Evaluation Data Report

Investigative Workshop: *Modeling Johne's Disease*

July 6-8, 2011

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Background

Introduction

This report contains evaluation data for a NIMBioS Investigative Workshop entitled "*Modeling Johne's Disease*" (Johne's workshop), which took place at NIMBioS July 6-8, 2011. NIMBioS Investigative Workshops are relatively large (30-40 participants), focus on a broader topic or a set of related topics than Working Groups, attempt to summarize/synthesize the state of the art and identify future directions, and have potential for leading to one or more future Working Groups. Participants may include post-docs and graduate students with less experience in the particular topic than those participating in Working Groups.

The Johne's workshop comprised 40 participants, including co-organizers Shigetoshi Eda (Center for Wildlife Health, Univ. of Tennessee Knoxville), Ynte H. Schukken (Dept. Population Medicine and Diagnostic Sciences, Cornell Univ.), John P. Bannantine (USDA, Agricultural Research Service, Infectious Bacterial Diseases Research Unit), Ian A. Gardner (Dept. Medicine and Epidemiology, Univ. of California Davis), Judith Stabel (USDA, Agricultural Research Service, National Animal Disease Center, Ames, IA).

Workshop Description

Johne's disease (JD) in ruminants is caused by intestinal infection with a bacterial pathogen, Mycobacterium *avium* subsp. *paratuberculosis* (MAP). JD causes reduction of milk production, weight loss, and premature culling of clinically affected animals. In the U.S., JD has been found in 68% of dairy herds and causes an estimated annual loss of $220 million to the U.S. dairy industry. Despite long and intensive national-level efforts for JD control, we are still far from preventing the significant economic impact of this formidable disease. One of the major reasons for the continuing struggle with JD is that there are many unknown factors in JD epidemiology and immunology. For example, we do not properly understand the host immune responses to MAP that lead to persistence and sudden exacerbation of the infection. Another major gap in our knowledge is in understanding the prevalence and importance of latent MAP infections. Since the early 1990s, mathematical modeling approaches have been applied for better understanding of JD epidemiology and for estimation of the cost-benefit of alternative JD control strategies. However, there has not previously been an opportunity to gather a multidisciplinary group of scientists to help facilitate mathematical modeling studies in JD. Further, there has been no mathematical modeling approach for studying the immunology (especially host-pathogen interactions) of JD. This workshop will invite scientists in mathematics, biostatistics, epidemiology, veterinary medicine, immunology, molecular biology, and genetics, to facilitate multi-disciplinary collaborations for better understanding of the epidemiology and immunology of JD.

The long-term goal of this workshop is to contribute to the control and ultimate eradication of Mycobacterium *avium* subsp. *paratuberculosis* (MAP), the cause of Johne's disease (JD), in dairy herds through application of mathematical modeling approaches for better understanding of JD epidemiology, pathogenesis and immune responses. Specific aims of this workshop are:

1. To provide an opportunity to gather diverse groups of scientists for facilitation of interdisciplinary discussions on the mathematical modeling of MAP epidemiology, including the role of latent infections in MAP transmission and management issues,
2. To establish an initiative in employing mathematical modeling approaches for studying the immune responses and host-pathogen interactions of MAP infections, and
3. To investigate methods for linking the epidemiology and immunology models.

Organizer Summary Report

During the first two days of the three-day workshop, 11 presentations were made on epidemiology and immunology and their mathematical models. Breakout sessions to discuss challenges, opportunities, and future directions for each objective of the workshop followed the presentations. On the last day, two scientific presentations were made, concluding remarks presented for each objective, and a final group discussion was held. In addition, NIMBioS leadership team members and leaders from the Johne's Disease Integrated Program described possible synergies between the two. During the workshop, new mathematical models were proposed, new research opportunities emerged, and future activities/goals were identified. A proposal for a NIMBioS Working Group will be made to continue this initiative.

