

## THE INFORMATION SYSTEM TO SUPPORT SAFE FOOD PRODUCTION IN CATTLE SECTOR

### INFORMACIJSKI SISTEM KOT PODPORA V PRIREJI VARNE HRANE V GOVEDOREJI

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#### ABSTRACT

In the year 2006 we started with the development of computerized system for monitoring the veterinarian treatments to support safe food production in cattle sector. Veterinary database and web application which will be used by PC or handhelds were created. Additionally the code listing of diseases was built up with technical support of Veterinary Faculty. The idea was that all treatments should be registered into database, connected to the database of Animal Identification and Registration Service (SIR). Slaughterhouses which are connected to SIR regularly check the identity of incoming animals. According to our project they are warned if the withdrawal period is not respected or health status is not suitable. The response time of slaughterhouses, dairy or other official authorities will be reduced in these cases. The suggested model upgrades the system of traceability and helps the veterinarians at their professional work, too. All the data will be accessible to breeders and other agricultural services.

Keywords: cattle, information system, safe food, health, monitoring system

#### IZVLEČEK

V letu 2006 smo pričeli z razvojem računalniško podprtega sistema za zajem podatkov o veterinarskih posegih kot podporo v prireji varne hrane v govedoreji. Zgradili smo podatkovno zbirko in spletno aplikacijo za osebni računalnik in dlančnik. S sodelovanjem z veterinarsko fakulteto je bil dodatno zgrajen šifrant bolezni. Ideja je bila, da vse veterinarske posege zajamemo v podatkovni zbirki, ta pa je povezana s centralnim registrom Službe za identifikacijo in registracijo živali (SIR). Klavnice, ki so povezane s SIR, redno preverjajo istovetnost prihajajočih živali, v prihodnje pa bodo istočasno tudi opozorjene, če ne bi bila spoštovana karenčna doba, ali če zdravstveni status živali ne bi bil ustrezen. Odzivni čas klavnic, mlekarn in drugih uradnih organov bo v teh primerih skrajšan. Predlagani model nadgrajuje sistem sledljivosti in pomaga veterinarjem pri njihovem strokovnem delu, zbrani podatki pa bodo dostopni tudi rejcem in ostalim kmetijskim službam po predhodnem dogovoru.

KLJUČNE BESEDE: govedo, informacijski sistem, varna hrana, zdravje, sistem spremljanja

## DETAILED ABSTRACT / RAZŠIRJEN IZVLEČEK

Varna hrana ima pomembno vlogo pri zagotavljanju zdravja ljudi in je med najpomembnejšimi cilji, ki mu sledimo na vseh nivojih njene pridelave in predelave. V Sloveniji smo že leta 1997, še pred izbruhom BSE bolezni v Evropski uniji, začeli z delom na projektu »Sledljivost govedu in govejega mesa od kmetije do potrošnika«. Glavni razlog za to odločitev je bil pojav prvih blagovnih znamk za meso, ki so med drugim zahtevali poznavanje porekla in sledenja živali. V letu 1999 smo projekt zaključili in sledljivost govedu ter govejega mesa vpeljali v vse izvozne klavnice.

Sočasno je bila na Ministrstvu za kmetijstvo, gozdarstvo in prehrano ustanovljena Služba za identifikacijo in registracijo živali (SIR) s centralnim registrom. Služba je odgovorna za identifikacijo in registracijo domačih živali (govedo, prašiči, ovce in čebele), za zagotavljanje korektnih sledljivosti označenih živali in beleženja vseh vrst izločitev. Klavnice se dnevno povezujejo s podatkovno zbirko SIR in pošiljajo podatke o zakolih, hkrati pa na podlagi te podatkovne zbirke preverjajo istovetnost živali, ki so namenjene zakolu. Sistem potrošnikom omogoča dostop do podatkov o izvoru živali prek spletnih strani z vpisom identifikacijske številke, ki jo dobijo na etiketi živila.

