Risk Assessment on the Battlefield

the road to a new specific military model,

to conserve fighting strength.

Research Project	Veterinary Medicine
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Summary

To investigate the opportunities of creating a relevant addition to already existing risk assessment models, specific for military personnel, three subjects were examined.

The first research focuses on useful components from the EmZoo report (2010) and the report of Krause (2008). The chapter written by Havelaar *et al.* (2010) "Emerging Zoonoses Information an Priority-setting system." contains 7 prioritizing criteria of which 5 where usable (Transmission between animals; Transmission from animals to humans; Transmission between humans; Morbidity and Mortality). Preventability and treatability are two health gain opportunity criteria selected from the report of Krause (2008), supplemented by the EmZoo (2010) criteria there is a start for a new model. To conserve fighting strength, deployment is the most important during a mission, so the operational readiness should be further examined.

The second research attempted to quantify operational readiness, by questioning health and safety offices. In the questionnaire information on work related absence was collected, unfortunately there was little information collected about infectious diseases. In order to gather information on the first days of work related absence, sick military personnel should be questioned.

In the last research an example of a disease symptom questionnaire was created. Every soldier visiting a doctor should fill up this questionnaire in order to gather information on disease symptoms they suffer from. However, creating a valid questionnaire will take more effort than possible in this project.

In conclusion an addition to already existing models can be made by a combination of criteria from the EmZoo report (2010) and Krause (2008) completed by "operational readiness". However, further research and elaboration is needed to create a valid model for military use.

Introduction

The aim of this study is to create a valuable extension to already existing Risk Assessment models, specifically military. A model which can be used to estimate the (zoonotic) risk of military personnel during military missions abroad. This model will be made with operational readiness as a main subject to work with because this is a key element in the success of a military mission.
The hypothesis of this study is that the information delivered in this paper will be a positive addition to existing methodology.

Soldiers on a mission are different from civilians in many ways. Soldiers encounter a higher level of pressure and stress. They can get in contact with unknown sources (food, vectors, animals, infectious diseases) and the requirements for deployment are higher during a mission in comparison with work at the home base especially for, for example, a mailman. The chance for a mission to be successful is related to the operational availability of staff.

Diarrhea is very unpleasant for civilians, but usually far from deadly. To military personnel this simple symptom can have disastrous consequences, as severe diarrhea can have an impact on the functioning of military teams. In case a whole group of soldiers gets affected by diarrhea, a planned military operation could perhaps be better rescheduled or cancelled, as insufficient properly functioning staff will be available.

An example of impact of general symptoms on military personnel described in literature can be found in outbreaks of norovirus. McCarthy *et al.* (2000) describes that gastroenteritis with subsequent dehydration due to norovirus had major implications on the crew of aircraft carrier ships. Part of the crew could fulfill their tasks due to the symptoms. Besides, the spread of norovirus is easily facilitated as crowding is difficult to stop on a ship. Reduction of spread of infections by means of isolation is difficult on a ship or at a crowded compound/camp.
During Operation 'Iraqi Freedom' infectious gastroenteritis was of larger health concern then the expected threat of chemical and biological weapons (Thornton *et al.* 2005).
The consequences of contagious gastroenteritis to the combat readiness are also mentioned by Wijnker and De Man (2014). Besides the decreased operational capabilities, also morale of the troops and logistical resources come under pressure during an outbreak of contagious gastroenteritis.

Operational readiness or fighting strength is a very important factor in success of deployment during a mission. This success can be supported by prevention of infectious diseases, but not all diseases are of equal importance. The EmZoo report is an example of how to prioritize infectious diseases by criteria with a certain weighting factor. Although the EmZoo report only focusses on the introduction of emerging zoonotic diseases, it can be of great importance to this study.

Some parts of the EmZoo report can be used in the military approach, for other parts a specific tool needs to be created. With operational readiness as the main objective, reduced operational readiness can be a measure to work with. Reduced operational readiness caused by infectious diseases logically results in the cessation of work.

From personal conversations with a military physician, it was noted that there is little insight in the impact of infectious diseases in the workspace, while infectious diseases can have an enormous impact on the operational readiness of staff.

As a result, a tool in order to estimate operational readiness can be of great help to inform a commander on any limitations in the operational readiness of his personnel.

Chapter 1 - Background

At first, there appears to be no clear link between soldiers and veterinarians. The Royal Netherlands Army does not have horses to pull carts or chariots. Horses used in ceremonial events are mostly private horses. The population work dogs and pack animals are small, too small to be accounted for daily routine work for a veterinarian. Most of the time, the working dogs have off-base private practice veterinarians who take care of the animals when they are in the Netherlands. When dogs get injured during a mission, veterinarians in these countries can take care of the dog or human medics can be instructed to perform first aid to the dog (Klein Haneveld, 2014)

Another perhaps less known expertise of the veterinarian, is the knowledge about infectious diseases, zoonosis and food safety, also familiar under the term “veterinary public health”.
Of all hospitalizations during a mission, only 5-25% are battle injuries, 5-10% are other injuries and a staggering 65-80% are caused by “diseases and non-battle injuries (DNBI)” (Klein Haneveld, 2012). Most of these 65-80% DNBI are infectious diseases, frequently spread by animals or vectors and can reduce combat power dramatically. To conserve fighting strength, deployment is the most important factor during a mission. That is why the prevention of illness from infectious diseases is very important.