Evaluation Design

Evaluation Questions

The evaluation of the workshop was both formative and summative in nature, in that the data collected from respondents was intended to both gain feedback from respondents about the quality of the current workshop and also to inform future similar meetings. The evaluation framework was guided by Kirkpatrick's Four Levels of Evaluation model for training and learning programs (Kirkpatrick, 1994[1]). Several questions constituted the foundation for the evaluation:

1. Were participants satisfied with the workshop overall?
2. Did the meeting meet participant expectations?
3. Do participants feel the workshop made adequate progress toward its stated goals?
4. Do participants feel they gained knowledge about the main issues related to the research problem?
5. Do participants feel they gained a better understanding of the research across disciplines related to the workshop's research problem?
6. What impact do participants feel the workshop will have on their future research?
7. What changes in accommodations, group format, and/or content would participants like to see at future similar meetings?

Evaluation Procedures

An electronic survey aligned to the evaluation questions was designed by the NIMBioS Evaluation Coordinator with input from the NIMBioS Director and Deputy Director. The final instrument was hosted online via the University of Tennessee's online survey host mrInterview. Links to the survey were sent to 34 registered workshop participants on July 21 2011 (co-organizers and NIMBioS affiliates were not included in the evaluation). Reminder emails were sent to non-responding participants on July 28 and August 2, 2011. By August 9, 2011, 30 of the participants had given their feedback, for a response rate of 88%.

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[1] From Kirkpatrick, D.L. (1994). *Evaluating Training Programs: The Four Levels.* San Francisco, CA: Berrett-Koehler.

Evaluation Findings

Overall Satisfaction

Figure 1. Satisfaction with various aspects of the workshop
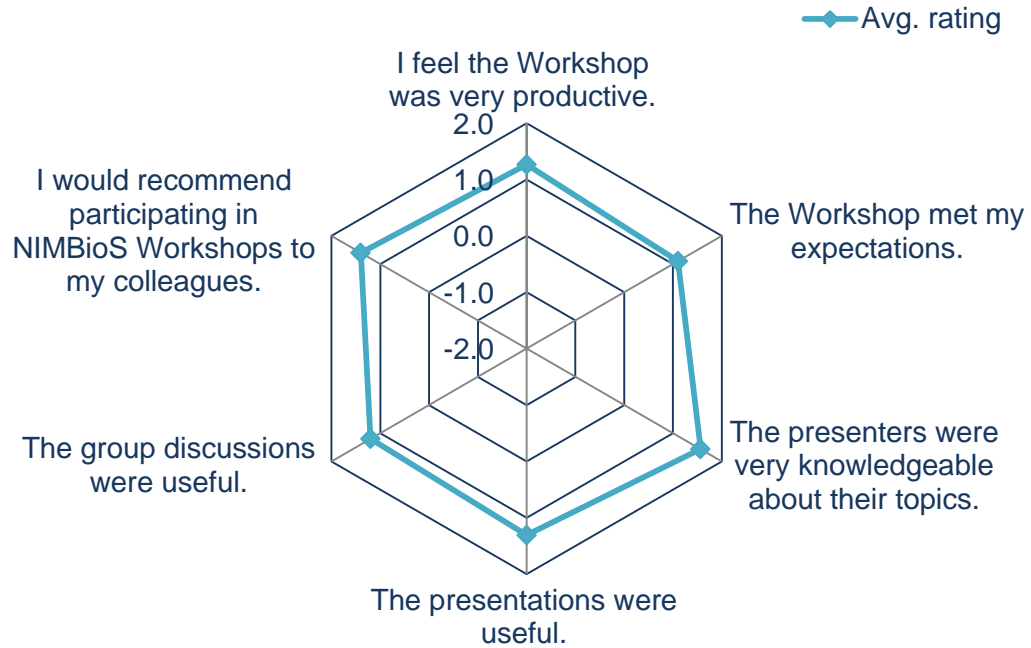
Scored on a 5-point Likert scale from -2 to 2 for "strongly disagree" to "strongly agree"

Workshop Content and Format

Participant Learning

Figure 2. Participant learning

As a result of attending this workshop, I have a better understanding of:

Scored on a 5-point Likert scale from -2 to 2 for "strongly disagree" to "strongly agree"

Figure 3. Do you feel that participating in the workshop helped you better understand the research going on in disciplines other than your own regarding Modeling Johne's Disease?