Z liberalizacijo trga hrane v ospredje vedno bolj prihaja pomen zaupanja potrošnikov v varnost hrane, kar lahko med drugim zagotovimo tudi z ustreznim spremljanjem zdravstvenega stanja živali, sledljivostjo krme in kontrole uporabe zdravil v veterini. Čeprav je poraba zdravil v veterinarske namene strogo nadzorovana, se lahko pripeti, da pride do nespoštovanja karenčne dobe (pretečen čas od zdravljenja živali pa do časa, ko je dovoljeno dajanje mleka in mesa v promet). Zaradi tega je bila dana ideja po razvoju učinkovitega računalniško podprtega sistema za zajem veterinarskih posegov na kmetijskih gospodarstvih v realnem času in v povezavi s sistemom sledljivosti.

Veterinar naj bi ob zdravljenju živali zabeležil diagnozo, uporabljena zdravila in predpisane karence prek dlančnika neposredno v veterinarsko podatkovno zbirko (slika 1). Izpolnjevanje veterinarskega dnevnika ni potrebno, izda pa le račun na katerega vpiše povezovalno številko, ki je vezana na veterinarski poseg. Kadar direktni vnos ni mogoč, izpolni veterinarski dnevnik in ga kasneje vnese prek spletnega portala v veterinarski ambulanti. Vnos zapisa o zdravljenju prek dlančnika poteka tako, da se najprej vnese identifikacijska številka živali. Po potrditvi se na naslednji strani izpišejo osnovni podatki o rejcu in živali (slike 3-16). Veterinar lahko pregleduje podatke o plodnosti živali, podatke o prirerji mleka, o somatskih celicah za obdobje 12 mesecev in zdravstvene podatke,

ki so pri posamezni živali že bili zabeleženi (zdravstvena kartoteka). Vnos nadaljuje z vpisom anamneze, diagnoze, porabljenih zdravil in karenčnega obdobja za meso in mleko. Register zdravil se dopolnjuje iz centralnega registra zdravil Javne agencije za zdravila in medicinske pripomočke (JAZMP), šifrant bolezni pa je nastal v okviru sodelovanja z Veterinarsko fakulteto in Veterinarsko zbornico Slovenije. Podatkovna zbirka je povezana s centralnim registrom SIR, kamor se bodo prenašali samo tisti podatki o zdravljenju živali, ki so potrebni za delovanje sistema in obsegajo identifikacijo živali, datum posega in predpisano karenčno obdobje (slika 2). V primeru, da žival, ki ima predpisano karence pride v klavnico pred iztekom karenčne dobe, se ob običajnih preverjanjih podatkov istovetnosti, sproži blokada klanja (slika 17). Veterinar v klavnici lahko naknadno preveri vse podatke o obolenjih in zdravljenju živali (kartoteka zdravstvenih posegov) ter se odloča o njeni nadaljnji usodi. Podobno kot v primeru nespoštovanja karenčnega obdobja se lahko sproži mehanizem opozarjanja tudi v primerih klanja živali za posebne blagovne znamke, kjer obstajajo tehnološki predpisi o uporabi dovoljenih zdravil in bolezni za katerimi je določena žival lahko obolela, da še ustreza blagovni znamki za katero jo rejec redi.

S sistemom, ki ga gradimo, želimo poleg neposrednega vpliva na pridelavo varne hrane, vplivati tudi na večjo učinkovitost veterinarske službe, ki bo ob uporabi tega sistema imela možnost vpogleda tudi v ostale zbrane podatke.

Podatki bodo na voljo rejcem pri njihovem rejskem delu in ostalim kmetijskim službam, seveda v okviru pristojnosti in pravic s katerimi je urejen dostop in razpolaganje s temi podatki.

Sistem je trenutno v razvojni fazi in glavni problem, s katerim se soočamo ob prenosu rešitev v prakso je slab sprejem novosti pri lokalni veterinarski službi zaradi strahu pred novimi tehnologijami ter nezaupanju in strahu pred dodatnim delom, ki naj bi ga jim po njihovem mnenju prinesel nov sistem.

## 1. INTRODUCTION

Safe food contributes a great deal to the assurance of healthy population and it is the main goal followed at all stages of food production. For good quality, safe and healthy foodstuffs, which are bought by consumers in stores or restaurants, it is very important that all participants in food chain are collecting all the important data about food safety. Traceability of foodstuff is regulated with EU directive [7] where it is explicitly prescribed that it must be assured at all stages of harvesting, processing and distribution.

