An Open-Source Husbandry Repository

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FIG. 1. Accurate and efficient management of Zebrafish Inventory is made possible by QR™ updates through Google Forms.

Abstract

Electronic databases provide effective and efficient management of zebrafish colony operations, but commercially available options are expensive. In this study we have developed a free zebrafish management repository alternative using free Google applications. Husbandry information is logged into a Google Sheets-based catalog through Google Form (GF) entries. Form autopopulation can be streamlined by barcodes, which can be gen-

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erated and deciphered through free smartphone applications. The repository is capable of calculating pertinent husbandry dates from GF input and sending e-mail reminders to users for specified tasks. A Google application-based repository allows for a free simple zebrafish husbandry management solution.

Keywords: animal model, husbandry, database, zebrafish, open source

ZEBRAFISH ARE AN ESTABLISHED MODEL for biological research because of their high genetic and physiological homology with humans,¹ inexpensive maintenance costs,² and large clutch yields.³ Recent technical improvements in gene editing and transgenic line generation have facilitated the production of a large number of transgenic models and reporter lines.⁴ Although these innovations have advanced our scientific knowledge in many fields, they have also resulted in colonies of, often, thousands of animals that require careful tracking.⁵ Electronic systems provide effective organization methods with faster and less error-prone colony management than physical documentation. Free electronic databases and tracking systems are available but are typically specific to mouse colonies and use software unfamiliar to many users with limited functionality or flexibility.⁶ Commercially available options can cost up to \$100,000,⁷ or require servers with cumbersome setup due to institutional firewalls.⁸ In this study we describe our development of a free and flexible zebrafish husbandry repository, using Google Sheets (GSs), Google Forms (GFs), and a smartphone. All software applications required for this database are freely available and detailed operation instructions can be found in the Supplementary Data (Supplementary Data are available online at www.liebertpub.com/zeb).

Our repository is designed to maintain a log of important animal husbandry information by automated GS updates from GF. Repository usage assumes moderate literacy in Google applications and spreadsheets, but an intuitive environment and online “Help” pages (see Supplementary Material 3A section) can guide less experienced users. By employing a cloud-based system, the repository can be accessed anywhere, by all laboratory members, through mobile devices most people already own. It is important to note that any data stored in a cloud-based system or with Google should meet the requirements of NIH best practices as well as all institutional policies. All data recorded from GF entries are integrated into a catalog (Supplementary Material S1) GS file named “Zebrafish Inventory.” The catalog is automatically populated by three GF files named “New Line Input,” “Breeding,” and “Mortality” (Supplementary Material S2A–C). To expedite data logging, we implemented three-dimensional barcodes (QRTM codes), which are easily generated and used to embed demographic information and populate the repository. QR keyboard applications are also employed and allow for any activated field in GFs to be populated with the code deciphered from a QR reader (Fig. 1).

The “New Line Input” GF consists of demographic metadata for differentiating strains, including tank name, tank number, location, and parents, which allows the user to easily name, locate, and access genealogical data for each labeled tank. For instance, within our system, we have designated a 15-digit code for each tank along with a 15-character alphanumeric code signifying tank location. Each code has been embedded within a QR code and labeled on the tank and rack location, respectively.

Fields for tracking important dates are also included in the “Zebrafish Inventory” catalog. Clutch date of fertilization (DOF) is recorded upon all “New Line Input” GF updates. “DOF” input informs the “Year One” field, which automatically calculates a recommended date for tank euthanasia and the “Generation” field automatically calculates a specified outcross date. Furthermore, scanning a tank code from the “Breeding Form” populates the “Breed” field in the “Zebrafish Inventory” catalog to inform a user when a tank requires maintenance breeding. By implementing the GS add on “Add Reminders” and designating a tank “Owner” and entering his or her e-mail address in the “New Line Input” form, the owner will automatically receive notifications of significant dates associated with his or her tank. Moreover, if the designated e-mail address is a Gmail account, specified husbandry dates will also be automatically added to Google Calendar through the “Events for Gmail” calendar feature.

The number of animals per tank is tracked upon all “New Line Input” form entry in the fish number field. Users update fish mortality through the “Mortality Form” and track individual animal deaths within a tank. Reports of animal fatality automatically inform the fish number field and subtract deaths from the total number of animals. In addition, the “Mortality Form” can mark a tank as euthanized for notification of tank removal from the “Zebrafish Inventory” catalog GS file.

Importantly, the Google application-based repository described here is extremely versatile and can be adapted to fit the needs of any laboratory. The provided repository is merely a template and any form field information can be added or omitted. Finally, all animal demographic information can be coded for QR as needed and the template can be adapted for any animal model. The described system provides a free, simple, and highly functional alternative to traditional electronic zebrafish databases.

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Disclosure Statement

No competing financial interests exist.

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