Comments

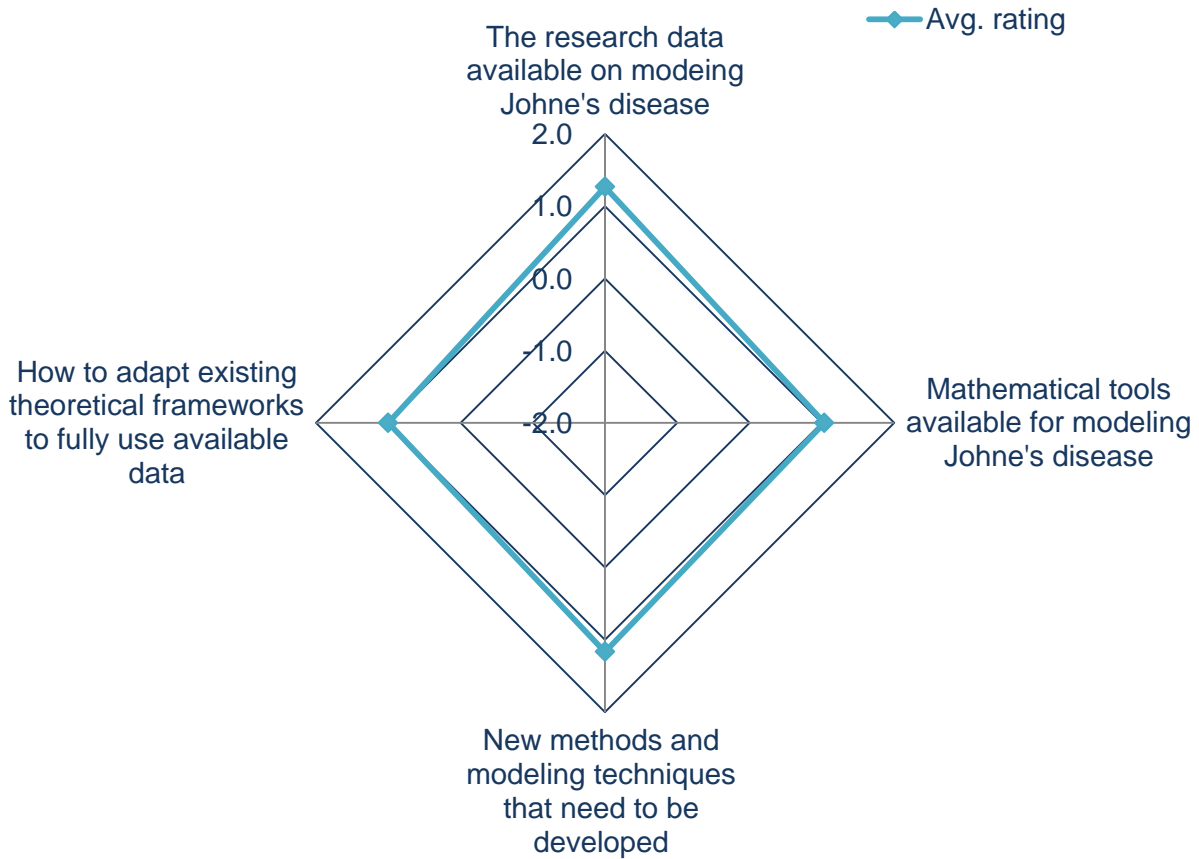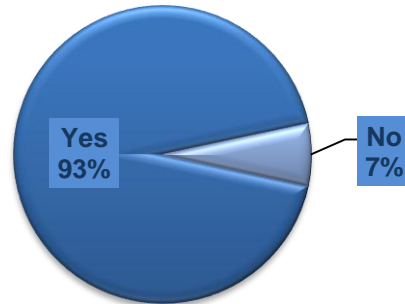*I am very satisfied to have brief knowledge, through personal and group discussion, what kind of immunopathological and epidemiological data is NOT AVAILABLE so far to really understand the disease, and to develop useful models for its control. Thank you very much for all the effort of organizers and staff for the success of the workshop.*

I have a broader understanding of immunological approaches to MAP and also potential for modeling including immunology in addition to host/infection status.

Immunology modeling was new to me.

Yes, especially immunology.