The goal of the Force Health Protection (FHP) is to monitor, promote and restore health in deployment. This can be done by preliminary research, risk analysis and hygiene education. During a reconnaissance mission of the area, search for disease spreading vectors and pest animals, potential food risks and other hazards (radiation, cold etc.) is performed. Since 2013, each of the four brigades has incorporated a veterinarian who joins the FHP-hygienists-team to counsel on zoonosis and vector borne diseases (Klein Haneveld, 2014).
Close collaboration between veterinarians, hygienists and medical personnel is necessary to reduce risks and increase effectiveness of missions.

In this study a new approach of a model to estimate influence on operational readiness or fighting strength will be described. Attention will be paid to the One Health approach (the knowledge of infectious diseases on the interface of human, animal and environmental factors) and the importance of veterinary knowledge.

Chapter 2 - EmZoo - Prioritizing system

The Emerging Zoonoses: Early warning and surveillance system, EmZoo report, is a report with the ultimate objective to develop a blueprint for an effective early warning and signaling system in the Netherlands (Van Der Giessen *et al.* 2010). This goal has been fulfilled by 8 publications/projects following 3 aims:

1. to provide a systematic approach for the signaling of emerging zoonoses,
2. to prioritize emerging zoonoses important for the Netherlands, and
3. to develop a blueprint for an early warning and surveillance system for emerging zoonoses.

The second aim seems to be the most relevant in this project.

Summary EmZoo Report

In the following chapter a short summary of all eight projects of the EmZoo report will be described. The importance for the main question of this study and the usability in addition to the already existing Risk Analyzing models are listed.

A. Early warning and surveillance systems

1a. Inventory of early warning and surveillance systems. (Van Duynhoven *et al. 2010*)

In this project the authors describe how, if available, surveillance is obtained and by which institutes. The surveillance was best in humans and farm animals, no adequate surveillance in companion animals was found. Surveillance in arthropods, wildlife and exotics is underdeveloped.
The results described in this chapter are not directly usable for the specific military risk assessment model although it is a collection of information on surveillance, which might be useful in other projects.

1b. Technology assessment and data sharing for the purpose of early warning. (Swanenburg *et al.* 2010)

The aim of this article was to identify gaps in surveillance systems, as well as an inventory of diagnostic methods and information sharing between veterinary and human domains. Gaps were found in surveillance of several endemic and non-endemic zoonoses. Recommendations for improvement are described. This chapter is not directly relevant for the research on military approach of operational readiness. However, the authors mention that the report should be used as a guide. In this way military policy makers can also use it.

2. Syndromic surveillance in companion animals and horses. (Wagenaar and Van Maanen, 2010)

Syndromic surveillance options for companion animals and horses are viewed and compared, based on information from human surveillance and passive surveillance in “Veekijker”. The “Veekijker” has four aims, of which the helpdesk purpose (partly) ensures that the other aims (early detection of well-known exotic diseases; early detection of new or emerging diseases; description and analysis of trends and developments of cattle health) are achieved. Farmers and veterinarians contact the “Veekijker” for the advice of cattle experts. As a result, it is possible to get an impression of trends in (new) cattle diseases and health.
This way of (passive) registration of new diseases or trends in known diseases can be very useful in early detection of disease during mission and subsequently informing commanders about the health status of the troops.

B. Direction of the early warning and surveillance systems.

3. Emerging Zoonoses Information an Priority-setting system. (Havelaar *et al.* 2010)

In this project emerging zoonoses were prioritized based on multi-criteria analysis by 7 criteria. A website was created in order to show the results, together with general information about the diseases.
This chapter is further used and an extended description can be found further on in this article.

4. Scenario studies for vector-borne zoonoses. (Braks *et al.* 2010)

Four possible scenarios where identified, of which two scenarios where illustrated. The pathogen and vector of Crimean Congo Haemorrhagic Fever has not currently been identified in the Netherlands. The second scenario describes the absence of the Rift Valley Fever-causing pathogen, while several potential vectors are endemic.

C. Infrastructure of collaborating institutes.

5. Connecting human and veterinary early warning signaling. (Wever *et al.* 2010)

The exchange structure and assessment of health disorder signals where studied in both the human and the veterinary sector. Improvement of early warning and detection of zoonoses, as well as protection, should be established by the collaboration between one another.

6. Blueprint for the early warning signaling and surveillance of emerging zoonoses in the Netherlands. (Van Der Giessen, 2010)

In conclusion, the EmZoo report contains plenty of useful information. In the development of a relevant addition to existing models, the only chapter usable in this study is the chapter about prioritization. The broad outlines of this chapter and the underlying ideas will be used in the current study.

