



## Comparison of Knowledge, Attitudes and Practice of Dental Safety from Eight Countries at the Turn of the Century

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### ABSTRACT

**Objective:** To compare infection control (IC) knowledge, attitudes and practice of dentists across eight countries.

**Methods:** Self-administered infection control surveys were completed by 1,874 clinicians in eight countries. Practitioner's knowledge, attitudes, and practice of infection control were examined using over 100 variables. Chi-squared statistics ( $\alpha = 0.05$ ) were used to compare respondents from different national groups.

**Results:** Immunizations rates varied significantly across the eight countries ( $p < 0.01$ ) with Asian countries having a lower rate of immunization against HBV than the United States practitioners. Perceived risk of acquiring HIV varied significantly across the study groups ( $p < 0.01$ ); China had the lowest portion (75%). Dentists in the US reported 92% surface barrier use; only 15% in China reported use. Only 58% of practitioners in Pakistan reportedly used disposable exam gloves; 97% of US practitioners regularly use these gloves. For all groups assessed, including the United States, little over 50% of practitioners understood and practiced Universal/Standard (UP/SP) precautions effectively.

**Conclusion:** Analyses from this study suggest that the dental IC knowledge and practice varied widely across the eight countries of interest. Many of the countries were found to have barriers to access IC materials. Results indicate that all eight countries could use improved education standards for universal precautions.

**Clinical significance:** Knowledge, attitudes and practice of dental safety vary in different parts of the world. This study compares the compliance rates in dental safety among countries and pegs them to the level of practice in the United States. This study also provides evidence-based data on the needs in the regions surveyed and could be used to implement remedial educational measures in improving safe practices.

**Keywords:** Knowledge, Attitudes and practice, KAP, Dental safety, Dental infection control, Occupational safety, India, Surveys, Stigma, Infectious diseases, Universal precautions, Multicountry surveys.

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### INTRODUCTION

This paper contains data from over 10 years ago and may not reflect current information on disease, practice of infection control or standards in each surveyed country. Most of these countries now have protocols for dental infection control and occupational safety and may differ to a certain extent from those being followed in the United States of America. Many of the Asian countries evaluated in this study have only recently been able to divert resources to dental infection control and no prior data on this subject exists.

### BACKGROUND

Worldwide, the number of people living with HIV has risen from around 8 million in 1990 to 33 million today and is still growing. About 67% of people living with HIV are in sub-Saharan Africa.<sup>1</sup> In 2008, 4.7 million people in Asia were living with HIV, including 350,000 who became newly infected.<sup>2</sup> In North America about 1.2 to 2.0 million people are living with HIV.<sup>3</sup> Due to the impact of HIV, infection control and safety is now a predominating interest in the field of dentistry, where surgical procedures and risk of exposure to blood and saliva are commonplace. Infection control is defined as—'Control measures taken by health care personnel in reducing the risks of transmission of infectious agents to patients and employees'. The levels of these measures are based on the routes of transmission, the risk

of anticipated exposure to blood and saliva during a given dental procedure.<sup>4</sup> Oral healthcare workers come in close proximity to blood and other potentially infectious materials on a daily basis during provision of care and have a potential to infect patients and themselves if prescribed dental safety measures are not followed. Dental safety measures, if implemented, can also reduce occupational exposures to employees and cross infection in the clinical arena.<sup>5</sup> As of today, many countries have regulations and regulatory agencies to ensure abidance with safety standards. In the United States of America, Occupational Safety and Health Administration (OSHA) that regulates employee safety estimates about 5.6 million workers in the healthcare industry and related occupations annually are at risk of occupational exposure to bloodborne pathogens, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), among others.<sup>5</sup> According to centers for disease control and prevention (CDC) that formulates safety guidelines and recommendations in the United States of America, thousands of Americans are infected with HIV but are unaware of their seropositive status.<sup>6</sup> Therefore, all patients must be treated as potentially infectious. Even in the late 1990s it was predicted that newer epidemics, such as HIV/AIDS were expected to reach epidemic proportions in Asia, undoubtedly taking a large toll on the less economically developed countries with few resources.<sup>7,8</sup> Also at possibly higher risks of contracting and spreading the virus are the dental and other healthcare workers who do not follow standard infection control and safety practices.<sup>9-11</sup> Formulation of disease surveillance measures and development of safety standards in healthcare settings began during the 1960s<sup>12</sup> and this may have been the precursor of development of safety standards for dental practice. Although there were many clusters of HBV infections related to dental care in the 1960s,<sup>13</sup> control measures against bloodborne pathogens were still being developed.<sup>14</sup> The emergence of HIV in the 1980s increased awareness about the importance of infection control. Therefore, many countries now have safety standards and regulatory agencies to ensure abidance to infection control practice and education.<sup>15</sup>