All the sessions in the workshops were very helpful and interacting with mathematicians working in the interface of biology was very good.

I recognized that cooperation of immunology, pathology and disease control study with mathematicians will produce new dimensional studies. I thought find and select of more effective key words and parameters to mathematical analyses are necessary.

Thanks so much for allowing me to be in such an excellent meeting. I learned a lot and I hope to apply this knowledge in my research work. Best regards

I came to the workshop with a very limited knowledge on MAP. I have learnt in a few days an amazing amount of information. This was one of the most useful workshops I ever participated in.

As someone trained almost strictly in mathematics, this was a good way for me to get a thorough grounding behind some of the biological / genetic processes inherent when dealing with Johne's disease.

Entire workshop was absolutely flawless, except little more time for discussions would have helped to give better output at the end in proposed models. Since JD is complex the time was less to address all issues. A day more would have done justice for making crisp recommendations in Epidemiology group. Lack of Global Perception was limiting factor. Countries wise status paper would have given global vision and model for control. Model could have gone to OIE for global application. From Indian perspective present models need to answer key questions on estimation of prevalence, with minimum of sampling & tests to be used and a model for control if infection rates are high and prediction of losses in productivity & burden on National resources due to high morbidity. NIMBioS gave excellent platform for future collaborations among researchers, especially for India as we can learn from expertise of US. Being first edition of workshop by NIMBioS on JD it was a great experience especially for me on modeling.

This was a strong positive aspect of the workshop.

On reflection, the discussion group composition and subject matter should have been pre-arranged before the workshop. This would have resulted in more discussion across disciplines. As it was the epidemiologists and immunologists largely worked separately. There was also a lack of direction. With 20-20 hindsight, it might have been better to organised the groups into cross-disciplinary themes such as Diagnosis, Approaches to Treatment, etc. and ensure that there was a mix of immuno and epi in each group.

I would have preferred that: 1) the presenters had been better in presenting to non-modelers (the modeling presenters) and non-MAP people (MAP presenters). Despite that many expressed that they "learned a lot", I believe that that could have been better if the presentations had better overviews of the actual knowledge that should be linked 2) there were fewer presentations and more group discussions. The group discussions were relatively fruitful but could have been better with more time and development of more specific tasks. This process should have started already at noon. A set of tasks could have been given /specified before the workshop.

Workshop Format

Figure 4. Effectiveness of workshop format
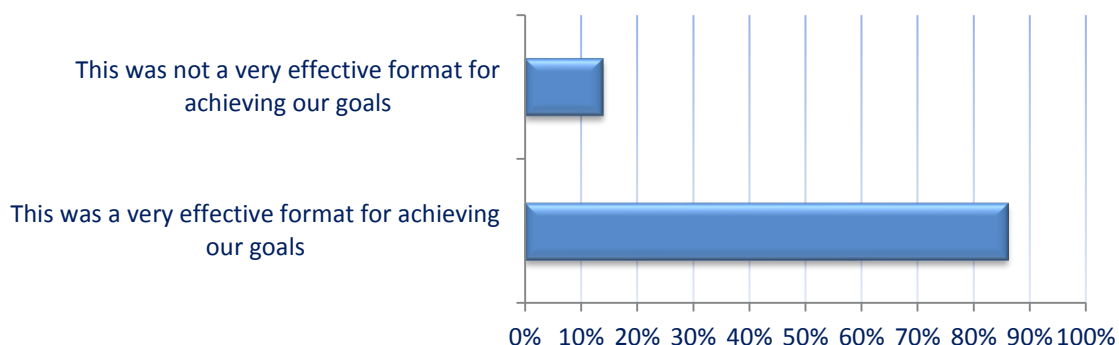
Format could be improved if:

As I wrote earlier, less sitting and listening to research presentations, and more 'synthesis' sessions involving audience members.

There was more group work, fewer presentations, and the presentations should have provided overviews, not technical details

There was a clear agenda with clearly defined goals and breakout groups focused on achieving those goals. The workshop would also have benefited more from clear leadership, direction, and better facilitation of breakout groups.

The goals had been explicitly stated - I am still not sure what they were. Hence the answer to the previous question - I don't know if we reached the goals. In particular the discussion sessions were enjoyable and informative, but meandering and too intra-disciplinary focused.

