One health concept of measuring and monitoring wellbeing

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Abstract. The Quality of life is one of the most important things in life. The one health concept is aiming to attain optimal health for people, animals and the environment. The article reviews what subjects and environmental characteristics are currently measured for assessment of wellbeing in people and animals. How to measure the important parameters is still unknown, as their characteristics and relevance are either poorly or not defined at all. The importance of systems that are adapting to an individual welfare evaluation is stressed. Future characteristics of parameters that should be taken into account when assessing welfare are discussed in the article.

Keywords: Quality of life, Human, Animal, Environment, Measurement, Wellbeing, Welfare

1 Introduction

How to improve the quality of life is one of the hot topics in recent human and animal science. Especially in human, substantial gain and extension of length of individuals' life was achieved in industrialized world.

Wellbeing and welfare are usually used as synonyms and are the key terms used in the concept to measure happiness. It is important to know that wellbeing of people and animals depends on each other and also depends on environment (Fig 1).

The concept of One Health has been defined as "the collaborative effort of multiple disciplines — working locally, nationally, and globally — to attain optimal health for people, animals and the environment".

The animal welfare ethics for domesticated animals started from enduring pact, self-interest demanded that people take good care of their animals. "If we take care of the animals, the animals will take care of us." is the motto. Different scoring systems

evolved, measuring different mostly animal based indicators of welfare, which are more or less practical, but all of them are essential in the path to improved welfare. John Webster defines animal welfare by advocating three positive conditions: living a natural life, being fit and healthy, and being happy [1]. Such example is a recent Welfare Quality® assessment protocol for cattle, which elaborates these issues more precisely in evaluating cattle welfare [2]. Some issues in this paradigm are straightforward in some domesticated species and can be easily connected to five basic freedoms of animals. These are:

1. Freedom from Hunger and Thirst - by ready access to fresh water and a diet to maintain full health and vigor.
2. Freedom from Discomfort - by providing an appropriate environment including shelter and a comfortable resting area.
3. Freedom from Pain, Injury or Disease - by prevention or rapid diagnosis and treatment.
4. Freedom to Express Normal Behavior - by providing sufficient space, proper facilities and company of the animals own kind.
5. Freedom from Fear and Distress - by ensuring conditions and treatment, which avoid mental suffering.

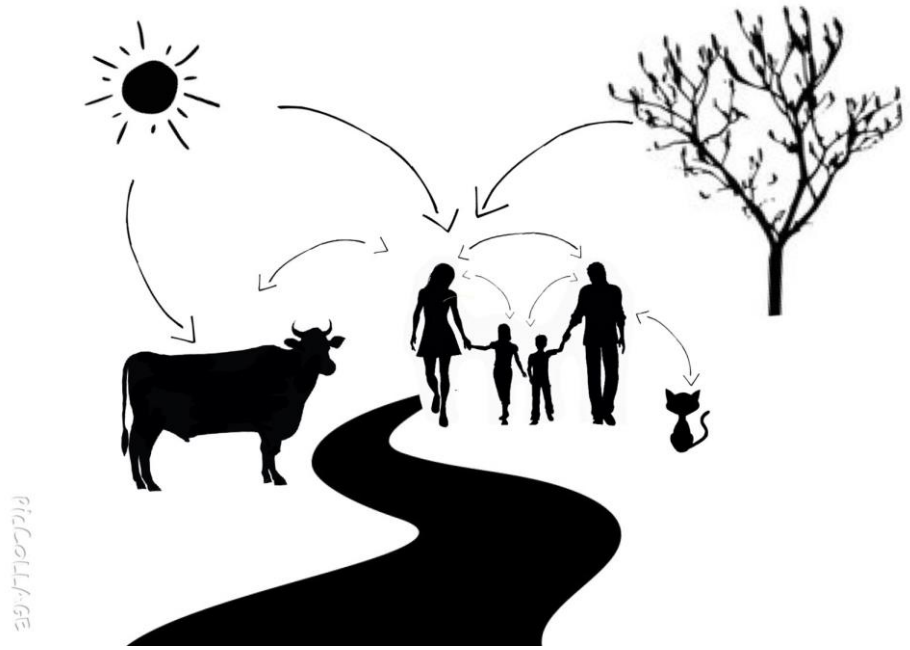

Fig. 1. Concept of One health: The connection of wellbeing and health of people, animals and the environment.

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

World health organisation recognizes the importance of improving, maintaining and evaluating people's quality of life [3]. Definition of welfare in people is more complex and so it is its monitoring. People's lives are usually highly dynamic, engaged in variety of complex activities, when compared to animals.