In the United States, the CDC along with the OSHA have developed and disseminated rules and recommendations for infection control and safety to protect both the patient and the practitioner. The first set of recommendations for dentists was published by the CDC in the 1980s followed by amendments and newer standards.<sup>10-12,16-18</sup> These recommendations are a firm foundation for the improvement of care in addition to changes in dental school education and continuing education programs regulated by each state's board of dental examiners in the United States of America.

Dentistry, a surgical field involves exposure to blood and other potentially infectious materials (BOPIM)

responsible for disease transmission through percutaneous means, direct contact, droplets, aerosols and fomites.<sup>19</sup> Therefore, high standards in infection control and occupational safety are required in controlling cross-infection and occupational exposures to bloodborne diseases.<sup>20</sup>

Few studies have been conducted to assess knowledge, attitudes, and practices in infection control outside of the United States and most of those studies have focused on developed nations like Italy, Canada, the United Kingdom, Japan and Sweden.<sup>21-27</sup> Such studies typically use the United States' CDC's recommendations for comparison to the nation of interest. Though general knowledge of infectious diseases and control measures is seemingly adequate in such economically advanced nations, there is still a large amount of room for improvement. For instance, many dentists that were interviewed in these studies still held the outdated belief that saliva is a major route of HIV transmission. If such knowledge gaps exist in nations that we would assume have advanced dental education systems, we can infer equal or greater problems would be found in developing nations with little financial and structural support to develop and provide thorough dental education for dental students and for dental practitioners.

## OBJECTIVES

The primary objective of this study was to explore and compare infection control knowledge, attitudes, and practice of dentists in eight countries. Seven of the countries located in South, Southeast, and East Asia have had little or no prior research conducted on the subject of dental infection control.

## MATERIALS AND METHODS

### Sampling

These data were collected between 1998 and 2004 from a multinational survey employing a nonprobability, convenience sampling method. Approval for this study was attained from the World Health Organization's committee on dental healthcare for disadvantaged communities for use in the Asian countries, while the portion of the study conducted in Texas was approved by Safeguard Dental Health Plans. No subject identifiers were used during data collection, thus ensuring participant confidentiality. The survey was self-administered in all countries but the United States where in the latter was administered through a telephone survey. The total number completed were 1,874 clinicians employed as dental faculty, private, and government appointed dentists in eight countries including India, Pakistan, Thailand, the Philippines, Taiwan, China, South Korea, and the United States, with an overall response rate of 74% (Table 1). Taiwan had the lowest number of surveys returned with 77 surveys completed (51%).

**Table 1:** Country of data origin, surveys distributed, completed and response rate

Country	Distributed	Completed	Response rate
USA	100	99	99.0 %
India	550	456	82.9%
Pakistan	200	113	56.5%
Thailand	400	293	73.3%
Philippines	300	199	66.3%
Taiwan	150	77	51.3%
China	500	357	71.4%
South Korea	350	279	79.7%
Total	2550	1,873	73.5%

### The Data Collection Instrument

The original data collection instrument was developed and qualitatively tested as a joint effort by investigators from Baylor College of Dentistry, Texas A&M Health Sciences Center, Dallas, Texas, USA and the Transcultural Health Unit, Eastman Dental Institute, University College of London, London, UK. This instrument was in English and included over 100 variables covering topics, such as demographics, infection control knowledge, attitudes, and practice as well as the clinician's perception of knowledge, educational needs, and risk of disease transmission. The instrument was translated into Korean and Chinese to be used in Korea and China.

### Statistical Analyses

Data entry and analyses were conducted using SPSS 11.5. Analysis included descriptive statistics, and for inter country comparisons  $\chi^2$  and Cramer's V ( $\alpha = 0.05$ ). Data levels of variables other than those for assessing demographics were predominantly dichotomous.

## RESULTS

All variables analyzed differed significantly across the eight nations ( $p < 0.01$ ) as listed in Table 2.