As early as 1997, before the outbreak of BSE disease within the European Union, Slovenia started a project called "Traceability of Beef Meat from the Farm to the Fork" [1, 2, 3, 5]. The main reason for such a decision was the appearance of the first trademarks for meat. In the year 1999 the project was finished and the traceability was introduced in all Slovenian export slaughterhouses.

Due to liberalization on food market the consumer's complete trust in the food safety is evidently important and this can be proven by a good health monitoring system, feed traceability, and control of the usage of veterinary medicines. Even though the usage of veterinary medicines could be strictly controlled, it may happen that the required interval between administration and meat or milk harvest (withdrawal period) is not respected. The main problem is that the time between the incident situation and the reaction of official authorities is too long and foodstuffs could already be consumed. In such cases even if good traceability exists, we can just register the occurrences which do not contribute to better trust in the food safety.

Germs resistant to antibiotics are now an emerging public health problem. The more antibiotics are used by breeders the more likely it is that resistance will develop. These resistant germs can be carried with the animals in slaughterhouses into the food chain. Therefore, it is crucial for both animal and human health that antibiotics are used sparingly and not as a replacement for good husbandry.

Finally, the breeding service can provide an efficient system for monitoring animal health. With systematical collecting and processing of data it is possible to perform a focused selection on animal longevity and their natural resistance against diseases which are causing economic loss. Potential risk of not respecting the withdrawal period would also be reduced. In Scandinavian countries, health monitoring system is a part of routine process included in the national selection model. One of the most evidential consequences is the reduced appearance of clinical mastitis in cattle. As the frequency of clinical mastitis in the year 1994 was 20%, it has been reduced for 5% in only five years to 15% in the year 1998 [4]. Furthermore, the decision was made to develop an efficient computerized system to monitor the veterinarian treatments of cattle and connect it with the traceability system [6].

## DESCRIPTION OF INFORMATION SYSTEM

In the year 2006 we started to work on the project Harmonization of Cattle Traceability with EU Regulative and Implementation of Collecting Veterinary Events on the Farms. The system of cattle traceability was

fully operational, so we could start with the design of database for the animal health monitoring system. This information system is designed to collect, analyze and report useful information on animal health status and it is one of the most important factors of safe food assurance. The idea was that veterinarian simultaneously, as he treats the animal, records the diagnosis, the drugs used and the withdrawal period through the handheld. All data is stored in central database which is connected to Animal Identification and Registration Service (SIR). If an animal under the treatment comes into the slaughterhouse, the slaughter of that animal is blocked by the process of data checking. The veterinarian in the slaughterhouse can also check the history of health status events, and medicaments used and then he decides what to do with the animal. The system enables to check the past health status and medical treatments of animals that are bred for special trademarks (meat of higher market value). If an animal does not fulfill the required demands (the usage of not allowed medicaments, certain illnesses) that were defined in the contract for special trademarks, the slaughterhouse also obtains a remark for that animal.

### Design and creation of veterinary database

Oracle Designer has been used for design and creation of database which consists of relational tables, packages, trigger logics and other attributes. Building up of database was made with CASE (Computer Added System Engineering) methodology which binds the workflows across requirements, analysis, design, implementation and test, and hence drives the whole software development process. The database is running on Oracle 11g and Windows XP platform and with this system we covered many needs concerning the administrative management and data security. In the newly created database we imported all necessary codes and started with the development of web application. The web application has been developed in MOD\_PLSQL which is an Apache (Web Server) extension module that allows one to create dynamic web pages from PL/SQL packages and stored procedures.

### Dataflow of veterinary treatment on farms into veterinary database (VD)

The veterinarian can decide for immediate entry of data with handheld, or afterwards at the veterinary station during the web use. With the entry of data through handheld there is no need of filling up a veterinary diary (VD). At the same time it is possible to browse the past disease events of a treated animal. After each successful entry of veterinary treatment the link number is gathered pointing at the record in database. This computer added number is used as linkage between an official account

and the record of veterinary treatment in VD. When entry through handheld is not possible, veterinarian writes in data concerning the treatment to ambulant daily round usual procedure and adds an entry into VD later at the veterinary station. The next step is the transmission of meaningful data from VD to the central database of registered animals in SIR which is done by database triggers. Animals that come into the slaughterhouse are checked on identity, ownership and on respecting of withdrawal period. When all checks are passed, the animal is slaughtered otherwise the slaughterhouse gets a warning that something is wrong.