Usefulness

Because the EmZoo report has its only focus on the Netherlands, zoonotic diseases that are of negligible relevance are not mentioned in the list of pathogens. Diseases that are not of interest for the Netherlands are not listed. Also, pathogens transmitted by primates are not included, because they do not exist in the Dutch wildlife. Besides vector-borne pathogens of which the vector does not occur in Europe and diseases without a reservoir in Europe were not included in the list. The report is based on the Netherlands, which is something to consider when the EmZoo prioritizing system is used in other countries. (Havelaar *et al.* 2010)

In the following paragraph the motivation to use or remove EmZoo criteria in a military model will be described. Further on also the criteria of Krause (2008) are viewed for their possible usefulness.
The model and criteria of Krause (2008) are viewed because the author has made an overview on risk analyzing models and there criteria, in the EmZoo report the authors refer to Krause (2008) as a simple and less specific model (Havelaar *et al.* 2010).

1. Probability of introduction of the pathogen into the Netherlands.

This criterion gives insight in the probability of introduction of infected material, vectors, food or (wild) animals and humans. The risk is dependent on the prevalence in the Netherlands and the chance of introduction (by import of animals, wildlife or humans).
This criterion is not usable if used for another country than the Netherlands. To convert this criterion to another country will be very hard since there is very little information on the prevalence of infectious diseases in counties of war.
In summary, this criterion is not of use and will be excluded from this study.

2. Transmission between animals.

Transmission between animals describes the prevalence of infections in the animal reservoir.
This registered prevalence in animal reservoirs can be of influence to the total burden of infection in a region and subsequently in human. The prevalence of infections in the animal reservoir will have a significant influence on the 4th criterion (transmission from animal to human), as a higher prevalence in the animal reservoir will lead to a higher burden and subsequently a higher risk of transmission from animals to humans.

3. Economic damage in animal reservoir.

Apart from physical damage, the introduction of a pathogen in the Netherlands will also have an impact on the economic status. In this criterion the costs for the agricultural sector are calculated in case of an introduction of a pathogen. These costs will include the costs related to control of the disease, reduced yields, loss of breeding animals and genetics, damage to the market and loss in tourist industries.
Although its great importance, this criterion will be very difficult to use in military situations and is of secondary importance in this specific study.

4. Transmission from animals to humans.

The number of humans infected by animals is an important and valuable criterion that will be included in this study.
Although military personnel should not get in contact with (wild) foreign animals, there is always a chance of unpredicted contact.

5. Transmission between humans.

This criterion describes the prevalence of infections caused by human to human contact.
The point estimates used in the EmZoo report will be used in this study.

6. Morbidity

Morbidity describes the loss of health related quality of life, obtained out of severity and duration of certain diseases. This criterion can be used, although the implementation of the decision rules might not be possible.

7. Mortality

Mortality describes the case fatality rate of illness, which is a combination of health status, infected host (human/animal) and nature of the disease.
This criterion and its point estimates can be used in the description of a new model.

Of the 7 EmZoo prioritizing criteria only 5 will be usable in a military model. The residual criteria are not enough to create an innovatory and specifically military model. Further on the EmZoo report will be compared to another model, to search for additional criteria to complete the new model.

Figure 1. Highlighting the used criteria with their levels and values, based on Table 1. Quantifying criteria to assess risk of emerging pathogens (Havelaar *et al. 2010).*

Criterion	Description	Unit	Levels	Value (X)	Scaled value (X)	Transformed value (X)*
C1	Probability of introduction into the Netherlands	% / year	<1	0,5	0,005	0,000
			1-9	5	0,05	0,435
			10-99	50	0,5	0,869
			100	100	1	1,000
C2	Transmission in animal reservoirs	Prevalence per 100.000 animals	<1	0	0,0000001	0,000
			1-100	50	0,00005	0,385
			100-1.000	500	0,0005	0,528
			1.000-10.000	5.000	0,005	0,671
			>10.000	50.000	0,1	0,857
C3	Economic damage in animal reservoirs	Million euro per year	<1	0,5	0,0005	0,000
			1-10	5	0,005	0,303
			10-100	50	0,05	0,606
			>100	500	0,5	0,909
C4	Animal-human transmission	Prevalence per 100.000 humans	1-100	50	0,00005	0,000
			100-1.000	500	0,0005	0,233
			1.000-10.000	5.000	0,005	0,465
			>10.000	50.000	0,1	0,767
C5	Transmission between humans	Prevalence per 100.000 humans	<1	0	0,0000001	0,000
			1-100	50	0,00005	0,386
			100-1.000	500	0,0005	0,528
			1.000-10.000	5.000	0,005	0,671
			>10.000	50.000	0,1	0,857
C6	Morbidity (disability weight)	None	<0,03	0,02	0,02	0,000
			0,03-0,1	0,06	0,06	0,281
			0,1-0,3	0,2	0,2	0,589
			>0,3	0,6	0,6	0,869
C7	Mortality (case-fatality ratio)	%	0	0	0,0000001	0,000
			0-0,1	0,05	0,0005	0,528
			0,1-1	0,5	0,005	0,671
			1-10	5	0,05	0,814
			10-100	50	0,5	0,957

*Point estimates x were first scaled (x') between 0 (best possible option) and 1 (worst possible option). C1, C6 and C7 are naturally bounded between 0 and 1: for C2, C4 and C5 a worst possible option of the prevalence of 100.000 per 100.000 was used. For C3, a worst possible option of 1.000 M€ was used. Best possible options of 0 were replaced by 0,0000001. Subsequently, transformed scores were calculated as $X=1-\log(x')/\log(x'_{ref})$, where x'_{ref} is the scaled score for the best possible option.

