the cytometry community? This was an open ended question designed to solicit an opinion on what the cytometry community would like to share and what would encourage them to use the website. The lively discussion singled out training and documentation as the overriding themes. Participants wanted examples of standard operating procedures (SOP) for user and instrument training, techniques, reagent composition, DIY devices, and protocols. It was felt that many labs were needlessly reproducing the same documentation, wasting valuable time and resources. There was interest in physical hacking of instruments, with access to 3D printer schematics for tube holders and chilling units for sorters as examples. Software resources such as tools to simplify routine tasks including automatic search for customer publications, automating quality control (QC) of instruments, and scripts to simplify data backup. A database of software versions and instrument compatibility was mentioned as being a useful and currently missing resource for the community. Databases for antibody panel designs, online resources, e.g. spectrum viewers, educational resources, fluorophores, and of manufacturer instructions/best practices were other listed examples. An overarching theme of the discussion was the need to find ways to save money and time. The CYTO

Lab Hacks resource was seen as a promising solution by saving time through offering a central store of useful resources and in offering a way to easily search technical solutions that could circumvent costly replacement parts or entire instruments by manufacturing your own parts or implementing software upgrades.

How should CYTO Lab Hacks website look like? What should each submission include? The prototype website and a video demonstrating the envisioned submission process (Supplementary Video 1) were presented to the group. The group responded to both overwhelmingly positively, finding the concept genuinely useful to their workflows. None of the participant were aware of any existing alternatives. The group emphasized the need to develop the website as a directory for innovations rather than an all-purpose data repository. Suggestions for practical features arose from the discussion. The group emphasized the need to provide powerful search and categorizing tools for the website, including subscription for automatic notifications. The user experience (UX) should be simplified by avoiding one-fits-all submission process, but rather offering conditional questions leading category-specific submission workflows. Forms should include predefined default checkboxes and selections to simplify submission process. An edited list of tags (keywords) should be prepared to prevent the use of multiple similar keywords. Submissions should additionally include a free text description area spelling out presumed applications and uses for the innovation. Comments section needs to follow each submission to serve as peer-review. An effortless scoring and basic peer-review should be offered through like/dislike, star-rating and ”used it” buttons. The website should offer a forum and an area to post questions and requests for help in accomplishing tasks. Finally, the website should be automatically scoring innovations according to popularity and prioritise displaying valued innovations over old and rarely visited ones. Beyond the website and the submission process, the group raised the point of needing to keep the operation streamlined and low cost in terms of money and labor. A contingency plan should be included for anticipated failures and breaking points.

How to organize the CYTO Lab Hacks group to work efficiently towards its goals? This discussion was centered about the professional resources required for the successful delivery of the website. The top role everyone mentioned was an IT professional involved in the organization, development, and maintenance of the website. The community input is critical in the feature selection process and the donation of innovation submissions to the website. The next role centered on communications to maintain regular progress communications. There should be a general communication to the users of the website and an ISAC-centered communication to drive traffic specifically from ISAC members. The third role was for a ”curator”, one looking for potential submissions and inviting their authors. The group expected early adopters would volunteer to supply material, but the curator would continuously procure new material. This role would work with the communications contact to request material from ISAC members; but then go beyond and actually look outside membership for relevant hacks. The curator would also maintain and add relevant tags (keywords) and categories. The group agreed on the need for a project lead, while retaining the committee approach to build resilience, institutional memory, and legacy and avoid overbearing the project lead. The project lead would encourage other volunteers to remain on track and inform everyone of deadlines and progress. There should be quarterly video conference calls to check progress. The group also discussed the question of ownership of the content and licensing and question of transfer of ownership from the employer to the website. However, this discussion did not conclude with specific suggestions.

CONCLUSIONS AND PERSPECTIVES

This workshop was successful and demonstrated the virtue of crowdsourcing ideas for this community-led project. With only 60 minutes available, we divided the participants into breakout groups small enough for everybody to be heard. This maintained high level of authentic engagement within each group, while allowing us to cover three discussion topics in parallel.

The three discussion groups returned a wealth of actionable ideas. As a result, we will reorganize the group of volunteers into a more distributed leadership model. This should allow agile and robust governance and higher productivity in delivering the CYTO Lab Hacks project and website. The crowdsourced evidence for the most desired innovations will guide the future ”curator” to prioritize submissions based on a representative opinion rather than personal preference. The development of the website functions, user experience, and interface will be driven by the feedback from this workshop. Preparing a prototype website and a case study video for the purpose of this workshop turned out to be very important (Supplementary Video 1). It effectively engaged the participants minds and allowed them

to provide constructive feedback. Moreover, the workshop served the important purpose of confirming the interest of the cytometry community in the CYTO Lab Hacks concept. It was an important reality check ensuring the project represents the opinions of the community not just the limited group of volunteers. Finally, the workshop was an excellent advertising opportunity informing ISAC members about the progress of this initiative.

Following this workshop, we will restructure the volunteer group to drive the project towards completion and roll out at CYTO 2020. We will seek funding support from within and outside ISAC to cover the development cost of the website. We expect a significant volunteer effort being required during the development and roll-out phases. We anticipate gradual growth of interest from the cytometry community, developing a self-moderating and self-reviewing process. This will eventually lower the required volunteer effort to editorial and communication roles. We anticipate CYTO Lab Hacks integrating well with educational and innovation related activities of ISAC. It would provide resource of state-of-the-art content for these activities and a communication platform with significant outreach to the ISAC members and the wider cytometry community. We encourage anyone interested in CYTO Lab Hacks to visit its prototype website (`http://bit.ly/CytoLabHacks`) and contact the authors of this manuscript.

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CONFLICTS OF INTEREST

Bunny Cotleur is employed by Biogen; Virginia Litwin by Caprion Biosciences; and Betsy Ohlsson-Wilhelm by SciGro.

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GLOSSARY

ISAC International Society for Advancement of Cytometry. 1, 3, 4

QC Quality Control. 2

SOP Standard Operating Procedures. 2

UX User Experience. 3