Most Useful Aspects of Workshop

The breakout sessions.

Breakout discussion in small groups with clear (self-defined) aim

The open discussions

Putting all experts in the disease together in one place. Great opportunity to foster scholarly discussion.

Gathering Johne's disease researchers together for 2-3 days

The expert's presentations on different aspects of JD. IT will be great if we get a copy of all the presentations we had from stalwarts in their field (JD and mathematical modeling. The congenial environment for expressing the views and

appreciation of each other's requirements. Conclusive recommendations which we were required to make by developing models.

Seeing different research techniques for theoretical modeling

The discussion and know the scientific point of view depending on experience.

Hearing what others were doing in their research

Engaging in frank discussions concerning the reality of not being able to 'eradicate' this disease and freeing ourselves to start to be able to work towards optimal control on a variety of production systems.

Johne's research has a relatively strong base including mathematical modeling which gave feeling that a significant progress can be done.

The presence of immunological review and ideas, the presence of epidemiological ideas, and the presence of models. Very well set up.

Interaction with modelers and finding out new ways for the control of the disease.

The discussions and interactions between people in different fields

Fostering a genuinely interdisciplinary discussion of Johne's disease.

The idea of merging two sciences, immunology and epidemiology, was highly original and generated a lot of discussion. The discussion alone was invaluable in centering the participants on what data is currently available and perhaps what aspects of research need further focus.

Concept of the workshop to unite researcher who know disease side and bacteria side in various level, and researcher who know how to analyses data was very fresh for me. For better collaboration, we should know each side, even though partially.

The need for math-biology interface is very useful.

The presentations

Presentations by immunologists

The brief presentations that were made to the group as a whole, across disciplines

The structure of a day's presentations on recent findings and developments in research followed by the break-out sessions to come up with new ideas was quite useful.

Quality of the guest speakers' talk and the interaction within participants.

Small group interaction focused on different aspects of one disease.

Understanding possible interactions between animal level epidemiology and the role of immune markers.

The understanding of current status of JD in animal populations, and its association to human Crohn's disease. This may help us to think about what is the next if we want to address some important JD relevant issues using mathematical modeling approaches.

Communication

Figure 5. How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?
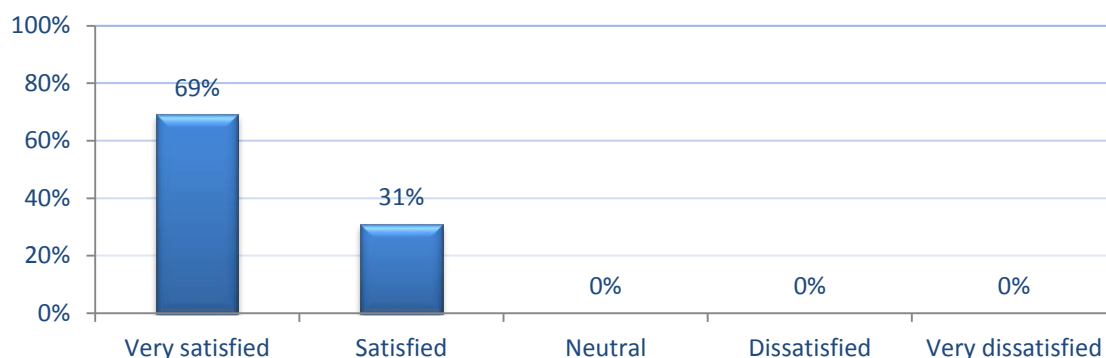
Comments

As mentioned before, a clearer understanding of the tasks to be accomplished during the breakout sessions.

Participants grouped according to their experience such as working with immunology, epidemiology, strain typing, etc.

After the NIMBioS moves to a new building, I hope you'll have a small space where the participants can eat their lunch in group table, not in the workshop room, to have more interaction during breaks and meals.

Presentations by each participation as what he is doing, what are his achievements, and what are the requirements before and at the end of workshop, what he learned or model how is developing or wants experts to look in to help at later stage. A PDF of presentations before coming would have given time for gaining more in this short time.