In this paragraph the criteria by Krause (2008) are compared to EmZoo criteria in order to complete the new model with military focus. The remaining 5 EmZoo criteria will not be enough to create a relevant addition to already existing models.

Burden of disease

- Incidence: this is an important criterion, but in comparison with the EmZoo criteria is this criterion very simple and are the values not specifically. This criterion "incidence" replaces the EmZoo criteria; transmission between animals, transmission from animal to human and transmission between humans, because those three criteria are very different this is not to replace by one criterion. The focus on zoonoses might be the reason the EmZoo report has three criteria instead of "one" incidence, only in humans.
- Severity: Probably is this criterion compatible with morbidity in the EmZoo report. Values are scaled by hospitalization, work loss and persisting handicap, which can be a good indication

on the severity of a disease. In EmZoo's morbidity besides severity also duration is included. Both criteria can be good to use.

- Mortality: the mortality value is described by number of deaths, a proposed alternative mentioned to mortality is case fatality ratio. In EmZoo the value of criterion "mortality" is described by case fatality ratio, but the intervals/point estimates are more specific.

Epidemiologic dynamic:

- Outbreak potential: this criterion does not exist in EmZoo but can be very interesting.
- Trend: this criterion does not exist in EmZoo, and will be very hard to tell in a potential war zone
- Emerging potential: similar to EmZoo probability of introduction.

Information need

- Evidence for risk factors / groups: this criterion is actually why this project is done, describing risk factors or the "group" military personnel.
- Validity of epidemiologic information: General epidemiologic information should be used from reliable sources (e.g. OIE, WHO, CDC) local information can be less reliable.
- International duties and public attention: this is part of general information on specific pathogens.
- Evidence for pathogenesis: This is also part of the general information generated by reliable sources.

Health gain opportunity

- Preventability: this might be information that should be counted.
- Treatability: this information can be linked to the preventability and should be counted. The opportunities of prevention and treatment can decrease the impact of a disease. Preventive measures can be carried out in preparation for a mission as well as research into therapy and purchase of drugs/medication.

In addition to the already selected prioritizing criteria from the EmZoo report, the two "Health gain opportunity" criteria of Krause (2008) are valuable and potentially usable.

Figure 2. Explanation of Krause's model, including criteria and 3-tiered values, based on "Table 2 Criteria and definition of the respective scores for the prioritization of pathogens (Krause, 2008).

Criteria	Values		
	-1	0	1
Burden of disease			
Incidence	<1-100.000	1/100.000-20/100.000	>20/100.000
Severity	hospitalization is very rare, work loss less than 2 days, no persisting handicaps	hospitalization is rare, work loss of more than 5 days is rare, very rarely persisting handicaps	hospitalization is frequent, work loss of more than 5 days is frequent, persisting handicaps do occur
Mortality*	<50 deaths/year in Germany	Between 50 and 500 deaths/year in Germany	More than 500 deaths/year in Germany
Epidemiologic dynamic			
Outbreak potential	Outbreaks are very rare	Outbreaks with 5 or more cases are rare	Outbreaks with 5 or more cases are frequent
Trend	Diminishing incidence rates	Stable incidence rates	Increasing incidence rates
Emerging potential	Disease already endemic or very unlikely to be introduced to Germany	Disease has the potential to be introduced to Germany sporadically	Disease is likely to emerge in Germany in a relevant way
Information need			
Evidence for risk factors/groups	Risk factors and risk groups are identified based on scientific evidence	Risk factors and risk groups are basically known but scientific evidence is missing	Risk factors and risk groups are not known
Validity of epidemiologic information	Epidemiologic situation is well known and scientifically valid	Epidemiologic information exists but is scientifically not very valid	Epidemiologic information is insufficient
International duties and public attention	No international duties or political agenda, minor public attention	No international duties but informal political expectations, moderate public attention	international duties or explicit political agendas, high public attention
Evidence for pathogenesis	Information on pathogenesis and transmission routes is available and well supported by scientific evidence	Information on pathogenesis and transmission routes is basically available but not well supported by scientific evidence	Information on pathogenesis and transmission routes is hardly available
Health gain opportunity			
Preventability	There are hardly any possibilities for prevention or there is no need for prevention	Concepts for prevention are established but there is need for further research to improve its effectiveness	Strong need for further research on preventive measures because need for prevention is clear but concepts for prevention are missing
Treatability	Medical treatment is rarely necessary or effective treatments are available to positively influence the burden of disease or the prognosis	Medical treatment is frequently indicated but medical treatments only have a limited influence on the burden of disease or the prognosis	Medical treatment is desirable but currently there is no treatment available that positively influences the burden of disease or the prognosis
Proposed alternative to mortality			
Case fatality rate*	<0,01%	0,01-1%	>1%

Conclusion

By comparing the criteria and values from both Krause (2008) and EmZoo, the best of both should be used in a new prioritizing model. They differ in many ways; EmZoo is more specific and detailed, but logically harder to implement in an area with poor information on disease aspects, like a country at war. The simple values of Krause (2008) will be easier to implement, although in comparison with EmZoo the values are very low and to create a reliable model, it will perhaps be better to use the more specific values of the EmZoo report.