The report by the "Commission on the Measurement of Economic Performance and Social Progress" identified eight key dimensions that should be taken into account when defining human wellbeing. These are [4]:

- Material living standards (income, consumption and wealth);
- Health;
- Education;
- Personal activities including work;
- Political voice and governance;
- Social connections and relationships;
- Environment (present and future conditions); and
- Insecurity of an economical as well as physical nature.

Children's wellbeing is very important as it has also significant long-term effect on adulthood. There is emerging consensus that childhood wellbeing is multi-dimensional and should include dimensions of physical, psychological, social, cognitive/educational, each of these contains a number of subareas.

Urban densification increases exposure to noise, light, odors, and vibration in urban dwellings [5]. Exposure from combined environmental stressors intruding into homes could increase the risk of adverse effects on wellbeing, even when the exposure is at a relatively low level. It is of crucial importance to consider all factors when evaluating a complex and multifactorial phenomenon as wellbeing.

2 Related Work

2.1 Measuring of Human Wellbeing

Measuring human wellbeing requires an act of defining and creating models and measurements, which define health and quality of life. According to Sarvimaki, this requires an opinion of what it means to be a "whole human being" as well as what is worthwhile in life, and how we ought to [6] seize the wellbeing.

Traditionally, objective or social indicators such as educational outcome or household income are the means of measuring wellbeing. However, such indicators are only a proxy for the quality of people's lives. More recently, people's perspective of their lives has started to be valued in informing policy making. The indicators of wellbeing and the inequalities that are uncovered should not be assessed independently, but should be linked and correlated to other factors of wellbeing and inequality in terms of individuals, socio-economic groups, gender, and generations.

Subjective wellbeing is measured through surveys asking people about their satisfaction and happiness about multiple facets of wellbeing. Their findings can be an important complement in understanding what matters in people's day-to-day lives.

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

Some measures of wellbeing only include objective indicators, some only subjective indicators and some evaluations use both subjective and objective measures of wellbeing. These evaluations either have one dimension called "subjective wellbeing" or proxy wellbeing domains by a combination of subjective and objective indicators. Measures of wellbeing tend to look at the same dimensions but proxy them by different evaluation methodologies.

Within the construct of psychological wellbeing, there are at least three different approaches, each capturing a different aspect: (i) life evaluation, (ii) hedonic wellbeing, and (iii) eudemonic wellbeing [7].

Life evaluation refers to peoples' thoughts about the quality or goodness of their lives, their overall life satisfaction or sometimes how happy they are with their lives. Measurement uses such questions as the Cantril Ladder wherein individuals are asked to place themselves on an 11-step ladder with 'worst possible life' representing the lowest rung and 'best possible life' the top rung [8].

Hedonic wellbeing refers to everyday feelings or moods such as experienced happiness (the mood, not the evaluation of life), sadness, anger, and stress, are measured by asking respondents to rate their experience of several affect adjectives such as happy, sad, and angry. It is important to note that the negative adjectives are not simply the opposite of positive indicators of wellbeing – they carry unique information about peoples' emotional states; in other words, hedonic wellbeing is not a simple unipolar dimension, but is composed of at least two modestly associated dimensions. Therefore, positive and negative adjectives are required for a reasonable assessment of hedonic wellbeing [9].

Eudemonic wellbeing focuses on judgments about the meaning and purpose of one's life; because the construct is more diverse, several questionnaires addressing various aspects of meaning have been developed [10].

Recently, because of technology development not only questionnaires are used for monitoring people. A key is developing new technology that can assist individuals in maintaining a healthy lifestyle by keeping track of everyday behavior. A variety of health outcomes are tightly linked to everyday decisions involving sleep [11], diet [12], exercise [13] and socialization [14] patterns. Positive health effects can be observed when indicators (e.g., sleep, physical activity, social behavior) are kept in healthy ranges.

If the outcomes of the monitoring are clear and are easily understood they could motivate change to more prosperous life.

2.2 Children

Childhood can be perceived as a stage in one's life or as itself. There is considerable on-going work in relation to the definition and measurement of childhood wellbeing in children. From an earlier implication, which focused on child poverty, survival and health, the range of wellbeing domains included in definitions has expanded considerably over time. Traditionally, social indicators such as educational outcome or household income measure child wellbeing. Child was in the past measured passively. More recently, the child is put into the centre of care which makes the child

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

the active participant in his/her own wellbeing [15]. The discourse on child wellbeing is thus also one of wellbeing and well-becoming, focusing on children's current (during childhood) quality of life and adopt a future oriented perspective in which the focus lies mainly on opportunities and possible outcomes in the future [16].

2.3 Animal Wellbeing

Animal wellbeing or welfare refers to the relationships people have with animals and the duty they have to assure that the animals under their care are treated humanely and responsibly to fulfill their physiological and behavioral needs. Animal welfare is prescribed in laws. Mainly animal abuse, cruelty and neglect are effectively cowered by laws in many countries. But due to lack of information about specific animal needs, it is often hard to implement welfare beyond this obvious unacceptable extreme.