Pre-assigning discussion groups helps people to interact and meet more people.

Reduction of number of participants.

Everything was fine for me. After sub-group discussion results were reported the representative person of the group. Some of them were new for me, but parameters, immunological parameters for example were not very new. I wanted know why many kinds of research on paratuberculosis have been carried out, but the incidence was not decreased well in most countries. I hope mathematicians will analyze the reason. I hope some of them study comparative analyses of previous practice in Japanese and US or other countries. Since the big difference of the incidence, 2% in Japan and over 70% in US. This difference should be very significant. There should be reasonable different parameters in both countries.

Progress Toward Goals

Figure 6. Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?
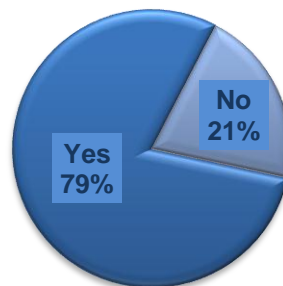
Comments

I am not an expert of mathematics but at least I could learn many keywords of modeling, which will allow me to discuss more effectively with my concurrent collaborators (infomaticians) on the topics other than JD.

This kind of follows up with my previous comment... I think most people, when asked, would agree that the mathematicians learned a lot more biology, and the biologists learned a lot more mathematics. Moving ahead, it will be important for each to learn the other's language. This workshop did a great job of bridging the gap.

Being first edition of workshop on a very complex disease by NIMBioS the achievements were satisfactory and was a great learning experience especially for people from developing countries. And it is there the need of mathematical modeling for control of chronic diseases like JD is absolute necessity, as these countries have not calculated the National Burden of JD on scarce resources these countries are wasting by not placing due emphasis on the control of JD

bug which not only playing havoc in animal population but also infecting human beings.

The 50% of the topics on paratuberculosis was very familiar with me, but another part of mathematical analyses were not familiar before. However my allergic part of mathematical analyses study is mild case now. I cannot use formula but I could understand what mathematicians are doing.

It laid the framework... much yet to be done and will need a smaller more dedicated Working Group

I would say perhaps if that was an option.

See earlier comment. I learnt a lot from the immunology presentations and informal discussions, but I am not sure that there was a coming together of concepts and approaches.

I think we spent far too much time just sitting and passively listening to presentations (many of which were self-inflating talks on the researchers' own work, rather than syntheses of the subject area) rather than engaging in the cross-disciplinary discussions that were really needed. There was typically only 1.5 hours left at end of the first two days to do this and as a result it felt more like a series of seminars rather than a 'workshop'

I lean towards a "No", but there was some mutual understanding. However, I felt that all presenters were too technical - trying to impress rather than reaching out.

Yes, we decided merging immunology and mathematical modeling for the control of Johne's disease.

Impact on Future Research Plans

Figure 7. Do you feel that the exchange of ideas that took place during the workshop will influence your future research?
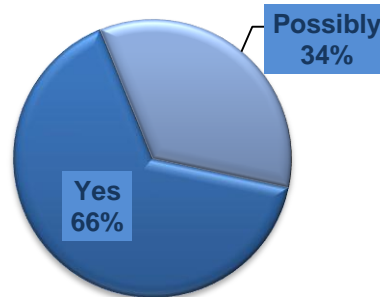
Comments

Despite my comments earlier about how I felt the interaction: seminar ratio was too low, I always learn from everything (almost!) I am exposed to.

This was a great way to take a look at the work we at NIMBioS have already done and compare it to what everyone else is doing. There are areas in which we are excelling, and areas in which other people have had creative ideas that we can consider using.

I see which stage many people are at and that helps identify problems that will eventually be addressed.

My future modeling activities will be more focused on supporting evidence from good field data.

It has helped me orient my research in a better direction.

It will help develop models which in turn will help direct research and help decide where to invest the limited funds for experimental studies

Yes now I realize the importance of modeling to address our needs, wherein I can seek help of the individual experts who have necessary experience to guide us. Yes I am re-shaping some of thinking on diagnosis and estimation of losses and develop a model for our needs and use.

I will not directory use their calculating formula by myself. But I may propose cooperation.