Another difference can be found in the aim of the prioritizing models. EmZoo focuses on the impact of the introduction of zoonoses in the Netherlands. Whereas Krause (2008) focuses on the general impact of infectious diseases, including source of information, legislation, prevention and therapy of diseases. No attention is paid to the prevalence of specific diseases in animals.

The data from Krause (2008) and the EmZoo report (2010) can be used in the development of a new model, although attention has to be paid to the weights of the criteria and should be adapted to the military situation. Experts should do an accurate description of the weights.

The five remaining EmZoo criteria (Transmission in animal reservoirs, Animal-human transmission, Transmission between humans, Morbidity, Mortality) measure the impact of a disease. The preventability and treatability criteria, described by Krause (2008), add value to the measurement and complete the image of a disease impact. But a critical comment must be made for the usability of the model for military personnel as soldiers will differ greatly from citizens in means of work pressure and work environment. A new model must take into account that this difference has an impact on the disease prevalence of soldiers from citizens.
This adaption to the military section should not only contain the epidemiological information on infectious diseases but should also raise awareness to facilitate a quick and accurate response to disease control and preventive measures. Havelaar *et al.* (2010) agrees on these terms and noted that 'Further work to include risk perception as a second dimension in the priority model is recommended'.

Success of a mission can be realized, by a soldier's ability to follow the instruction of his commander. To conserve fighting strength, deployment is the most important during a mission, so the operational readiness should be used in the additional criterion.

Chapter 3 - Operational readiness quantification

The expectations for military personnel are different from what is expected from civilians. Moreover, there is a discrepancy in work condition. Not being able to carry out regular work can have impact on reaching the goals of a military mission. By describing and quantifying the operational readiness calculations can be made to estimate the impact of (infectious) diseases.
Information providing websites on work-related diseases only describe occupational diseases. No information is provided on infectious diseases in general, causing these websites not to be useful for the quantification of military operational readiness (www.beroepsziekten.nl , www.kiza.nl).
Apart from the differences that exist between civilians and military staff, there are also many similarities with certain other professions, such as hospital staff, because they can get in contact with infectious diseases and work under pressure. We compare the military staff to the hospital staff in order to find data on work related absence, which is not available for military personnel. One of the arguments to choose for hospital staff is the continuous work pressure they experience and the possible contact with (unknown) zoonotic infectious diseases. This parallel comparison is used to find information on work absence caused by infectious diseases.

In order to find out which infectious diseases (and related symptoms) are important in reduced ability to work, information on work absence due to infectious diseases is needed. Duration of illness, impact on job proceedings, possible transfer to colleagues, can all be encountered as important information for employers. Therefore, registration of this information is valuable.

Sample group

Health and safety offices of various medical authorities (both human and veterinary) where chosen to send a questionnaire. Health and safety offices register everything that has anything to do with work conditions and health of the employees of a company. Assumed was that these offices should have information on work absence and diseases incidence within a company. Hospitals and other medical authorities where chosen because employees where assumed to have more contact with infectious diseases and will stay home earlier to prevent transfer of infectious disease from health worker to patients.

Defensie, Fac. Diergeneeskunde, KNMvD, RIVM, UMCU, UMCG, AMC, VUmc, LUMC, Radboud UMC, Erasmus MC, Maastricht UMC, Arbo ned. (Appendix 1)

Short questionnaire

From all the named authorities the questionnaire (*fig. 3*) was distributed to, only few helpful responses (Appendix 1) were received." Initially an attempt was made to obtain answers to the questionnaire by telephone. Phone contact was preferred because it can provide quick answers to the questions. It proved difficult to get the contact details of the required 'Arbo-doctors' and thus the right person to answer the questions. As a result it was decided to send the questionnaires by email.

Only three questions were included in this questionnaire to increase the probability of response, as people are more willing to answer a short questionnaire instead of a long and time-consuming one.

The first question in the questionnaire was formulated to find out whether there is any information registered on work absence related to disease. If this information was available, the next part of questions concerned the first day(s) of absence of work. In the last question the impact of infectious diseases on the ability to go to work was asked.

Short Questionnaire on absence of work
• Is there any information on work absence caused by infectious diseases   ○ Especially in the first day(s) of absence from work? • What symptoms/infections are most common? • What is the impact of infectious diseases to personnel's ability to go to work?

Figure 3

Results

The main outcome was that information on short work absence was not registered. That is one of the reasons why the response to the questionnaires was low. Another explanation for the low response rate was the confidential nature of this default information. Also, it is stated by law (Wet Verbetering Poortwachter) that a manager or employer does not have the right to ask an employee for the reason of absence. An employer is only allowed to ask about the expected duration of the complaints.
One respondent, an employee of one of the hospitals, explained that short absence of work is only reported to managers, not to health and safety officers. After six weeks of absence the employee will inform the health and safety officer to make a plan for reintegration. This phased plan is also described in the aforementioned law. The employee also explained that, although not officially registered, disease cases can be divided into four categories: "flu", "other physical complaints", "mental complaints/disorders" and "other". In another hospital an employee described that about 75% of work absence is long-term. Of the residual 25% short absences, a large part can be attributed to "mental complaints", "locomotion complaints" and "other complaints" whereby infectious diseases cover only a very small part.

At the professional association of veterinarians there is also no registration of disease cases in members. It is possible that this kind of information can be found in individual practices, but because of the time-consuming investment to question all these practices this was not conducted.

In this inquiry, it can be concluded that currently there is only little insight into short-term work absence due to infectious diseases. The question, in what way infectious diseases can affect the operational readiness of staff, will remain unanswered.

A physician at the health and safety service of the Royal Netherlands Army indicates that, despite the fact that this registration could be very useful in missions abroad, there is no record of absence caused by infectious diseases.

Telephone contact with the military trade union VBM (Vakbond Burger en Militairdefensiepersoneel) resulted in the conclusion that military personnel may be asked for the cause of their illness. This is described in their regulation (Regeling ziek- en hersteldmelding defensiepersoneel).

The extensive results from the questionnaires, received from all contacted health and safety offices of the various medical authorities, can be found in Appendix 1.

Conclusion

The conclusion of this conducted research on available information on short-term work absence due to infectious diseases, is that there is very little insight in this situation. Improvements can be made, especially in the army, because the regulation states that employers can ask the cause of absence. Apart from the insight in reasons of work absence, the collection of information on disease cases can also be used in early warning. An example of this usability of data can be found in the registers from the “Veekijker”. They register all disease cases and generate a health trend description with the received information (Wagenaar and Van Maanen, 2010). This kind of early warning can be very helpful in situations or countries where there is little information on disease incidence.

How this information should be obtained can result in a follow-up research study.

Chapter 4 - Disease symptoms surveillance

During a search on information about work absence caused by infectious diseases, no usable information was found. Despite the fact that this information can be of great importance to employers, both civil and military. Disease information can give insight in the impact of infectious diseases, so that preventive measures can be taken.
The exception of military employers to be able to ask their employees about the reason of work absence, is a great opportunity to create a database of disease causes. The military branch hereby possesses the ability to complete a disease symptom questionnaire.
The questionnaire should focus on symptoms, not on diseases. The reason to focus on symptoms is that symptoms will have the same impact on the ability to work in many different diseases. Another benefit is that there will be no need to diagnose a specific disease to fill in the form. Also, it is easier to describe symptoms compared to describing a disease, especially when someone does not carry much knowledge about infectious diseases. This might also lead to a higher response rate on the questionnaires as the form can also be used by general personnel, instead of only medical personnel.
A list of seemingly important symptoms must be created with the help of experts and by the collection of data from health and safety officers.
This data, collected from questionnaires, will provide the commander with quick relevant (medical) information on (decreased) operational readiness. A very beneficial and valuable side-effect is that these data collections can be registered and transferred into an early warning and detecting system on infectious diseases.

Used materials

Various medical authorities were contacted by phone. From these conversations, insight was gained into assumingly important symptoms.

Disease symptom questionnaire

The disease symptom questionnaire consisted of four groups of symptoms: gastro-intestinal symptoms, respiratory symptoms, cutaneous symptoms and neurological symptoms. An example of gastro-intestinal symptoms are: vomiting, diarrhea, nausea, and anorexia.
When a person suffers from disease symptoms the questionnaire should be completed as soon as possible. The patient has to rank his/her symptoms between 1 and 5, whereby 1 is almost negligible and 5 is extremely serious.
Prior to possible use of the questionnaire, a panel of medical experts will be asked for their opinion on the questionnaire and it's practical usability. Feedback from the experts will lead to improvements and recommendations on the use of het form.
The questionnaire can be found in Appendix 2.

Results disease symptoms

The questionnaire was sent to a military doctor of the health and safety office, his reaction on the questionnaire was not initially positive. If a questionnaire will be used in the army, it has to be validated and such a process will take much time and research needs to be done on the validation rules. Moreover, there already seems to be a “disease information form” although this form is not digital and not currently used.
Another argument why this doctor thought this strategy was not usable is that the diseases which result in (massive) decrease of operational readiness are (in his opinion) not zoonotic and thereby not veterinary interesting as the diseases they encounter are mostly food- or water-borne.

Conclusion

The realization of a questionnaire on disease symptoms will take more effort than possible in this project. The request is present, but further research is required. It will be clever to use an already existing questionnaire or form in order to effectively realize a validated questionnaire. Apart from the questionnaire it is important to connect it to digital systems so that registration of information can be performed and the collection of data comes with less effort. Digitalization will also benefit an early warning system by signaling trends in disease symptoms.

