Community prevalence of sexually transmitted diseases and human immunodeficiency virus infection in Tamil Nadu, India: A probability proportional to size cluster survey

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ABSTRACT

Background. Human immunodeficiency virus (HIV) infection and AIDS is threatening the survival of many nations. To evaluate ongoing interventional strategies and burden of illness estimates, valid data on the prevalence of HIV are required. Often, in the absence of community prevalence data, estimates are based on surrogate markers such as prevalence of HIV in antenatal clinics. Even though the antenatal prevalence of HIV is easier to measure and can be repeated for evaluation, it is important to establish the association between antenatal and community prevalence of sexually transmitted diseases (STDs) and HIV, so that the validity of the estimates can be verified.

Methods. A ‘probability proportional to size’ cluster survey was conducted in three randomly selected districts of Tamil Nadu in India. The basic unit of the survey was households from rural and urban clusters. Adults 15–45 years of age from the selected households were eligible for recruitment. Demographic, behavioural and laboratory data were collected. Clinical examination was done to identify STD syndromes and blood, urine, vaginal/urethral and endocervical swabs were taken for laboratory diagnosis of STDs from the subjects. Direct smear examination for Trichomonas vaginalis; serological tests for syphilis, hepatitis B, HIV, herpes simplex virus 2, Chlamydia trachomatis; and culture of Neisseria gonorrhoeae and Haemophilus ducreyi were performed on the collected specimens. The data were analysed adjusting for cluster effect.

Results. We selected and screened 1981 individuals (1157 women and 824 men) for STDs and HIV from 1114 households representing the 25 million projected adult population of Tamil Nadu. The overall community prevalence of STDs including HIV and hepatitis B was 14.6% (CI: 14.1–15.1), and 8.3% (CI: 7.9–8.6) when HIV and hepatitis B were excluded. Community prevalence of HIV and hepatitis B infection was 1.8% (CI:1.7–1.9) and 5.3% (CI: 5.1–5.5), respectively. The distribution of HIV involved both rural and urban regions of Tamil Nadu. On clinical examination, at least one STD syndrome was noted in 486 (24.5%) of the women subjects; vaginal discharge was the most common and found in 421 women (38.4%).

Conclusion. The prevalence of STD and HIV in Tamil Nadu is higher than expected and has extended into the non-high risk population (generalized epidemic).


INTRODUCTION

From the time of the first report of HIV in 1986, India has rapidly emerged as the country with the maximum number of HIV-infected persons in the world. Although data on HIV and STD prevalence among the high-risk groups are available from India, the true prevalence of HIV in the community is not clear and estimates range from 1.7 to 4.1 million. Currently, antenatal HIV prevalence data are used as a surrogate marker to estimate HIV prevalence in the community. It is important to establish the true relationship between community prevalence and antenatal prevalence to objectively evaluate the ongoing interventions to reduce the spread of STD and HIV in Tamil Nadu.

SUBJECTS AND METHODS

A team of experts considered a list of all STDs and by consensus, based on importance and technical feasibility, chose to estimate the prevalence of 8 diseases—syphilis, gonorrhea, chlamydia, chancroid, trichomoniases, hepatitis B (HBV), herpes simplex virus (HSV) type 2 and HIV in the community. In addition, the prevalence of common genitourinary symptoms and STD syndromes of genital ulcer, urethral discharge (in men), vaginal
discharge, inguinal bubo, scrotal swelling and lower abdominal pain (in women) were estimated.

Population for the study
A representative sample from the state of Tamil Nadu was chosen using the 'probability proportional to size' (PPS) cluster technique. Households were the basic unit of the cluster. A district was randomly selected from the 3 major regions of Tamil Nadu (Chennai, Coimbatore and Madurai). Thirty clusters were selected from each of the 3 districts—Thanjavur, Dindugal and Ramanathapuram—using the PPS method. The clusters were villages from rural areas and wards from urban areas based on the 1991 Census of India. In the selected clusters a prominent landmark junction such as a temple, school or government office was identified and a street was randomly selected. In the street the first household was selected from a list of random numbers and the next 15 consecutive households were included. If a house was found locked, the next household in the same direction replaced it. Thus from each district, a total of 450 households were invited to participate in the STD screening. Adults 15–45 years of age in the selected households were registered. Social workers and village leaders encouraged the subjects to participate in medical camps. Prior, written informed consent was obtained from the selected population. However, in each cluster only a maximum of 25 target individuals from the selected households who came first to the medical camps were included.