See above. I am also re-interested in the possibility of seeing chronic bacterial disease as something that can be modeled as a "macro parasite", i.e. as an intensity framework rather than a compartmental prevalence framework. I intend to post something on the wiggio.

Introducing immunology in epidemiological models

I would like to invite my colleagues (infomaticians) for the field of JD, proposing them to develop a model JD propagation in the state level, which can be used later on to advertise and educate the local farmers and animal health authorities.

Impact on Future Collaborations

Figure 8. Did you develop plans for collaborative research with other workshop participants?
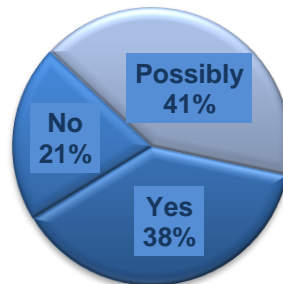
Comments

We are moving forward on future collaboration with Dr. Eda's lab on validation of our kits and application of his technology for developing quick, cost effective, specific and sensitive diagnostic kits. Besides in one test to differentiate bet wean TB and JD. I am also trying to make a model for control of JD a National Model with collaboration of individual experts. Collaborations in other areas are also being discussed with other experts in JDIP groups.

I made connections and discussed potential future collaborations using some data and approaches I have been working on.

I haven't developed a specific plan but I have agreed to possibly participate in a working group.

Agreed with Dr.Patrick Pithua (Univ.Missouri) to seek the possibility of collaboration on study of JD prevalence in small ruminants, seeking some grants at first.

We made some new connections, and may develop a working group out of them

I met some researchers and would try to contact them for further studies.

I'd like to cooperate some of participants I met the workshop; however it is not specific yet.

As someone working under Dr.'s Lenhart and Eda, I will more or less follow them. If they made collaborative plans, then I will take part. Individually, no, I did not develop any plans.

We aim to apply for a working group at NIMBioS this fall to further develop models for Johne's

I had some ideas already and am planning to apply for an ERC grant. This workshop has meant that I am likely to invite/include several of the participants that I spoke with during the workshop. The group discussions also made me aware of some potential pitfalls that could be avoided in the grant proposal.

Aim indirectly involved with the JDIP group who plan collaborations, and would like to participate in this.

I am visiting Cornell (Grohn, Schukken, Mitchell and Zhao) in August, and although this was arranged before the workshop my trip will benefit greatly from the interactions during the workshop. I remade contact with Morgan Scott (Kansas) and hope that we will develop collaboration from the meeting. It is unlikely to be specifically on Johne's disease, but will be on gut bacteria and the influence of antibiotic therapy. I will keep NIMBioS informed of specific outcomes.

Suggestions for Future workshops

Adding more biological data

I think it would be better if we added a section: What mathematicians or how mathematical modeling can contribute to Johne's disease?

A clear statement of the goals, particularly before the breakout sessions... i.e. was the goal to develop a model... identify knowledge gaps required to parameterize model, or merely to establish collaborative links? This might have been helpful to guide the smaller breakout sessions.

The group breakout sessions seemed haphazardly put together. Eventually they were a good way for all of us to work in a more informal setting, but at first, I think most of us felt largely unsure of what we were supposed to be accomplishing.

Perhaps offer a little bit more direction? Be more explicit in what our goals should be?

Breakout sessions should be better thought and explained (purpose) before sessions.

More planning and preparative cross-talk among participants prior to the meeting could have provided more realistic science-based models.

Development of global vision on subject, so as to address all issues and see a problem in totality. The recommendations of workshop in the form of models should be sent to OIE for inclusion in their schedule as how chronic production diseases need more focus for control and models available to address different issues. This is for specific disease like JD. One day extra for diseases like JD and developing test models, which can be improvised at later editions of workshops or meeting of working groups. Continuation from where we left.

Organization of breaking discussion (three groups). Maybe some kind of pre-workshop discussion or assignments we should have.

The discussion sessions (see comments above).

I was disappointed about the lack of application of research to real-world problems. I found the workshop very theoretical without a clear direction or focus.

It was excellent, but it would be good to include any practice or demonstration of mathematical models in computers, thus would help a better understanding.

Add hands-on practicals where participants develop simple models, targeting at least one example where immune markers inform disease dynamics.