Discussion

The EmZoo report was used as the standard model supplemented by Krause (2008), although there will be many other interesting models. In this study the EmZoo report was selected, because it is highly used by many well-respected researchers and it has focus on zoonoses. Another reason to use the EmZoo report is that it also consists of a website (http://www.ezips.rivm.nl) and it has a prioritizing system.
The report was published in 2010 and it counts many recommendations for improvements, probably many already are accomplished, which can make the use of the report less valuable. Nevertheless, the main chapter concerning prioritization is not subject to change and can be very useful.

From the phone contact with the health and safety offices of the various medical organizations it became clear that there was no consciousness of the veterinary background many infectious diseases have. The relation between human diseases and the use of veterinary knowledge was unclear for many medical organizations. Moreover, food-borne diseases were not linked to the possible contamination of (parts or waste of) animals and thus the usefulness of veterinarians in this field. The lack of knowledge on the subject of zoonosis by physicians can lead to the understatement of the impact of infectious diseases. The usefulness of collaboration between human and veterinary fields therefore seems to be underestimated.

Working on a military case proved to be difficult, although the possibilities in this field make research studies very rewarding. Information is hard to find and discretion is necessary. One important reason for the difficulty in finding data is the limited infrastructure in war zones. If a country is at war, registration of disease cases seems one of the least important things (for military personnel), while infectious diseases should not be underestimated in these environments. Operational readiness is an important military aspect, but it can be a vulnerable aspect as well. Military information, also on disease cases, can be of strategic importance and can be used against them.
The estimated risk of exposure in military personnel is difficult to determine, because the expectations of their work and work conditions are hardly comparable to civil jobs. Soldiers are generally healthy, but during missions they work in unknown environments with potential pathogens. These pathogens can be harmless to locals because of immunity development but can have severe consequences to soldiers for whom these pathogens are unknown.

Final Conclusion

The aim of this study was to create a relevant adjunction to already existing risk-analyzing models, specifically for military personnel. It can be concluded that the existing models can be improved by combination of existing models. In this study an example is given by the combination of EmZoo and Krause (2008) supplemented by the criterion “Operational Readiness” (Animation of). The hypothesis of this study, that the information delivered in this paper will be a positive addition to existing methodology, is highly likely although it remains to be confirmed after implementation of the proposed questionnaire.

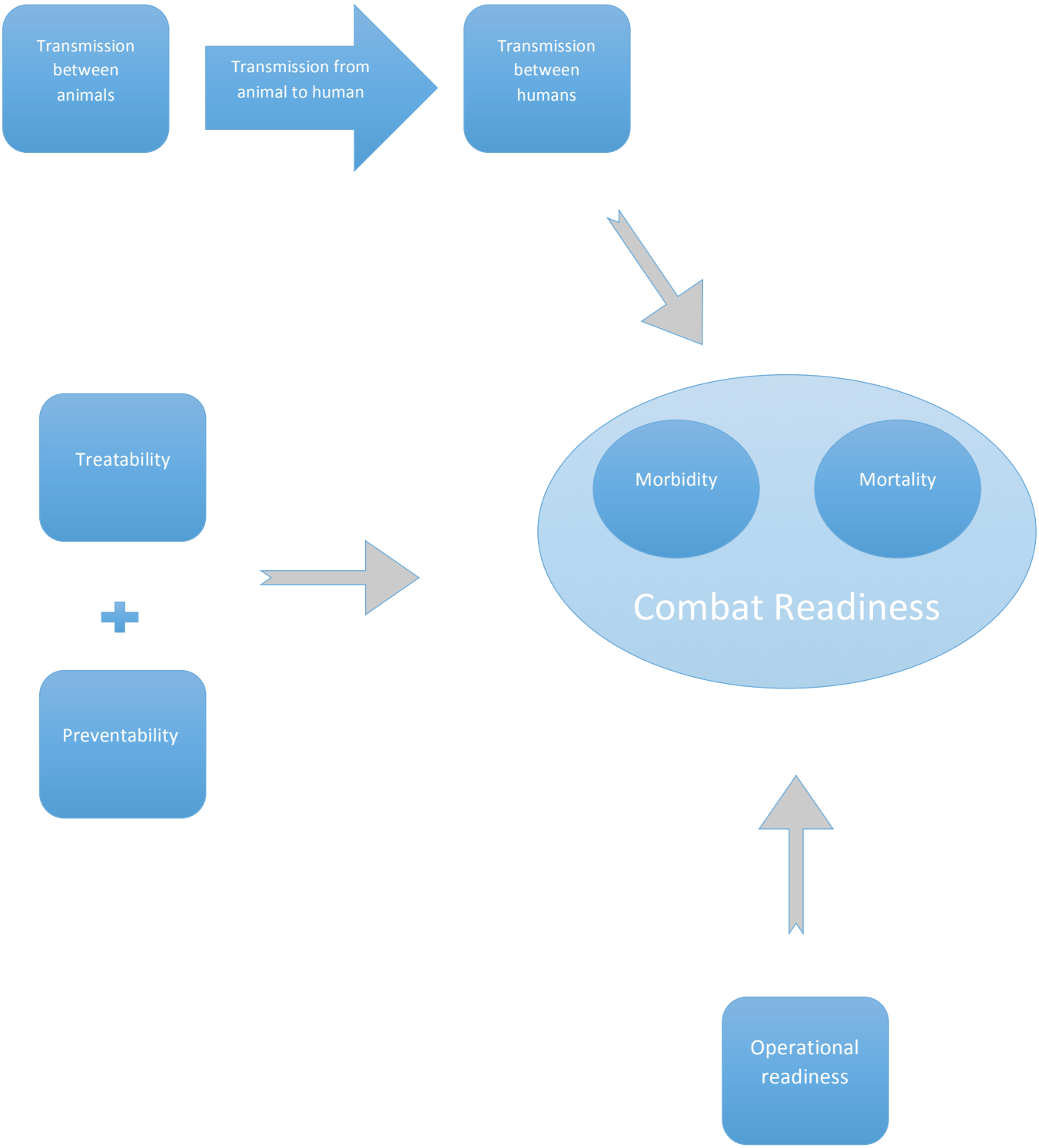
The addition will improve on operational readiness, which is one of the most important factors to military success. To quantify this operational readiness, data should be collected on disease symptoms, rather than specific diagnoses. By registering the severity of disease symptoms, the impact on the ability to work can be better understood. A questionnaire can be very useful in the conduction of registration procedures. Unfortunately, creation of such a questionnaire will be time-consuming, as a validation procedure must be incorporated as well.