### Perceived Risk and Perceived Need

Fewer dentists perceived that they were at risk of HIV infection in China (75%) than any other country (87-96%), which corresponds to a fairly high proportion of subjects who believed they practiced adequate infection control and safety (82%). Contradictorily, China had the lowest proportion of individuals who believed that infection control materials being used were adequate (23% vs 27-83%). Less than 53% from India, Pakistan, Taiwan, China, Philippines and South Korea felt that the infection control materials they used were adequate in comparison to 83% in the United States ( $p < 0.05$ ).

### Practice Immunization

Fewer dentists were immunized against HBV in Asian countries in comparison with US practitioners ( $p < 0.05$ ). Over 90% of United States respondents were immunized against Measles, Mumps, and Rubella, compared to the Asian countries where respondents reported between 20% (China: Mumps) and 80% (Taiwan: Measles). Other than for HBV vaccination, China reported alarmingly low immunization rates for common and childhood immunization (14% Influenza; 57% Measles). A higher proportion of respondents in India were immunized against Tetanus (87%), Diphtheria (86%), and Polio (89%) than any of the other seven countries, including the United States. The rates of Influenza vaccination among respondents in the seven Asian countries were particularly low, ranging from 12% in Taiwan to 46% in the Philippines.

### Practice Germicide Use, PPE, Barriers, Reprocessing, and Single-use Disposables

A very small proportion (19%) of dentists in South Korea reported that they use antimicrobial hand soap in stark contrast to the 100% in the United States. South Korea also reported lower use with respect to regular use of antimicrobial preprocedural mouth rinse (43%), surface disinfectant (43%), surface barriers (13%) and liquid sterilants (39%). With respect to personal protective equipment, protective eyewear use had the greatest disparity with 16% of respondents in China and 98% of respondents in the United States reporting regular use. Although the differences among the countries were significant ( $p < 0.05$ ), the range for regular use of instrument sterilizers was relatively narrow (83% India; 100% United States). Some of these countries still used boilers and referred to boiling instruments as sterilization. Regular use of single-use-disposable needles among the countries also appeared to be fairly high among the eight nations, though still significantly different ( $p < 0.05$ ). Pakistan reported the lowest usage at 71%, while Taiwan reported the highest use of single-use-disposables at 97%.

### Sterilizable Hand Instruments, Control of Bioaerosols

For all other items related to regular use of sterilizable hand instrument control of bioaerosols (high volume evacuator and rubber dam use), the ranges among the countries were much greater. For instance, use of bioaerosol control methods was 95% in the United States, but less than 46% in Thailand, the Philippines, South Korea, India and Pakistan.

