USEFUL RESOURCES

The death of MyMouseHouse: lessons for systems for the efficient management of mouse colonies

Paul S. Knoepfler and Kelly M. Bush

Introduction: low-tech methods for managing high-tech mice

I [Paul Knoepfler] started working with mice as a postdoc at the Fred Hutchinson Cancer Research Center about a decade ago. The lab maintained hundreds of mice and I was responsible for more than 100 of them. The method we used to keep track of the mice was decidedly low tech: a pen and paper. Basic facts were kept in tables: identification number, date of birth, sex and genotype, along with notes. Tracing the pedigree of a mouse was often cumbersome and meant thumbing through multiple notebooks to incorporate all of the facts. Notebook disorganization was not unusual as pages became dog-eared (or should I say mouse-eared). The system was inefficient and different people in the lab frequently maintained duplicate mice without even knowing.

Despite the modern technology that was used to make our mice, including electroporation, complex targeting vectors and embryonic stem cell selection, I relied on 19th century technology to manage them. There was an obvious need for a better, modern system. Dr Norman Greenburg saw the need too. He was also at Fred Hutchinson Cancer Research Center in Seattle and was developing a new software system for a mouse inventory called MyMouseHouse (MMH). When I began my own lab at the University of California Davis School of Medicine, we implemented MMH from the beginning. After more than 3 years of using MMH, we are very familiar with its strengths and weaknesses, and overall find it to be extremely helpful. Unfortunately, as of December 31, 2009, for funding reasons MMH will no longer be available, leaving the field with a serious gap in mouse management system options. Here, we discuss the strengths and weaknesses of MMH for the purposes of highlighting the type of management software that is still needed, but to our knowledge is not available outside of MMH. We also will discuss other colony management options, as well as their strengths and weaknesses relative to MMH.

One approach to organizing mouse colonies

MMH divides its organizational features into two main tools: the data manager and the cage manager. The 'data manager' compiles a list of all mice. The list includes pivotal information such as ear tag number, animal identification number, sex, date of birth, construct and age. The list enables the user to easily access commonly used information without desperately searching through stacks of cage cards. When using MMH, one can view all animals, past and present, by unchecking 'show only live animals' in the lower left-hand corner of the screen. By clicking on the 'family tree' icon (see example in Fig. 1), one can view the full lineage of an animal, including parents, all mates, and all offspring (and offspring's offspring, etc.).

The 'cage manager' sorts mice into facilities, rooms and racks, allowing multiple users to sort their mice by the construct that was used to generate them. Each rack contains cages that represent the physical cages in the mouse room, enabling the researcher to have a virtual record of cage placement and contents, which is extremely useful. The cage displays the ear number, age (in weeks) and gender of its occupants, and double clicking on any individual allows the user to view the mouse's 'record', including genotype, birth date, and the dates and descriptions of common events such as moving (among cages) and breeding. The program is capable of recording information about multiple constructs. If two different strains are mated, MMH automatically incorporates both strains into the genotypes of the offspring and reminds the user to screen the new pups by putting an 's' at the top of the cage. A simple right click can be used to select 'screen', which allows users to select the correct genotypes from the tabbed constructs for the new mice. Thus, MMH provides a highly convenient method for keeping track of transgenic mice.

Detailed cage cards can be printed through the MMH cage manager by clicking the 'cage card' option and dragging the desired cages onto the blank cards. The program immediately organizes the information, including cage location, institutional review (IR) number, principal investigator (PI), ear tag, construct, sex and date of birth, in an easy-to-read format. The setup for a breeding cage is slightly different, but just as convenient. The card specifies the mother and father (including ear tag numbers and constructs), and provides space for pup information.

Dragging and dropping a digital version of a male and a female into an empty cage establishes a mating cage. The program will immediately ask whether the cage should be identified as a 'breeding cage', and mark a calendar to notify the user at the end of gestation period (21 days or so) when the doe is due to give birth. Pups are added by right clicking on the appropriate breeding cage, selecting 'new pups' from the drop-down menu and entering the date of birth and the number of pups. The program sends a reminder after 21 days when the pups are ready to be weaned. An 'ear tag' option allows the user to enter the gender and ear tag number of the pups. Reminders can be set to signal when the pups reach breeding age. Thus, the program can give timed notifications about when pups are due, ready to be weaned, or ready to be bred.
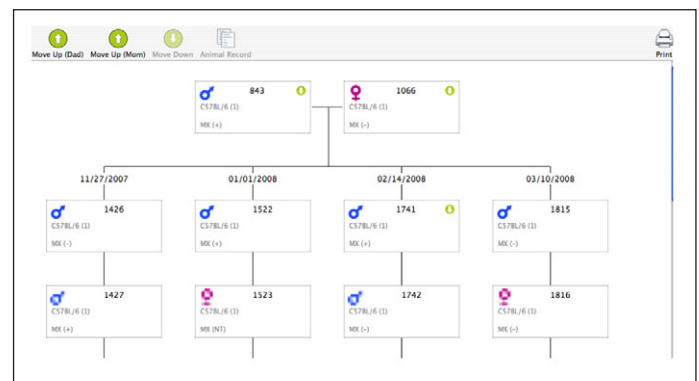

Fig. 1. Overview of a typical breeding schematic and mouse lineage in MMH.