Have less of a focus on the more technical aspects of the various research topics and more time to work on the integration of the different disciplines in workgroups

Less general presentations more time for interaction

More group discussions and fewer presentations. The presenters should be asked to make their presentations much less technical. I was very much in the middle (have done some modeling and have worked with immunology, but the "overviews" given provided way too many details to actually be useful).

It's a lot of information to absorb in a short amount of time. More days with shorter hours?

More time in breakout sessions.

Though, it was a good effort but it would have been better if there would be some training sessions for beginners.

Less passive time sitting and just listening. There was far, far, far too much in the way of formal presentations at this meeting. If they are to be included they should be along the lines of what Vivek Kapur presented (overviews of state of knowledge, where are we at, and where do we need to be)? They should be jumping off places for much focused discussion groups which could be much smaller than they were.

Some of the talks were quite technical and made understanding from a general audience with little background difficult. On the other hand I felt that everybody in the audience had talks that they understood well, and talks that were over their heads.

In the workshop, I proposed as followed; there is USDA data of incidence of JD in US. The incidence was various according to size of the herd. Large farm having over 500 heads showed very bad situation, over 95% farm was contaminated, in contrast small farm having less than 100 head showed much lower incidence. I'd like to know which parameter is the main cause of the difference. Management parameter or immune system parameter of accumulated bacterial factors for example. If we can find any essential parameter relates to the difference from this large scale surveillance, it will be very useful.

Perhaps 2 1/2 is too long. I think the goals could have been achieved in 2 days. I would also make the goals from NIMBioS' S perspective clearer to the participants. Having a designated moderator would help guide the discussions. We have had pretty good success using professional moderators.

Additional Comments

I enjoyed the workshop and appreciated organizational preps and conduct, thanks!

Thank you again for the organizers and staff for their hospitality and efforts for the success of the workshop. I already encouraged some of my students and colleagues to apply future NIMBioS events. Hope I can come back to Knoxville in the future.

Great opportunity, new learning and thanks to NIMBioS. Looking forward to next visit.

Thank you very much for providing nice chance to study this field. Exchange of information and to know each other were very nice for future research and provided me good motivation.

Appendix

Modeling Johne's disease Workshop Evaluation Survey

Modeling Johne's disease Workshop Survey

Thank you for taking a moment to complete this survey. Your responses will be used to improve the workshops hosted by the National Institute for Mathematical and Biological Synthesis. Information supplied on the survey will be confidential, and results will be reported only in the aggregate.

Please check the appropriate box to indicate your level of agreement with the following statements about this workshop: (Very satisfied, Satisfied, Neutral, Dissatisfied, Very dissatisfied)

> I feel the workshop was very productive.
> The workshop met my expectations.
> The presenters were very knowledgeable about their topics.
> The presentations were useful.
> The group discussions were useful
> I would recommend participating in NIMBioS workshops to my colleagues.

Please check the appropriate box to indicate your level of agreement with the following statements. As a result of participating in this workshop, I have a better understanding of: (Strongly agree, Agree, Neutral, Disagree, Strongly disagree)

> The research data available on Johne's disease
> Mathematical tools available for modeling Johne's disease
> New methods and modeling techniques that need to be developed
> How to adapt existing theoretical frameworks to fully use available data

Do you feel participating in the workshop helped you better understand the research going on in disciplines other than your own?

> Yes
> No
> Comments:

Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?

> Yes
> No
> Comments:

Do you feel that the exchange of ideas that took place during the workshop will influence your future research?

       Yes
        No
       Possibly
       Comments:

Did you develop unanticipated plans for collaborative research with other workshop participants?

       Yes
        No
       Possibly
       Comments:

What do you feel was the most useful aspect of the workshop?

What would you have changed about the workshop?

How do you feel about the format of the workshop?

       This was a very effective format for achieving our goals
       This was not a very effective format for achieving our goals ->
           The workshop format would have been more effective if:

How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?

       Very satisfied
       Satisfied
       Neutral
       Dissatisfied
       Very Dissatisfied

Please indicate any suggestions you have for facilitating communication among participants during the workshop:

Please use this space for additional comments: