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Computational intelligence in tropical medicine

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ABSTRACT

The application of computational technology for medical purpose is a very interesting topic. Knowledge content development and new technology search using computational technology becomes the newest approach in medicine. With advanced computational technology, several omics sciences are available for clarification and prediction in medicine. The computational intelligence is an important application that should be mentioned. Here, the author details and discusses on computational intelligence in tropical medicine.

1. Introduction

Computer is widely used at present and the advent of computation science is accepted. Computational technology can be applied in several fields. The application of computational technology for medical purpose is a very interesting topic. Knowledge content development and new technology search using computational technology becomes the newest approach in medicine. With advanced computational technology, several omics sciences are available for clarification and prediction in medicine [1]. The computational intelligence is an important application that should be mentioned. In tropical medicine, which is a specific branch of medicine dealing with tropical diseases (especially for infections) and public health, the computational technology can be very useful [2]. The new drug findings, vaccine search as well as biomarker discovery can be based on advanced computational technology. The application can be used for answering the question on gene,

protein, expression and interaction of host, pathogen and environment [2]. Here, the author details and discusses on computational intelligence in tropical medicine.

2. How can computational intelligence be useful in tropical medicine?

As already mentioned, the computational technology can be useful for medical work. The application of the new computation intelligence or artificial intelligence is a new thing in medicine. In fact, the artificial intelligence is proved to be useful and cost effective in several research studies [3]. For many decades, until present 2015, the artificial intelligence has been developed, introduced and applied in medicine [4]. Peek *et al.* concluded that "there has been a major shift from knowledge-based to data-driven methods while the interest for other research themes such as uncertainty management, image and signal processing, and natural language processing has been stable since the early 1990s" [4]. Patel *et al.* noted that the artificial intelligence can be applied in several works including to "clinical decision-making, reasoning under uncertainty and knowledge representation to systems integration" [5].

In tropical medicine, computational technology can be used for research and development [2]. Difficult questions can be

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simply answered with help of advanced computational technology. Simple, bioinformatics tools can be used for basic genomics and proteomics studies. With artificial intelligence, "translational bioinformatics" can be supported [5]. Several online tools are available for medical purpose and most of those tools are developed based on artificial intelligence principles [1]. Mainly, the tools can be classified as a) database for searching purpose and b) manipulation tool for prediction or simulation purpose [1].

2.1. Computational intelligence: interactive database in tropical medicine

In bioinformatics, the management of data is the basic principle. The first step is to gathering data to form database [1,6]. The database is the basic source of information. To make use of a database, searching is needed. With help of advance computational technology, there are many new developed medical databases at present. Borok noted that "work with data mining tools in health care is in a developmental stage that holds great promise, given the combination of demographic and diagnostic information" [7]. It is no doubt that the computational intelligence technique is used for supporting the online medical database. Berger and Berger noted that the computational intelligence can help "analyze massive amounts of data and provide useful and interesting information about patterns and relationships that exist within the data that might otherwise be missed" [8]. The interactive database can be helpful and help shorten the time for database searching.

At present, there are several interactive medical databases. One of the most widely used interactive medical database is PubMed (www.pubmed.com). It is a freely accessible open medical database. The PubMed contains several information in medicine including to medical journals, publications, books, proteins, genes, sequences, structures, *etc*. It is also the referencing website in medical society. Nevertheless, there are also other new interesting interactive medical databases. Here, the author will show some interesting interactive databases in tropical medicine in Table 1.

2.2. Computational intelligence: simulation tool in tropical medicine

The application of computational intelligence to perform an *in silico* experiment is an exact usefulness of computational technology in medicine. Many phenomena in medicine are difficult to study *in vivo* or *in vitro,* hence, using computation technology to help predict the result can help solve the complex queries [1]. The simulation can be used for predicting the change due to time and place. In addition, interaction can also be predicted. At present, many new neural networks are developed for using as computational intelligence in medicine. Traeger *et al.* noted that computation neural network can be very useful to model and forecast "complex, non-linear, and time depending relationships" [13].

The application of the new simulation tools in medicine can be in either diagnostic or therapeutic purposed. In diagnosis, Cleophas and Cleophas noted that the new tools could "predict clinical diagnoses with accuracies similar to those of other methods" [14]. In tropical medicine, there are also many reports

Table 1
Some interesting interactive databases in tropical medicine.

Databases	Details
AMPer [9]	AMPer is a database and an automated discovery tool for antimicrobial peptides [9].
MONI [10]	MONI is an intelligent database and monitoring system for surveillance of nosocomial infections [10].
PlasmoDraft [11]	PlasmoDraft is a database of *Plasmodium falciparum* gene function predictions based on postgenomic data [11].
Microbial Rosetta Stone [12]	Microbial Rosetta Stone is a database system for tracking infectious microorganisms [12].

on using artificial intelligence for help diagnose the disease. For example, Shamshirband *et al.* reported using artificial immune recognition system for diagnosing tuberculosis [15]. According to their study, the "classification accuracy was 99.14%, sensitivity 87.00%, and specificity 86.12%" [15]. Saybani *et al.* reported a similar study reported using artificial immune recognition system for diagnosing tuberculosis [16]. In this reported, classification accuracy was 100%, sensitivity 100%, and specificity 100% [16]. Rao and Kumar proposed for "a new computational intelligence-based methodology that predicts the diagnosis in real time, minimizing the number of false positives and false negatives" [17]. Rao and Kumar concluded that their develop computational intelligence was "more accurate than the state-of-the-art methodologies used in the diagnosis of the dengue fever" [17]. Andrade *et al.* used the neural network for help diagnose malaria [18]. Andrade *et al.* concluded that "an expert computational system based on artificial neural networks was worse that the light microscopy (56% of correct diagnoses)" [18].

In therapy, the intelligence can also be applied. For example, a "component-based approach to automation of protocol-directed therapy" was recently reported by Musen *et al.* [19]. Musen *et al.* reported that the new tool could help "offer advice regarding the management of patients who are following clinical trial protocols for AIDS or HIV" [19]. Luan *et al.* reported the use of neural network for predicting effect of the antimalarial activity of 1,4-naphthoquinonyl derivatives as potential antimalarial agents [20]. In this work, Luan *et al.* used forward stepwise multilinear regression and radial basis function neural networks as main techniques [20].

In addition to diagnosis and treatment, the application of neural network can also be used in preventive purpose in medicine. This can be seen in modeling of vaccination effectiveness. The good example is a recent report by Trtica-Majnaric *et al.* [21]. Trtica-Majnaric *et al.* reported the prediction of influenza vaccination outcome by neural networks and logistic regression [21].

Similar to the previous mentioned available databases in tropical medicine, there are also many new online computational intelligence tools for medical use in tropical medicine. Here, the author showed some interesting simulation tools in tropical medicine in Table 2.

Table 2
Some interesting simulation tools in tropical medicine.

Databases	Details
IMEX [22]	IMEX system is a computer-aided diagnosis and treatment of malaria [22].
RAIRS2 [23]	RAIRS2 is an expert system for diagnosing tuberculosis using artificial immune recognition system [23].
MycPermCheck [24]	MycPermCheck is the *Mycobacterium tuberculosis* permeability prediction tool for small molecules [24].
TB-Lineage [25]	TB-Lineage is an online tool for classification and analysis of strains of *Mycobacterium tuberculosis* complex [25].

3. Conclusions

The application of computational intelligence in tropical medicine can be seen in both diagnostic and therapeutic purposes. There are many new interactive databases and online simulation tools for help clarification and prediction in tropical medicine. Many reports mentioned advantage of the new system. Nevertheless, some problems on accuracy can still be seen. Computational intelligence in tropical medicine is an interesting topic for further research and development.

Conflict of interest statement

We declare that we have no conflict of interest.

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