**Connection of veterinary database with other databases (CPZ Cattle, SIR, JAZMP, slaughterhouses)**

In order to use data which is necessary for a good veterinary practice, animal health monitoring system and safe food assurance, this database is connected with other databases. Reproduction data, milk recordings and milk composition is one of many data collected by cattle breeding service at Agricultural Institute of Slovenia that can help at the decision-making related to medical treatment. Animal Identification and Registration Service,

which was set up at the Ministry of Agriculture, Forestry and Food with its central data collection provides a correct traceability of labeled animals, their movements and culling. The source of medical products is in the central database of Agency for Medicinal Products and Medical Devices of the Republic of Slovenia (JAZMP). Slaughterhouses are connected to SIR where they register all slaughters in the database on a daily basis. From that point on, consumers are serviced with the data of meat origin through the internet typing only the ID number of cattle.

**Disease codes for cattle**

At the beginning of the project we found out that there was missing an official common code listing of diseases which could be used by all services. So as a part of this project we made up a health code listing of cattle diseases divided into 13 organ system groups which has more then 830 cattle diseases.

**Computer program for health monitoring system**

The computer program for health monitoring system is a web application accessible from PC or handhelds. The

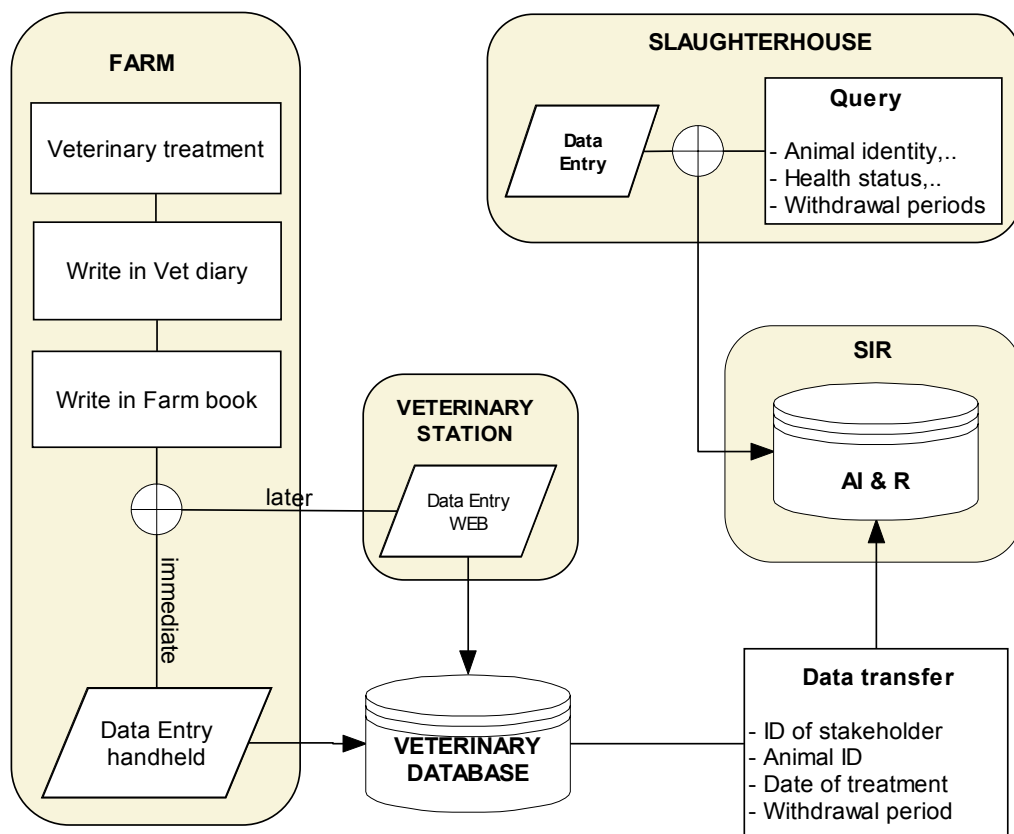


Figure 1. Entry of veterinary treatment data on the farm and connection with AI & R service and slaughterhouse  
 Slika 1. Zajem podatkov o zdravljenju na kmetijskem gospodarstvu in povezava s službo SIR ter klavnico