According to OIE [17] an animal is in good state of welfare if (indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behavior, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Animal welfare refers to the state of the animal. Many initiatives evolved in the last decade, which try to address this problem by evaluating obvious and subtle animal based measures that describe animal welfare state, which is obviously multifactorial [18].

But many times despite our thinking that all the five freedoms described in the introduction are soundly implemented; animals are still in bad welfare state. And this goes also for species that are domesticated for the longest time, like cattle and small ruminants for which we thought that we know, how to keep them properly. Especially intensification of animal production, where big deviation from traditional animal keeping appeared in relatively very short time, our knowledge of animal welfare in such systems is poor. In production animals, welfare issues often collide with economical issues, so there come to a compromise between both. Luckily good welfare positively influences animal production, but still implementing perfect welfare would result in too expensive animal product, lower production and thus insufficient food produced for human population. This goes especially for mega livestock units, which had for example thousands of dairy cows in the same farm. In such situation question arises, how to observe individual animal and provide it with individual needs. Questionable is also if in such systems animals can have good welfare, since it is not according to natural animal concentration and it is designed for an average animal needs, besides monitoring of individual animals in such agglomerations is physically impossible. Longevity of animals in such systems in general is short due to different reasons, like failure of conception and different diseases that overwhelm cost of replacing an animal with new one or unacceptable drop in productivity (which has reasons, but are often not known). For example dairy cows in intensive systems survive on average about 2.5 lactations, but we know that

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

in fourth or fifth lactation the best production can be achieved [19]. Effective technologies that assist good husbandry are urgently needed in this situation.

One answer to this question is precision farming, where individual animals are equipped with different sensors that follow their welfare and production and respond to any deviations from expected normal physiological indicators and production parameters. The primary goals of precision dairy farming for example are to 1) maximize animal performance, 2) detect diseases in individual cows early, 3) detect herd level health and production problems early and 4) minimize the use of medication through preventive health measures. With fast development of electronics this looks to become a reality in near future, but so far just limited use of this technologies is routinely implemented in dairy cattle rearing. Examples are accelerometers that measure physical activity of animals, which helps in heat detection in cows, sensors that measure different parameters in milk at time when cows are milked in milking parlor, like electrical conductivity as indicator of mastitis, milk components as indicators of nutrition [20][21][22].

New technologies based on sensors, which measure vital signs and other parameters are also commercially available in companion animals, like dogs and cats. For examples collars that can measure body temperature, respiration, activity level, heart rate etc. can warn a pet owner of measures that can be connected to possible early disease states as inflammation, infection, heart disease, etc. [23].

The issue of wellbeing is critical also in zoological institutions where knowledge of wild and exotic animal species needs and physiological parameters are even more unknown. In such situation individual animal quantitative monitoring of welfare is very limited and sometimes also impossible. With out knowledge of what is physiological for an animal species, it relies mostly on good practices and subjective animal keepers assessment. Even in such situations it is essential to record observations of subtle changes in animal behavior or physiological parameters and try to score them in order to have something, which enables taking steps in improving welfare [24].

2.4 Environmental influences on wellbeing

The exposome encompasses the totality of human environmental exposures. Recent developments in sensor technology have made it possible to better measure personal exposure to environmental pollutants and other factors. This currently include measurement of air pollution, noise, temperature, UV, physical activity, PIR motion sensors, location, blood pressure, heart rate and lung function and to obtain information on green space and emotional status/mood and put it on a person 25. Intelligent processing of the environmental sensors can provide information about the health status, comfort of the person, etc. Let us take low cost PIR motion sensors for an example. The PIR motion sensors activates in case the person walks by. Intelligent systems learn the person's normal daily pattern and statistics of the daily activities. One day the PIR sensor located in the bathroom activates more frequently than in normal daily pattern. The intelligent system can utilize this information to inform the caregivers or the clinicians about potential urinal problem. Other example is simple

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

comfort of the person. The intelligent system measures the humidity and temperature and automatically adjusts the heater and humidifier or advises the person what to change to increase the comfort level. Sensors in pets cradle can measure the wellbeing of the animal.

3 Proposed Connected health system for wellbeing

At this moment only a few smartphones applications are used in connection to wellbeing. They cover mostly basic parameters like eating, sleeping, socializing and exercising. Of course these are important parameters but not sufficient, especially for long-term welfare, but they contribute in prevention of diseases. To measure the hedonistic wellbeing is of course not enough, it is necessary to measure the extreme importance of eudemonic wellbeing as well.