Sample size
The prevalence of STD in the community in Tamil Nadu was estimated to be approximately 5%. The sample size was calculated with a precision of 2% and 95% confidence interval (CI) incorporating a 10% non-response. Thus, it was estimated that 600 subjects were needed per district. The total sample size was calculated to be 1800 subjects from the 3 districts.

Data collection by medical camps
In India, medical camps are often organized to address the health problems of the population that resides in remote areas of the country. Three such camps were organized simultaneously at different sites in a district. Each camp team consisted of 30 members, including supervisors, administrators, doctors, nurses, social workers and other support staff. In these medical camps organized primarily by the village leaders, the pre-selected individuals were examined for STDs. The other attendants were screened for common ailments such as anaemia, hypertension and diabetes mellitus. This avoided the labelling effect for the population coming for STD screening to the camps. STD syndromes identified during examination were treated according to the syndromic guidelines specified and follow up, if required, was done by one of the participating institutions.

Demographic, sexual behaviour, risk factor, clinical and laboratory data were collected from the selected population using a structured questionnaire. Genital examination was done with special emphasis to identify ‘STD syndromes’ of genital ulcer, genitalic discharge, bubo, scrotal swelling and lower abdominal pain using specific written criteria for diagnosis. The examining doctors were trained in the criteria at a standardization workshop. Study manuals were made available for reference in each camp. Standardized forms were used to collect data and at each camp supervisors scrutinized the forms for completion.

Microbiological methods
The clinical specimens for microbiological studies collected from the selected population included two vaginal and endocervical swabs from women, two urethral swabs from men and 5 ml blood from all subjects. A summary of the method of confirmation for individual diseases is given in Table I.

Specimen preparation and transport
Vaginal swabs were immediately subjected to wet-film microscopy for Trichomonas vaginalis (TV) at the camp site; urethral swabs and endocervical swabs were collected in AMIES charcoal transport media (Murex). Smears were prepared from the second swab and heat fixed. All clinical specimens were kept in an ice bath while processing. Each day they were transported in liquid nitrogen cylinders or in dry ice to the coordinating microbiology laboratory for processing.

Bacteriological cultures
Isolation of N. gonorrhoeae from urethral/endocervical swabs was performed using oxoid chocolate agar with horse blood and VCN (vancomycin, colistin and nystatin) supplementation. H. ducreyi was isolated from the swabs on oxoid chocolate agar with horse blood and vancomycin alone. Identification was done according to standard protocol.

Serological studies
Serology for syphilis, HIV, HBV and HSV-2 were conducted on the plasma/serum samples using commercial kits. The serological tests carried out for syphilis were RPR and TPHA (Wellcozyme-HA-Murex diagnostics, UK). Double ELISA for HIV was carried out using Genelavia I mixt kit mono of Sanofi diagnostics, Pasteur Inc, France and monozyme mixed kit. Anti-HIV reactive samples were re-tested and confirmed by Western blot. Hepatitis B surface antigen screening was done using Hepsostrika-Uniform II HBsAg kits (Organon Teknika, Netherlands). All the positive sera were reconfirmed using Wellcozyme-HBsAg kit of Murex Diagnostics, UK. IgM antibody to HSV-2 was tested by anti-HSV-2 ELISA kits (Novum Diagnostics, Germany). PCR test for the detection of C. trachomatis was done on urine samples.

Statistical methods
SPSS ver 6 for windows and SUDAAN softwares were used for data analysis. Probability of selection for age and sex distribution was obtained from the 1991 Census to adjust for the differences in

Table I. Summary of methods used for laboratory diagnosis of sexually transmitted diseases