Table 2: Percentage of positive responses by country

Variable	$\chi^2$	I (n=456)	Pa (n=113)	Th (n=293)	Ph (n=199)	Ta (n=77)	C (n=357)	SK (279)	US (n=100)
DHCWS at high risk of viral hepatitis	57.4***	98	100	98	95	100	92	99	88
DHCWS at high risk of HIV infection and aids	100***	94	97	90	95	96	75	89	87
Possibility of id transmission during dental care	90.3***	92	95	82	87	100	92	95	68
HIV infections and aids on the rise in respondent country	90.3***	93	84	83	78	95	97	94	94
DHCWS need to be immunized against HBV	24.7**	99	100	97	95	95	99	98	97
Need for IC&S	24.4**	99	97	98	95	99	99	96	93
Need for more training in IC&S	95.6***	84	94	73	82	91	94	95	87
IC materials being used are adequate	271 <sup>±</sup> , ***	36	27	68	53	42	23	25	83
Practicing adequate IC&S	236 <sup>±</sup> , ***	60	43	86	78	58	82	43	89
Respondent immunized against HBV	74.9***	80	68	74	73	47	80	67	94
Respondent immunized against chicken pox	108***	69	75	68	68	81	50	58	98
Respondent immunized against mumps	308 <sup>±</sup> , ***	68	63	64	67	62	20	56	98
Respondent immunized against measles	75.1***	74	81	71	67	80	57	70	96
Respondent immunized against rubella	171 <sup>±</sup> , ***	62	51	62	58	70	30	49	91
Respondent immunized against tetanus	267 <sup>±</sup> , ***	87	84	84	66	64	47	48	86
Respondent immunized against diphtheria	119***	86	75	77	62	73	55	65	84
Respondent immunized against polio	112***	89	81	88	67	71	69	65	82
Respondent immunized against influenza	191 <sup>±</sup> , ***	40	34	31	46	12	14	33	79
Use of any antimicrobial hand soap	427 <sup>±</sup> , ***	80	54	82	68	77	74	19	100
Regular use of any antimicrobial preprocedural mouthrinse	324 <sup>±</sup> , ***	91	79	56	86	84	58	43	99
Regular use of any surface disinfectant	241 <sup>±</sup> , ***	72	68	94	72	74	79	43	100
Regular use of surface barriers	573 <sup>±</sup> , ***	63	44	84	53	66	15	13	92
Regular use of exam gloves	143***	77	58	97	86	91	86	72	97
Regular use of surgical gloves	143***	72	59	57	82	84	49	64	97
Regular use of face masks	92.9***	87	74	97	93	83	98	89	97
Regular use of protective eyewear	505 <sup>±</sup> , ***	34	33	79	82	36	16	52	98
Regular use of protective gowns	421 <sup>±</sup> , ***	33	46	90	89	36	41	52	88
Regular use of any instrument sterilizer	90.7***	83	87	99	91	100	92	94	100
Regular use of any liquid sterilants	290 <sup>±</sup> , ***	67	49	76	74	87	92	39	98
Regular use of ultrasonic instrument cleaners	393 <sup>±</sup> , ***	30	20	43	57	92	80	46	97
Regular use of sharp containers	467 <sup>±</sup> , ***	19	21	44	49	78	66	14	98
Regular use of single-use-disposable needles	90***	87	71	96	84	97	93	80	96
Regular use of autoclavable handpiece	300 <sup>±</sup> , ***	49	45	65	76	81	26	39	98
Regular use of bioaerosol control methods (HVE and rubber dam)	545 <sup>±</sup> , ***	16	10	45	41	74	2	23	95
Regular use of heat sterilizable hand-instruments	324 <sup>±</sup> , ***	84	68	81	85	86	36	59	92
Regular use of heat sterilizable burs	308 <sup>±</sup> , ***	47	50	46	68	65	12	39	92
Regular use of heat sterilizable endodontic instruments	369 <sup>±</sup> , ***	53	60	62	75	80	9.5	38	23
Regular use of heat sterilizable orthodontic pliers	287 <sup>±</sup> , ***	40	50	32	65	40	5	20	13
Regular use of heat sterilizable mouth mirrors	470 <sup>±</sup> , ***	88	81	70	80	75	22	68	89
All patients to be treated alike irrespective of infectious disease status	186 <sup>±</sup> , ***	67	65	83	66	79	78	36	79
Medical history and appearance dictate the level of IC&S	137***	51	50	54	61	57	46	86	72
Double-gloving is more appropriate while treating know ID patients	52.9***	75	53	68	59	64	54	69	69
HBV and HIV status of patients is always known	330 <sup>±</sup> , ***	15	12	35	20	33	13	62	64
Respondent has the right to refuse care to infectious patients	188***	20	18	31	41	30	17	50	67
Respondent reports adequate knowledge of HBV, HCV and HDV infections	100***	73	39	58	53	51	51	42	67
Tested knowledge on outcomes of HBV infection	157***	77	66	70	57	79	43	66	94
Respondent trained to recognize oral manifestations of aids	251 <sup>±</sup> , ***	65	35	74	39	73	33	64	94
Respondent reports adequate knowledge of HIV infection and aids	150***	77	43	68	45	52	43	51	63
Tested knowledge on oral manifestations of aids	140***	87	63	80	67	75	56	71	94
Mandatory IC&S curriculum in dental school	31***	98	100	97	93	100	98	94	94

Notes: \*\*p < 0.01 ; \*\*\*p < 0.001; <sup>±</sup> Cramer's V > 0.3; India (I); Pakistan (Pa); Thailand (Th); Philippines (Ph); Taiwan (Ta); China (C); S. Korea (SK); United States (US)

## Variables Related to Stigma

The five items related to stigma varied among the eight countries where samples were collected. The idea that a dentist should treat all patients alike, regardless of infectious disease status, received a low positive response rate of 36%

from South Korea, while the highest positive response rate came from Thailand (83%). The United States had a surprisingly high positive response rate for a question asking if HBV and HIV status are always known (64%), but India, Pakistan, Thailand, the Philippines, Taiwan, and China had

positive response rates lower than 35%. The United States also had the highest rate of positive response for a statement about his/her right to refuse care to an infectious patient (67%).

