Social Epistemology Review and Reply Collective, 2014
Vol. 3, No. 8, 1-2. http://wp.me/p1Bfg0-1y8

Is Quantification the Key? A Reply to Nederbragt

Gerrit Koop, Utrecht University

In "Cells that Count: Networks of a Diagnostic Test for Bovine Mastitis", Nederbragt (2014) writes about somatic cell count (SCC), a diagnostic test for mastitis in dairy animals and argues that this diagnostic test should be seen as an epistemological network that functions within a larger actor-network. In his publication, he clearly shows that the context of the test should determine the interpretation of its outcomes, by 'weighing evidence against context' as Nederbragt puts it.

Using additional information in the process of decision making based on a diagnostic test outcome is completely natural, as shown for instance by the fact that finding a high SCC in a cow that also was diagnosed with high SCC in the previous month will generally lead to different actions than a high SCC in a cow that has never had a high SCC before. This difference in decision making is based on knowledge about, for instance, the decreasing probability of cure when SCC has repeatedly been high (van den Borne et al. 2010) and about costs associated with treatment, culling or other possible actions that can be taken. This illustrates that, in order to make an informed decision, it is necessary not only to have adequate information about sensitivity and specificity of the test that is used, but one should also have information about the cow, the farm and the farmer, economic factors, biomedical information and so on.

The primary merit of Nederbragt's study, I think, is therefore in the fact that it clearly shows that the context of the diagnostic test is much wider than the patient itself. However, without making his conceptual model of actor-networks concrete, it is of little help in the actual decision making process that has to be done by the farmer on a daily basis. In the end, the goal of any diagnostic test is not just to provide information, but to help making the best possible decision. In the context of subclinical mastitis, the decision can be to perform an intervention such as treating the animal with antibiotics or with something else or to cull the animal, to perform another test, to do the same test again, to do nothing, etc. A difficulty will of course be to decide on what makes a decision the best decision. In the context of a dairy farm, the optimal decision will frequently be determined by maximization of profitability, but other less tangible factors such as animal welfare and public health should also play a role.

In an ideal world, it should be possible to quantify all 'context data' and combine that information with the test outcome in order to calculate expected outcomes for all factors that matter in the decision making process, given the intervention options. At present, mathematical models combining test and context data to estimate the effect of interventions on the epidemiology and economics of a disease have been built (see Van den Borne et al. (2010) for an example on bovine mastitis). Such models, however, are based on literature and expert opinion data reflecting an average situation, whereas ideally, models should be based on data from the tested animal itself and its farm. Rutten et al. (2013) gives a nice framework for the use of sensor information in dairy farm management, describing how test-data and context-data (cow-data, economic information, farmer's information) can be integrated in a decision support model to generate advice to the farmer as output. However, according to this article, within the

field of dairy farming no systems integrating test data with context data have been developed so far. This means, according to the authors, that the farmer has to "rely on his or her herdsmanship (i.e. the combination of the farmer's intuition, experience, and knowledge as a herdsman) in interpreting the available information to make a decision" (Rutten et al. 2013).

A potential problem of integrating test and context data into a decision support model is that there is a serious risk that such a model will be treated by its users as a black-box. The user may have no proper understanding of the process leading to the output and therefore cannot correctly interpret the output. In terms of actor-network theory, there is need for depunctualization, but this will in itself be problematic given the complexity of the models employed. Therefore, I believe there is an optimum in the amount of information that should be quantified and used as input in a decision support model. When the model becomes too complex to be understood, there is a substantial chance that the model output will be misinterpreted. This seems already true for a relatively straightforward diagnostic test as the SCC. If the user of the test is not aware of the factors that contribute to the test-outcome, correct interpretation of the test-outcome is unlikely and using the test will not always lead to better decision making.

The work by Nederbragt, leading to the conclusion that a diagnostic test can be seen as an actor network in a wider network of the disease of interest, is helpful to learn to appreciate the complexity of such networks and for identifying the properties of the tools needed to deal with this complexity. At the same time, it helps realize that the complexity of these networks is such that it will be very hard to interpret all relevant information at once—even when using smart quantitative approaches.

Contact details: g.koop@uu.nl

References

Nederbragt, Hubertus. "Cells that Count: Networks of a Diagnostic Test for Bovine Mastitis." *Social Epistemology*, 27 January 2014. DOI:10.1080/02691728.2013.818730.

Rutten, C. J., A. G. J. Velthuis, W. Steeneveld, and H. Hogeveen. "Invited Review: Sensors to Support Health Management on Dairy Farms." *Journal of Dairy Science* 96, no. 4 (2013): 1928-1952.

Van den Borne, B. H. P., T. Halasa, G. van Schaik, H. Hogeveen, and M. Nielen. "Bioeconomic Modeling of Lactational Antimicrobial Treatment of New Bovine Subclinical Intramammary Infections Caused by Contagious Pathogens." *Journal of Dairy Science* 93 no. 9 (2010): 4034-4044.

Van den Borne, B. H. P., G. van Schaik, T. J. G. M. Lam, and M. Nielen. 2010. Therapeutic Effects of Antimicrobial Treatment during Lactation of Recently Acquired Bovine Subclinical Mastitis: Two Linked Randomized Field Trials. *Journal of Dairy Science* 93, no. 1 (2010): 218-233.