The upraise of non-invasive monitoring is providing more and more information not only in subjects that are unhealthy but also in borderline patients, so they can assume preventive measures before they get sick. Development of technology in recent years, enables measurement of many parameters through time, but the knowledge of their significance and interpretation is the drawback. Technology can collect a lot of unprocessed information but the shortcoming is the necessity of developing accurate and relevant models which utilize these information to provide the person with easy solution for their current state. How to utilize sensor information, either environmental, wearable or both is a hot topic in Pervasive Computing and Health community.

Social behavior and parameters that are contributing to wellbeing are still mostly unknown on individual level. There are significant differences among individuals in perceiving what is significantly contributing to their wellbeing. The frequency and quality of social behavior seems to be of great importance as well as the potential stress level of the person. With adaptable systems the optimal parameters for the individual could be established.

In recent studies we observed that he child is capable to monitor her/his wellbeing on hers/his own. Children in the developed world are equipped with a smartphone and other personal electronic devices. The activity and playing as well as schooling are some factors that are specific for children's wellbeing. These parameters can be easily processed utilising an intelligent smartphone application [26].

Animal welfare is a very important issue in animal keeping, but it assessment still is not implemented generally due to reasons mentioned. Many welfare improvements in production animal keeping already are implemented in many countries, but there is still a lot of work to be done especially in following individual animal welfare. Promising for the welfare is that consumers, especially in developed countries demand that animal products they consume are from animals in good welfare [27]. This pushed policy makers and production animals' producers to invest more in the development of animal welfare [28]. The information gathered from the centre could help people improving animal care to provide optimal conditions for them.

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

There are some other parameters that could be measured like light, noise exposure, odour and vibration, air freshness. We should not forget how the human change of the environment could change the quality of life of wild animals [29]. The monitoring of wild animals should be considered in future.

Personal sensors are showed to be feasible in monitoring multiple factors including environmental. With the help of sensors in the room the gait and posture can be monitored. The information of the movement can help us determine state of mind. All off the information would be gathered in the personal computer and smartphones so everyone could monitor his own wellbeing and the wellbeing of animals. The information would be sent to the centre that would interpret the results and help in managing and improve wellbeing (Fig 2).

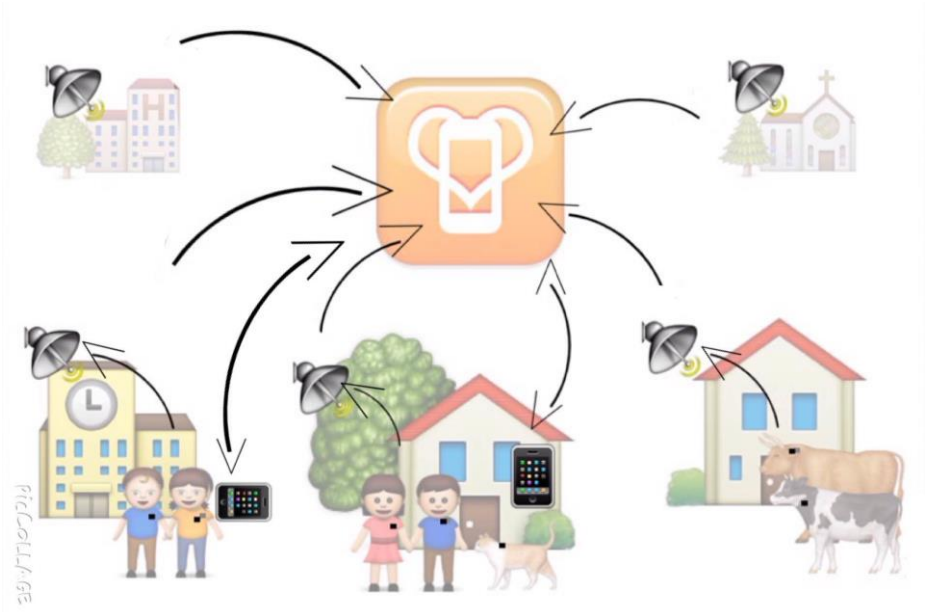

Fig. 2. The concept of monitoring in One health. Dots are showing personal monitors. Radars are external monitors.

4 Conclusion

The concept of One health is arising and becoming the mainstream. We would like to emphasize that One health concept is also important in implementation and monitoring of wellbeing. There is a strong connection in wellbeing of humans-adult and children, animals and environment. The point is to gather all information from the living beings and environment to create a whole picture and to centrally process information and transfer advice for better wellbeing to people and instructions for improving animal welfare. The sensors – personal and in the environment - could help us determine suboptimal factors and give advice how to improve lifestyle.

S. Loshkovska, S. Koceski (Editors): ICT Innovations 2015, Web Proceedings, ISSN 1857-7288

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