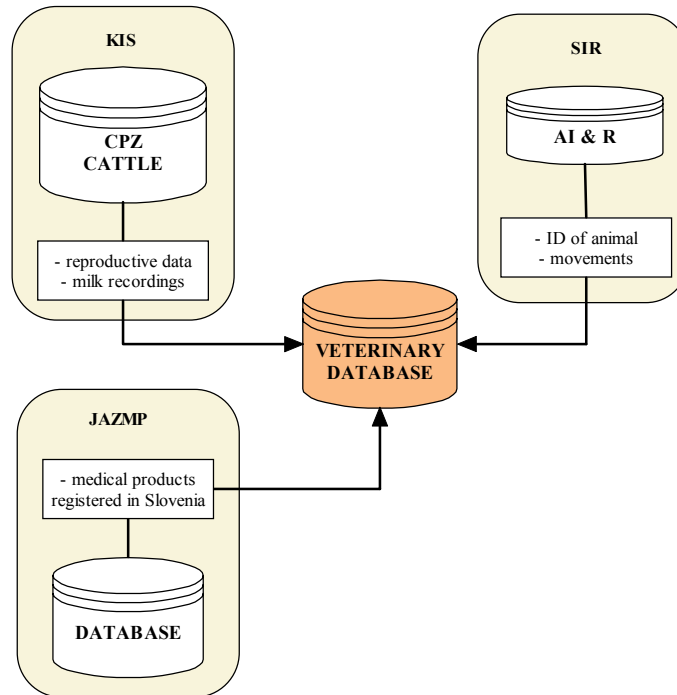


Figure 2. Connection of veterinary database to other information systems  
 Slika 2. Povezava veterinarske podatkovne zbirke z ostalimi informacijskimi sistemi

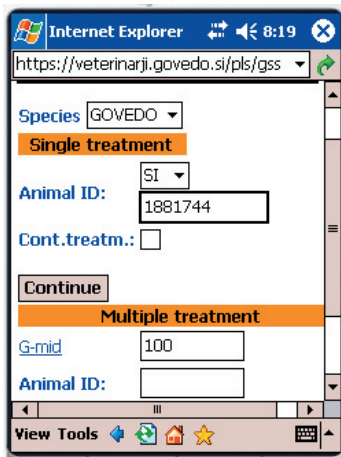


Figure 3.



Figure 4.

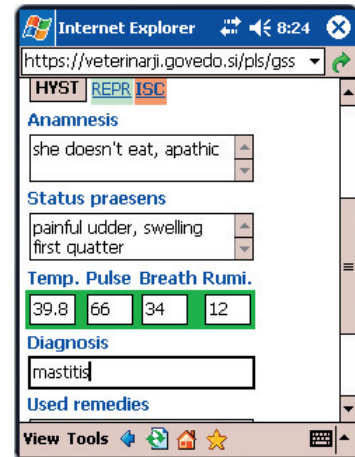


Figure 5.

program has been developed to maintain the veterinary database and is composed of modules for disease code entry to maintain the list of medical products and entry of veterinary treatment. Some of them can be used from web site and the others with handheld.

When the veterinarian is connected to the database in the main frame he can choose between browsing and data entering. Regarding the single or multiple treatments of the animal (Figure 3) he has to enter the animal ID

number or the stakeholder number and press the continue button. If the animal exists all data of breeder, animal date of birth, last calving and last insemination is shown in the next screen (Figure 4). For females it is possible to look into reproduction events by pressing the button "REPR" where the system returns all calving with appropriate inseminations (Figure 13). Breeders with milk recordings can access data about milk yield, milk composition and somatic cell counts (Figure 14).

In the next step he can enter data about anamnesis, status presence, temperature, pulse, breathing and rumination (Figure 5).

Diagnoses can be entered with full name, key or partial word definition. In the next field you can fill in used remedies and doses (Figure 6). After pressing the continue button the page has renewed and you get the list of illnesses (Figure 7) and list of remedies (Figure 8) where you check in an appropriate diagnose (Figure 9) and the amount of used remedies (Figure 10). The entry is finished by entering the description of treatment and withdrawal period for milk and meat respectively.

Confirmation is done by pressing the button "Save" (Figure 11). If all entered data passed logical controls of database the record is saved and a message of successful input is shown (Figure 12).

The system is being built to upgrade the traceability system

which was introduced in all Slovenian slaughterhouses in the year 1999. Even though all movements of an animal are being traced and the farmers must fulfill a special form for cattle that goes to the slaughterhouse entitled "Statement concerning nutritional safety for animal assigned to slaughter" (information concerning food chain), it is difficult to assure undoubtedly that the animal that came into the slaughterhouse was healthy and that all withdrawal periods were respected. The situation is more complex when animals are reared for special trades, because special requirements exist in order of using medicaments and illnesses of particular animal. If the farmer decides to sell his cattle directly to the slaughterhouse or indirectly through a mediator, checks are performed to establish the proper identity of the animal and its health status. If the animal is being sent to slaughter inside the withdrawal period it gets a remark

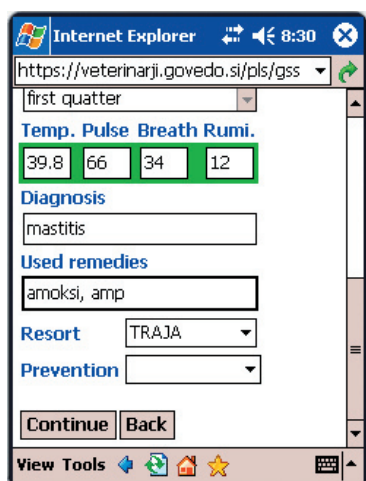


Figure 6.

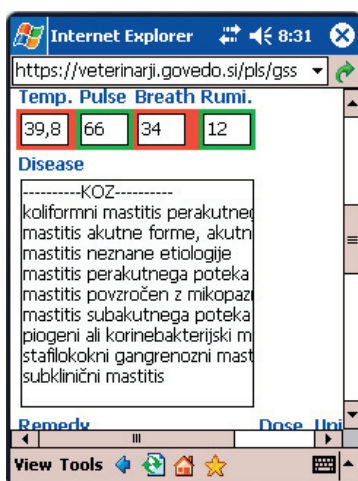


Figure 7.

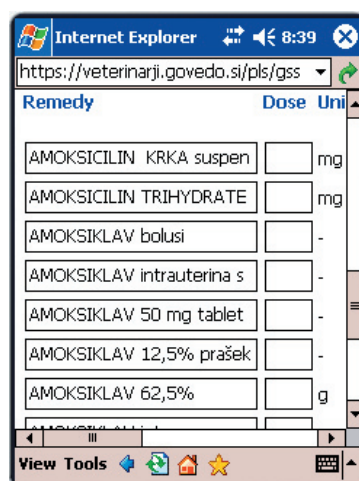


Figure 8.

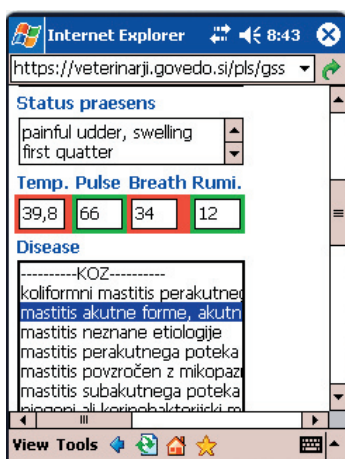


Figure 9

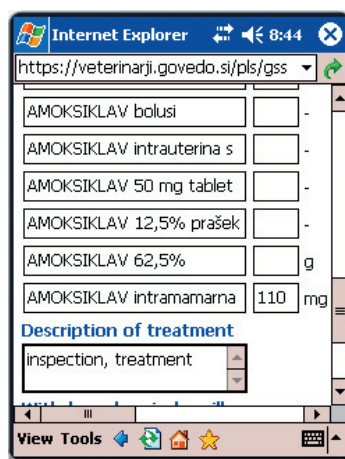


Figure 10

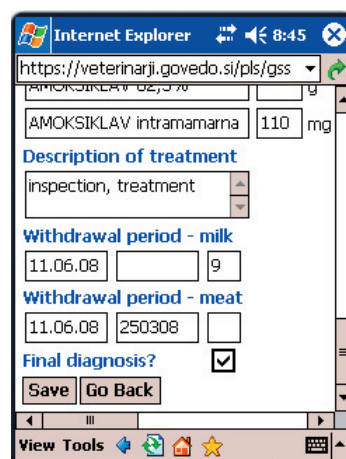


Figure 11

and it is rejected before the processing. If the system confirms that the animal is O.K., then it is accepted for slaughter (Figure 17).

The alert system in dairy

This system works in the same manner, so that in case of veterinary treatment, cows that are treated with drugs in the withdrawal period for milk are marked. The idea is that the dairies get the information about the potential presence of drug residues in milk for each requested farm or tank, but only for those which are their customers. In all those cases dairies can take inspection samples and analyze them on known substances.

2. DISCUSSION

With the system under development we intend to cover many important areas which contribute to food safety and efficient and more professional veterinary

services. Upgrading of traceability system with health data monitoring will have an important role in getting the consumer's trust. Improved traceability will be achieved by on-line data entry on the place of origin of veterinary treatments and usage of data from databases held by cattle breeding service, SIR and JAZMP. In case of communication disorders data can be entered later on at the veterinary station. The whole system is functional when relational connections exist between databases, slaughterhouses and dairies.

The response time between the incidence occurrence (for example: presence of remedies) and reaction of slaughterhouse or dairy will be reduced by routine checking inside the system.

Data gathered within the health monitoring system could be used in animal breeding for selection on animal resistance to some major diseases (mastitis, reproductive diseases,...). The benefit of the selection focused on the

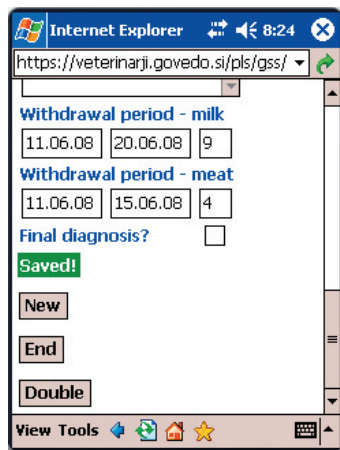


Figure 12

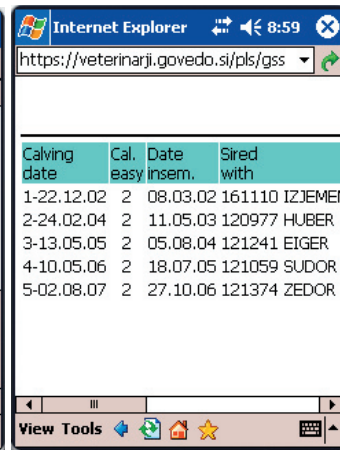


Figure 13

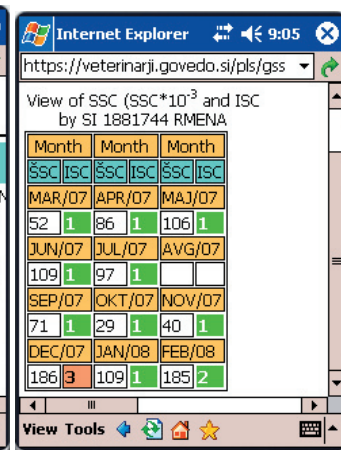


Figure 14



Figure 15

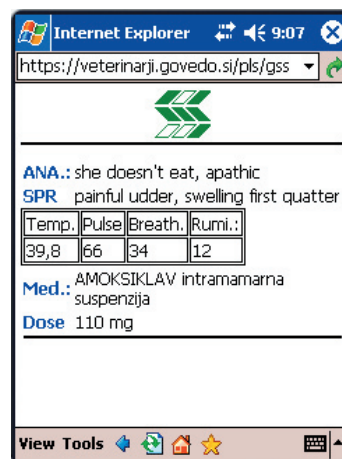


Figure 16

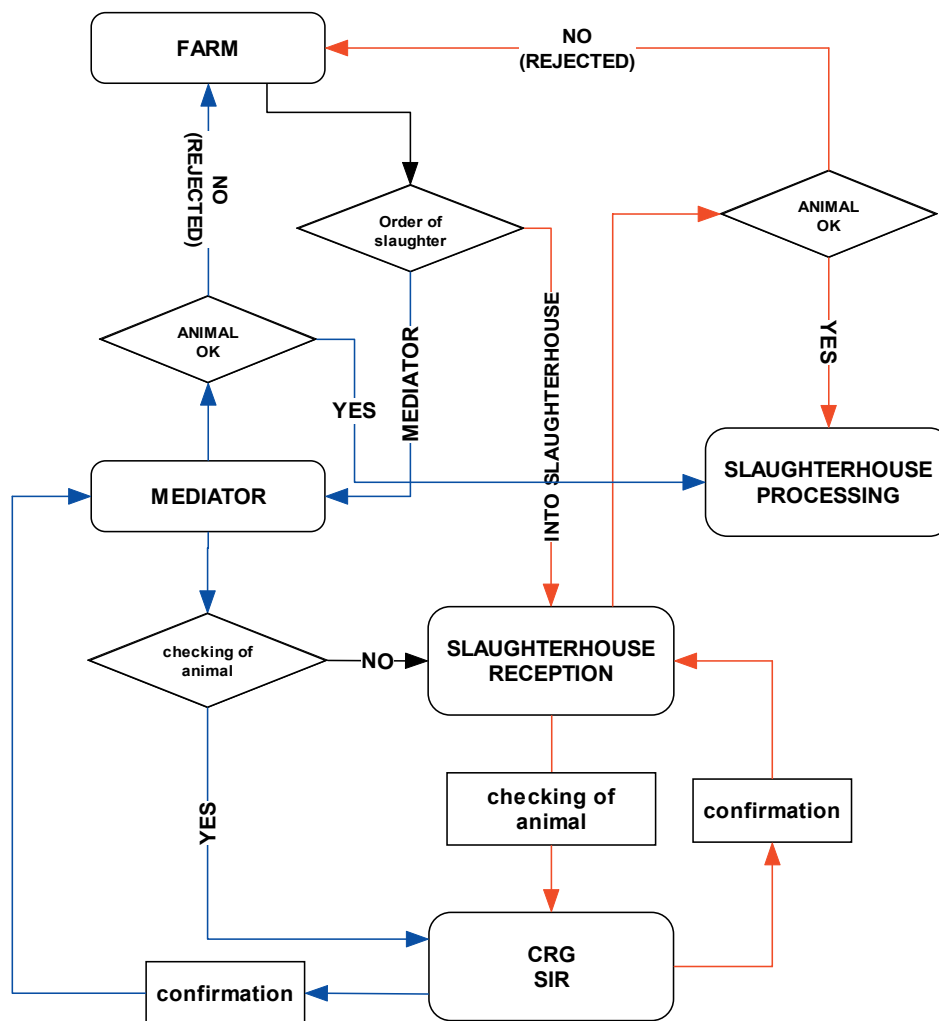


Figure 17. Alert System of slaughterhouse  
Slika 17. Opozorilni sistem klavnice

reduction of diseases could be the reduction of remedies used and lower costs for veterinary services.

Furthermore, we found out that we need a common official health code listing for unambiguous interpretation and data processing. For this purpose we made up a health code listing of cattle diseases which consists of more than 830 diseases divided into 13 organic system groups. The health code listing was made in cooperation with Veterinary Faculty and Veterinary Chamber of Slovenia.

On the other hand, all data collected by veterinarians will be accessible to breeders for their own purposes concerning cattle breeding and to other agricultural institutions which will get permission to access data from farmers and governmental authorities.

Despite of promising advantages the main problem which has arisen since the introduction of these system solutions

was the poor acceptance by the local veterinarians due to their fear of new technology and more work as they explained.

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