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Organism</th>
<th>Specimen</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis</td>
<td>T. pallidum</td>
<td>Plasma/serum</td>
<td>RPR and TPHA</td>
</tr>
<tr>
<td>Gonorrhoea</td>
<td>N. gonorrhoeae</td>
<td>Urethral swab</td>
<td>Culture</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>C. trachomatis</td>
<td>Urine</td>
<td>PCR</td>
</tr>
<tr>
<td>Chancroid</td>
<td>H. ducreyi</td>
<td>Urethral/vaginal</td>
<td>Culture</td>
</tr>
<tr>
<td>HIV</td>
<td>HIV-1 and</td>
<td>Serum</td>
<td>ELISA (antibody)</td>
</tr>
<tr>
<td></td>
<td>HIV-2</td>
<td></td>
<td>Western blot</td>
</tr>
<tr>
<td>HBV</td>
<td>Hepatitis B virus</td>
<td>Serum</td>
<td>ELISA (HBsAg)</td>
</tr>
<tr>
<td>Trichomoniasis</td>
<td>T. vaginalis</td>
<td>Vaginal swab</td>
<td>Direct wet mount</td>
</tr>
<tr>
<td>Herpes type II</td>
<td>HSV-2</td>
<td>Serum</td>
<td>Anti-HSV2 IgM</td>
</tr>
</tbody>
</table>

HBV hepatitis B virus HIV human immunodeficiency virus HSV-2 herpes simplex virus type 2
Ethical issues

Ethical clearance for the study was obtained from the institutional review board of Christian Medical College and Hospital, Vellore. Informed and written consent was obtained from all the selected subjects before clinical examination and collection of specimens. No coercion was applied to unwilling participants. Individuals detected to have any STD syndromes were treated according to the syndromic management guidelines during the medical camps. After providing treatment to subjects with syphilis and gonorrhea, names of subjects and their spouses were deleted from the database. The household identification key was destroyed so that no individual could be traced based on the information available in the database. Linked anonymous HIV testing was performed on stored samples.

RESULTS

In the three districts selected, 20,975 people attended the medical camps. Data were obtained from 1114 (82.5%) of 1350 study households. From these households 1981 individuals attended the camps. Data were obtained from 1114 (82.5%) of 1350 study households. Seventy-seven people (3.9%) refused to undergo either genital examination or provide blood or urine for tests.

Demographic data of target individuals

There were 824 men and 1157 women in the selected population. Of them, 163 (8.2%) were 15–19 years old, 699 (35.3%) were 20–29 years of age, 709 (35.8%) were 30–39 years old, 410 (20.7%) were 40–45 years old. There were 1504 people (76%) from rural and 477 (24%) from urban areas. In the selected population, 1590 (80%) were currently married, 345 (17%) unmarried and 46 (2.3%) either divorced or widowed. The educational background showed that 465 (23.5%) were illiterate, 642 (32.4%) had primary education, 601 (30.3%) had high school education and only 273 (13.8%) had higher education. Most (968/1981; 48.9%) of the subjects were manual labourers; 102 (5.1%) were semi-skilled, 41 (2.1%) skilled and 28 (1.4%) professionals among the selected subjects. Of the 42.5% (843) subjects classified as unemployed, 622 were housewives.

Genital symptoms and STD syndromes

There were 1904 subjects (96%) in the selected population who were willing to answer the questionnaire. Genital symptoms were noted in 900 (47.3%) respondents. At least one of the STD syndromes was present in 486 (25.5%) subjects. Among women, genital discharge was the most common STD syndrome found in 421 of 1097 women (38.4%). The other syndromes found with lesser frequency were genital ulcer (2.7%), scrotal swelling in men (2.1%), pelvic tenderness in women (0.6%), urethral discharge in men (0.2%) and bubo (0.02%).

Prevalence of STDs

The prevalence of individual disease conditions, as diagnosed by microbiological tests and their distribution by age, sex and residence is shown in Table II. The number of subjects who were positive for various STDs were: syphilis by TPHA 8, gonococcal culture 73, H. ducreyi culture 2, urine PCR for C. trachomatis 16, wet smear for Trichomonas 57, HIV-1/HIV-2 ELISA 34 and HBsAg 106. The prevalence of a microbiologically proven STD in the community was 14.6% (CI: 14.1–15.1); 182 were women (62%) and 111 men (38%). In this group, 23 (7%) had 2 STDs and 2 subjects (0.6%) had 3 STDs. If subjects with HBV infection and HIV infection were excluded, the prevalence was 8.3% (95% CI: 7.9–8.64). The prevalence of many STDs varied significantly

| Table II. Prevalence of sexually transmitted diseases (STDs) by residence, gender and age groups |
|-----------------------------------------------|-----------------------------------------------|
| STD               | Location  | Gender  | Age group (years)  |
|                   | Rural     | Urban   | Men          | Women          | 15–19 | 20–29 | 30–39 | 40–45 |
| An STD            | 14.6      | 14.8    | 14.0        | 12.6           | 16.0           | 14.4 | 14.1 | 15.1 | 14.4 |
| Classical STD     | 8.3       | 7.6     | 10.2        | 5.6            | 10.1           | 4.8  | 9.2  | 8.2  | 8.2  |
| Gonorrhea         | 3.8       | 3.5     | 4.4         | 3.5            | 3.9            | 2.3  | 4.4  | 3.7  | 3.5  |
| Syphilis          | 0.3       | 0.2     | 0.5         | 0.3            | 0.3            | 0.4  | 0.08 | 0.01 | 1.1  |
| Chlamydia         | 1.3       | 1.0     | 2.1         | 1.1            | 1.4            | –    | 1.6  | 1.4  | 1.0  |
| Trichomoniasis    | 5.2       | 5.3     | 5.0         | –              | 5.2            | 0.25 | 4.4  | 6.4  | 6.0  |
| HBV               | 5.3       | 6.0     | 3.3         | 6.0            | 4.8            | 10.4 | 4.0  | 5.7  | 4.8  |
| HIV               | 1.8       | 2.2     | 0.8         | 1.5            | 2.1            | –    | 1.9  | 1.8  | 2.3  |
| HSV-2             | 1.2       | 1.0     | 1.8         | 1.0            | 1.4            | 2.3  | 1.6  | 1.3  | 0.4  |

HBV hepatitis B virus  HIV human immunodeficiency virus  HSV-2 herpes simplex virus type 2
The prevalence of HIV among commercial sex workers (CSWs) in India is reported to be as high as 47% and that of STD up to 80%. In STD clinic attendees the seroprevalence of HIV is 21%. HIV prevalence in antenatal mothers is rising and is 2%–4% in some centers. However, none of these truly represent the community. Antenatal data on HIV prevalence is available from many states in India and they show that there is a significant difference in prevalence across states and populations. Tamil Nadu along with Maharashtra, Andhra Pradesh and Karnataka are estimated to be high-prevalence states with a median prevalence of more than 1%. A report from the National AIDS Control Organization suggests that antenatal prevalence in Tamil Nadu is 1% (median value). However, no community data are available to validate these estimates.

A well-validated PPS sampling technique was used in this study to generate population-based data. The medical camps were conducted at a time when the men were at work. This could account for the predominance of women in the sample population. Despite the fact that asymptomatic subjects had to undergo genital examination, the compliance was high and we were able to recruit subjects from 82% of the target households and only 3.9% of the subjects who came to the camp refused to provide specimens for testing or objected to genital examination. This high level of compliance is largely due to community participation, the camps being conducted primarily by the community, for the community with organizational and financial support from the study team.

The prevalence of STDs in Tamil Nadu was 14.6%; excluding HIV and HBV it was 8.3%. This falls in the 'high endemic rate' for the region. An HIV prevalence rate of 1.8% is alarming and is higher than previously estimated, but is not yet of the magnitude seen in many African countries. This finding offers a window of opportunity to enhance strategies to prevent the spread of HIV in the community by optimal interventions since those at highest risk of acquiring HIV are the same people who are at risk for developing STDs. In many states of India, antenatal surveillance is the only method for HIV surveillance as it is much easier to measure than true community prevalence. However, our study shows that antenatal surveillance significantly underestimates the true prevalence of the disease in the community. Our data suggest that the disease is currently more prevalent in older subjects who are not well represented in the antenatal population. Differences in prevalence in men and women subjects is another factor that could skew the estimates based on antenatal data. It is, therefore, important to understand the relationship between antenatal and community data to make valid conclusions based on the ongoing HIV antenatal screening.

The prevalence of Std was significantly different in the three districts. We did not note any significant rural (14.8%; CI: 9.8–20.3) and urban (14%; CI: 12.7–19.5) differences in the prevalence of STD in Tamil Nadu. We noted a marginally higher prevalence of HIV in the rural areas but one has to be cautious while interpreting this result. The classification of 'rural' and 'urban' was based on census data which is dependent on the population size and not on accessibility by road or social characteristics of the geographical area. There were no city-based clusters selected among the urban centres and many of the rural clusters were semi-urban (<10 km from an urban centre). Therefore, the population from the urban clusters does not represent a city slum population and the rural clusters do not truly represent the isolated village population. The observations of this study can, however, be generalized across the whole population of Tamil Nadu and it demonstrates that STDs and HIV are not limited to the urban slum setting and high-risk population, but have already spread into other regions of the state. The data on the distribution of 34 HIV-positive subjects in the study show that the disease is evenly distributed in the community and the result obtained is not due to accidental selection of a few high-risk clusters.