It is recommended that research will be conducted to create a disease symptom questionnaire to score disease symptoms and their severity.

This study has shown that the combination of criteria from different models can lead to an improved operational readiness. A further elaboration of the prioritizing model is required in order to create new criteria on operational readiness. Adjustment of values to the idea of EmZoo and new relevant weighting factors should be created and described by experts.

In realization of all this, a collaboration between human and veterinary medical personnel is desirable. Of all human infectious diseases a little more than 60% is zoonotic and thus have a veterinary background (Taylor *et al.* 2001). Veterinarians possess a lot of potentially valuable knowledge about infectious diseases and should be used in the achievement of a new model.

Figure 4. Animation of prioritizing criteria and their relation to one and other



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Appendices

Appendix 1

Short Questionnaire on absence of work
• Is there any information on work absence caused by infectious diseases   ○ Especially in the first day(s) of absence from work? • What symptoms/infections are most common? • What is the impact of infectious diseases to personnel's ability to go to work?

Figure 3

The responses of all contacted health and safety offices of the various medical authorities are described down below.

	Response
CEAG	Information on disease absence has been requested again recently.
Fac. Diergeneeskunde	No registration on the cause of disease is available, this is private information.
KNMvD	Does not know whether there are data recorded. Probably at the veterinary practices.
RIVM	They cannot share information relating to confidential information.
UMCU	There is no registration of cause of disease during the first days of work absence. In general, employees will come to the health and safety officer after 6 weeks, or when they expect the work absence to last longer than 6 weeks. Before 6 weeks, little till no infectious diseases are seen.
UMCG	There is no registration of disease cause during the first days of work absence and very limited registration of longer duration of work absence.
AMC	Only a small part of work absence consists of short-term absence (25%). Within this short-term absence the main complaints are psychological or locomotion problems. Only a small part is due to infectious diseases. Specific symptoms could not be cited.
VUmc	Refers to AMC
LUMC	No response received
Radboud UMC	There is no registration of disease cause. In case of disease absence infectious diseases are rarely seen. Employers do ask whether there is a risk of exposure when employees have a certain infection. In conclusion, risk of infection has more influence on work ability than the absence of people that do not feel well.
Erasmus MC	
Maastricht UMC	Short –term absence is only mentioned to the manager, no registration is available. Main symptom groups are: flu-like symptoms, physical complaints, psychological or other complaints. Patients will go to the "Arbo" office after 6 weeks of absence.
Arbo ned	Currently There is no insight in the scope of this problem. Short-term work absence does not receive specific attention.

Appendix 2

Form disease symptoms at doctor visits:

Name: Date: Place:	

Rate the disease symptoms in the following table with a number between 1 and 5. Score 1 is related to mild-negligible, whereas score 5 is severe. Note an X if this symptom is not recognized.

Symptoms:	Rating Severity Gastro-intestinal	Rating Severity Respirator	Rating Severity Cutaneous	Rating Severity Neural	Total scores
Vomit					
Diarrhea					
Nausea					
Decreased appetite/anorexia					
Total score					
Dyspnea					
Upper respiratory tract/ snotty, sneeze					
Deeper airways/ cough					
Malaise					
Total score					
Itch					
Pain					
Rash/bumps					
Injury					
Total score					
Headache					
Decreased consciousness					
Incoordination					
Paralysis					
Total score					

Other comments about illness:
Symptoms other than noted in the table: