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Modeling of Hepatitis B Epidemic Process by the Risk Factors Analysis

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Objective

To develop model to study risk factors for hepatitis B (HB) and to identify the main causes affecting the incidence of HB.

Introduction

Viral hepatitis is a global public health problem affecting millions of people every year, causing disability and death [1].The hepatitis B virus (HBV) is transmitted through the contact with the blood or other body fluids of an infected person. For formulating evidence-based policy of Public Health and data for action we should know about main ways of transmission HBV and population group with high risk of infection.

Methods

We used the time series of morbidity Xi, i = {1, . . ., n} in absolute indicators for obtaining strength of impact of risk factors concerning medical interventions and common risk factors in general. Using the data distribution of morbidity by age and years to construct statistical confidence intervals and histograms for determination the age in which the probability of infection is the highest.

For investigation of the relations between the factor features and effective features of the statistical data (causal relationship) or dependencies of parallel changes in several features of this data from some third variable (the total reason) the methods of the Spearman's rank correlation were applied [2].

Results

Correlation portrait is a graphical representation of the structural organization of relations between all indicators, which are quantified. This type of representation allows to provide more "transparent" analysis [3]. The obtained correlation portrait of the relations between risk factors of hepatitis B depicted on fig. 1.

So, it is obvious that increasing of the impact of medical interventions reduces the impact of vertical risk factor (weak) and common risk factor (strong), simultaneously increasing the impact of drug users (addicts), injections outside of health facilities and sexual risk factors (strong).

For determination of dependence between morbidity and medical interventions we analyzed time-series correlation (fig.2). We founded the presence of positive dependence between morbidity and infection in dental procedures and injections.

The trend to a permanent reduction of morbidity indicates that the presence of positive dependence is a consequence of sterilization control at medical interventions. Particular attention should be given to weakly controlled risk factors which are constant despite the general downward trend of morbidity.

Estimation of age groups of risk shown that people aged 20-29 have the high risk of infections of hepatitis B.

Conclusions

Proposed model allows to identify the dependencies between the risk factors and the HB morbidity, detect major factors that affect the intensity of the epidemic process and verify the effectiveness of preventive measures. As a result the program was developed, which allows to improve the quality of management decisions at epidemiological surveillance, decreasing economic burden. The computational experiments conducted with data obtained in Kharkiv (Ukraine), results were verified by epidemiological experts.

The perspective directions for further research is using fuzzy relational maps for more deep analysis of dependencies between the risk factors and symptoms for early identification of the high risk individuals that can help to prevent HB morbidity.

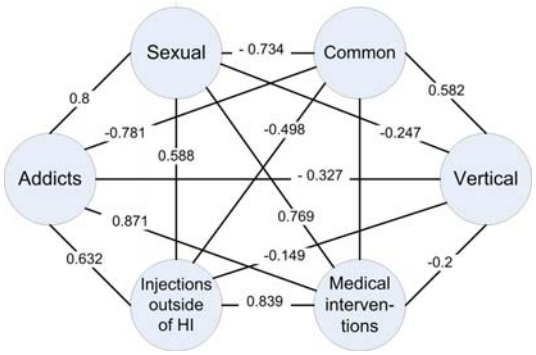

Fig.1. The portrait of the relations between risk factors of hepatitis B in Kharkiv

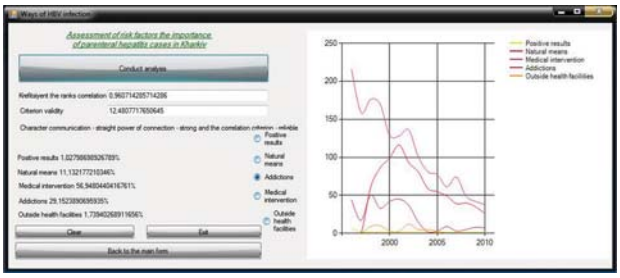

Fig. 2. Estimation of HBV transmission ways in Kharkiv

Keywords

time series; correlation portrait; model; morbidity

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