Hospital-based studies reported earlier on STD clinic attendees showed a preponderance of men subjects with STD and HIV. The data from the community show that the disease is found equally in both genders, women (18.1%; CI: 14.6–21.6) and men (12.5%; CI: 8.9–19.8). The apparently higher prevalence in women observed in our study is due to trichomiasis, measured only among the women of the target group. When this STD was excluded, the difference (11% and 12.5%) was not statistically significant (p=0.34). The higher prevalence of STDs in men in the earlier reports is likely to be due to the treatment-seeking behaviour of men attending STD clinics.

The distribution of STDs in different age groups shows that the maximum risk is in the 30–39 years age group. The prevalence

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**DISCUSSION**

The epidemiological synergy between STDs and HIV/AIDS has been established in many studies worldwide. They have indicated a 2- to 5-fold increase in the risk of HIV infection in persons who have STDs, both ulcerative and non-ulcerative in nature. With the advent of the HIV/AIDS epidemic in India, STDs have become a major public health problem. A recent study used a purposeful non-random sampling technique from 5 urban and 5 rural centres and showed a high prevalence of HIV in Tamil Nadu, India. However, it is difficult to generalize this result to the population due to the methodological weakness of the study design. With the exception of a few studies from Africa, there are no published reports on a population-based prevalence of STD and HIV in the community.

The prevalence of HIV among commercial sex workers (CSWs) in India is reported to be as high as 47% and that of STD up to 80%. In STD clinic attendees the seroprevalence of HIV is 21%. HIV prevalence in antenatal mothers is rising and is 2%–4% in some centres. However, none of these truly represent the community. Antenatal data on HIV prevalence is available from many states in India and they show that there is a significant difference in prevalence across states and populations. Tamil Nadu along with Maharashtra, Andhra Pradesh and Karnataka are estimated to be high-prevalence states with a median prevalence of more than 1%. A report from the National AIDS Control Organization suggests that antenatal prevalence in Tamil Nadu is 1% (median value). However, no community data are available to validate these estimates.

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**FIG1. Subjects HfV positive by cluster**
was 15.1% (CI: 14.2–16.1) in this age group compared to 14.4% in those <20 years (p=0.08). However, HIV infection was significantly more (p=0.0001) in those >40 years (2.3%; CI: 2.1–2.5) as compared to the <20 years age group, among whom no HIV infection was detected. This is consistent with an early stage of the epidemic in Tamil Nadu, where those who have multiple sexual encounters with CSWs are at higher risk. The age group maximally at risk for HBV infection was the <20 years group as compared to the older age groups. The prevalence in those <20 years of age was 10.4% (CI: 8.9–11.8) as compared to the overall prevalence of 5.3% (p=0.02). The pattern of involvement of HBV infection seems to be different from that of other STDs suggesting that the transmission of HBV in the community occurs most often by a non-sexual route. The high prevalence of HBV infection in the community highlights the need for a policy to vaccinate the population against HBV infection.

Standard microbiological diagnostic methods were used in the study, for the diagnosis of syphilis both the RPR test and the more specific TPHA test were performed; however, only those who had a positive TPHA test result were categorized as having syphilis. Urine PCR testing is a well validated technique for the diagnosis of chlamydial infection. H. ducreyi was not isolated from genital ulcers; however, positive cultures were obtained from the urethral swabs of 3 men who did not have any ulcer. This could represent asymptomatic infection which has been described earlier.

Of the 133 subjects who sought help for STDs in the past, only 69 (51.9%) chose modern medicine. The remaining 64 (48.1%) preferred traditional or alternative systems of medicines such as Ayurveda and Siddha. Very few attended large hospitals. This shows that private medical practitioners and practitioners of alternative medicine are the ones primarily treating STDs in India. An important strategy for interventions to reduce HIV would include upgrading the quality of STD services provided by alternative systems of medicine.

The limitations of the study need to be understood when interpreting the results from this report. The choice of the 8 STDs from a large group was arbitrary. HBV was included, although our data suggest that the mode of transmission is probably predominately non-sexual. The medical camp approach and time constraint did not allow us to spend more than 4 hours in any one cluster to recruit the target population. However, we do not think this has biased our results greatly since we obtained representation from more than 82% of the target households. On the other hand, if those who refused examination (3.9%) and those who did not turn up at the medical camp were indeed those who had high-risk behaviour, then we may have underestimated the true prevalence. In the sampling design, ‘household’ as a unit may increase the measured prevalence of STDs since within-partner sexual contact is likely to be higher. We did not find concordant HIV infection but there were concordant couples for syphilis, chlamydia and hepatitis infection.

In Tamil Nadu, the 15–45 years age group currently forms about 25 million of the population. At the present levels of STD prevalence, this accounts for about 2.5 million subjects with any one of the STDs, 1.3 million with HBV infection and 450 000 with HIV/1-HIV-2 in the community. This is alarming and calls for urgent attention. The programmatic implications of the study need to be highlighted. Initiating targeted interventions to control STDs, strengthening the information, education and counselling (IEC) activities in rural and urban settings, integration of reproductive tract infection (RTI) and STD management at the grassroots level, expanding the diagnosis, support and care of HIV-infected persons in rural areas are some of the activities requiring priority.

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We gratefully acknowledge the financial support obtained for the project from the United States Agency for International Development (USAID) through the AIDS Prevention and Control (APAC) project of Voluntary Health Services (VHS), Chennai, India. This study would not have been possible without the enthusiasm shown by the team of doctors, nurses, laboratory, technical and other administrative staff from Meenakshi Mission Hospital and Research Centre (MMHRC), Madurai. We put on record the help obtained from Dr (Air Cdr) K. P. Das (Director, Administration, MMHRC) and Dr V. N. Rajasekaran (Medical Director, MMHRC) during the survey. The Clinical Epidemiology Unit at Christian Medical College and Hospital, Vellore expresses gratitude for help and encouragement provided by the International Clinical Epidemiology Network (INCLEN Inc).

CONTRIBUTORS

Kurien Thomas was the technical coordinator for the study. He participated in the design, quality control, data gathering, analysis and was a member of the writing committee. S. P. Thyagarajan was the microbiology coordinator for the study and participated in the design, data gathering, quality control, microbiological identification, and was a member of the writing committee. L. Jeyaseelan was responsible for statistical analysis and database management and participated in the design, data collection and writing of the manuscript. Jacob C. Varghese was responsible for human resource management of the study. He organized and conducted the medical camps in the districts for data collection and was responsible for other administrative coordinating duties. P. Krishnamurthy and Lakshmi Bai participated in the design, data collection and supervision of the study. Abraham Peedicayil participated in the design, training of doctors and data collection. P. Rajendran participated in the data collection, quality control and microbiological identification.

K. Sudhakar was a study consultant and participated in the design and coordination of the project.

Subhash Hira was a consultant for the project and participated in the design and quality control of the study.

Soshamma George trained the doctors, participated in the standardization workshop and data collection.

Renu George trained the doctors, participated in the standardization workshop and data collection.

Hemant Gharpure participated in laboratory quality control. He also participated in the standardization workshop and in training the laboratory personnel.

D. Hari, Balakrishnan, A. G. Joyce participated in the data collection during the survey.

Vijaya Srinivasan was in the APAC supervisory team and helped in coordinating the study.

N. Sethuraman was an administrative consultant.

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Management strategies for duodenal ulcer in India in the Helicobacter pylori era: An economic analysis

UDAY C. GHOSHAL, ANANYA DAS

ABSTRACT

Background. Duodenal ulcer (DU) is widely prevalent in India. Eradication of Helicobacter pylori (H. pylori) is considered to be the most cost-effective first-line therapy for DU in patients without a history of use of non-steroidal anti-inflammatory drugs. Western investigators recommend initial empirical anti-H. pylori therapy for such patients. However, in India similar recommendations are lacking due to the absence of appropriate clinical studies.

Methods. An economic analysis for the management of DU with particular attention to H. pylori infection was performed using a decision analysis model. Three treatment strategies for DU diagnosed at index endoscopy were evaluated: In strategy I,

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