Table 1. Summary of strengths and weaknesses of MMH

Strengths	Weaknesses
The symbols 'S', 'B' and 'W' on each cage are an easy way to keep track of which mice are breeding, need to be weaned, or need to be genotyped	Program can be slow and sometimes freezes
Easy way to keep track of which pups need to be weaned, can be bred, etc. MMH automatically marks dates on the Mac calendar and activates alarms to alert you	Sometimes problems removing mice from 'uncaged'
Screening allows you to keep track of multiple constructs – an easy way to keep track of all genotypes in multiple transgenic mice	Mice are lost at times
	Operates only on Macs
Sacrificed mice have to be confirmed before they are removed from system – can be tedious, but is a good safety measure. Any animal can be resurrected (for breeding purposes) and information about all mice, dead and alive, is saved	Error messages need upgrading
	Shows an 's' when cages have already been screened; shows a 'b' in cages with two of the same sex
Life cycle manager keeps track of when animals were born, weaned, screened, bred and sacrificed	Manual could be more user friendly
Cage cards can be printed showing cage number, PI, ear tag, construct, sex and date of birth	
Pictures can be attached to an animal's record if phenotypic variations occur	
Family tree allows you to keep track of lineage	

Areas of MMH that could have been improved and lessons for other systems

MMH needs fine-tuning in a few areas. One of the biggest obstacles is that MMH only runs on Macintosh computers and cannot be used in labs that only have PCs. The program is also intolerant of rapid movements, so if the user is not slow and careful when he/she drags and drops mice, it will sometimes freeze. Sometimes this can be overcome by simply opening up a new data manager or cage manager, but frequently the user must log out and re-open MMH to resolve this problem. When new mice are received from an outside source, they must be added to MMH using the 'new animal' tab. Most often, the process of adding new mice is smooth and painless, but sometimes the program gives the wrong gender to mice. To overcome this, one can simply go to 'modify animal' and edit the gender. Moving mice from the uncaged section to a cage can pose problems. At times all but one of the mice can be successfully moved. However, when attempting to move the last mouse to a cage, the program presents an error message and boots the mouse directly back to the uncaged section. In general these issues are relatively minor and overall the program remains extremely user friendly and helpful.

Currently available animal housekeeping programs

There are other animal housekeeping management software programs available. The best-known free application is Jackson Labs' JAX-CMS. Many commercial applications are also available, including Big Bench Mouse, Transgenic Software's Villager, and Facility from Locus. All such programs, including MMH, have different advantages and disadvantages and share many similar features (see Table 1). A major strength of MMH over the others is its intuitiveness. The MMH 'cage manager' provides a useful visual representation of where and how mice are caged. JAX-CMS is designed to include more mouse details, which can be very useful, but it is not particularly intuitive (user-friendly) and its user manual has more than 100 pages. This program gives researchers a section to outline dietary restraints to all mouse

handlers and a place for the dates of plugs/pregnancies, with more detailed records regarding expected birth dates. Big Bench Mouse takes a slightly different approach, organizing mice according to specific planned experiments. This program requires the user to set up an experiment before it will accept information about mice, protocols, etc. Some researchers may find this experiment-centered interface very useful, but others will not. Big Bench Mouse runs on both Macs and PCs and has an extensive PDF tutorial and user manual.

These systems are all great improvements over pen and paper, but none is ideal, and all could benefit from enhancements. They will continue to improve and greatly facilitate research involving mice and other model animals. Our hope is that, as these software systems and new ones evolve, they will incorporate some of the strengths of MMH, particularly its user-friendliness and highly intuitive nature. The choice of the most helpful, specific animal management software system depends on the needs of the laboratory and its approaches to working with the animals. From our perspective, the ideal management system would include: affordable software (less than US$500) that runs on any computer (including smart phones that could be taken into the care facility); trial periods (which are only offered by some vendors now) so that labs can see whether the software is a good fit for their needs; a visual representation of the animal cages; a highly flexible calendar, including automatic weaning reminders; networking capability; a clear user manual; and helpful technical support. With the loss of MMH, our lab is likely to use Microsoft Excel, or go back to pen and paper, to give us time to select another resource that meets our needs. We challenge vendors to come up with new and improved software systems that meet the criteria described above.

Paul S. Knoepfler (knoepfler@ucdavis.edu) and Kelly M. Bush are based at the University of California Davis School of Medicine and the Institute of Pediatric Regenerative Medicine at the Shriners Hospital for Children Northern California.