### Knowledge

Perceived knowledge about Hepatitis B, C, and D ranged from 39% in the Pakistan sample to 73% of the Indian sample. South Korea was the one of the eight countries where respondents reported a higher perceived knowledge about Hepatitis than tested knowledge. This was not the case for perceived and tested knowledge on oral manifestations of AIDS, although South Korea did have the lowest scores (Perceived: 43%; Tested: 56%).

### DISCUSSION

Based on the results of this study, one must consider the cultural differences, resources and exposure to diseases among the eight nations. A point to be made is that the respondents from the United States may have had lower concerns about risk of disease transmission in part because immunization levels were high and infection control and safety practices more ubiquitous. The only exception was that participants from China, where HIV has a prevalence of 0.1%<sup>3</sup> had a lower rate of perceived risk of HIV infection. Results also suggest that the need for infection control and safety was higher in the Asian countries while perceived availability of materials low. Immunization against HBV varied greatly among the eight respondent countries, with the United States having the highest rates of immunization. This was probably because there possibly were no consistent policies on HBV vaccinations for healthcare workers in Asia during the time of the survey. Immunization against other immunizable childhood diseases and Influenza was also low in most countries.

Aseptic techniques, including use of surface disinfectants and disposable surface barriers intended to control cross contamination, were lacking in most countries. A very important finding was that out of the five personal protective equipment items, the use of face masks was most prevalent while the use of protective eyewear and gowns was very low. The rule of thumb in the level of PPE is that when splash/spatter/dust/mist anticipated, full PPE is to be worn (protective eyewear, mask, gown and gloves worn collectively) and if not splash/spatter/dust/mist anticipated, only gloves may suffice. Therefore, the use of 'only' protective eyewear more often is not founded on any infection control principal or rule. Use of ultrasonic instrument cleaners and the use of sharps containers to dispose of regulated waste were both minimal in most

surveyed countries. Ideally, these items should be used in all practices to reduce injuries from sharps. Use of autoclavable handpiece, bioaerosol control measures, and sterilizable hand instruments including endodontic and orthodontic instruments also varied to a great extent. In the US group, the use of sterilizable endodontic instruments was very low because most endodontic procedures are referred out to specialists and that most endodontic instruments used are single-use. This may explain the non-use/reduced use in the United States; however, one would hope these practices be more common in the Asian countries not having the same referral systems and disposable resources.

Respondents in all countries scored poorly on 'stigma and infectious diseases' and universal/standard precautions. Thus, we can deduce a serious lack of understanding in the appropriate use of protective equipment and provision of treatment for all patients. Pakistan, the Philippines, China and South Korea scored poorly on both perceived and tested knowledge of infectious diseases. A large portion of participants in the United States believed that the patient disease status is always known compared to a relatively low agreement in the Asian countries. This may be due to the belief among US practitioners that history taking was very thorough and that HIV patients more accepted in society and HIV serostatus readily revealed to the care provider. Alternatively, it could also mean that there was possibly evidence of poor understanding of the universal precautions in that 'all patients be treated as infectious' since disease status could be often unknown. This paradox was apparent present in the United States sample. Therefore, respondents who scored very high on most aspects of IC&S and were consistent with respect to knowledge and practice, but a significant proportion of respondents still lacked understanding of universal precautions (Attitude). There was almost unanimous consensus on implementing a mandatory curriculum IC&S at the dental School level.

Out of the 45 items analyzed for this study that had positive answers indicating better understanding and practices in IC&S, China had the lowest positive response rate out of all eight countries 21 times. Even though the United States had the highest proportion of positive responses for 22 items (where positive response equated to better understanding or practice), the Asian countries sometimes did not have drastically lower response rates.

This study provides information for academicians, health policy professionals and the dental industry on the needs, the perceptions and the level of practice of IC&S in various countries, using responses from the US as a comparative point. Dental care infrastructure requires bolstering in order to increase the knowledge, attitudes, and practices of care providers nationwide. International aid organizations should

prioritize this unmet need to provide a safe, comfortable environment for patients and employees which, ultimately, is of economic and social interest to the United States and all nations. Academic dental institutions in other countries may collaborate with those within the United States to implement proven curricula to enhance present day dental school education and continuing education programs. This study also highlights a ubiquitous flaw in understanding of universal precautions. In the United States and in the Asian countries, stigma against patients with infectious diseases was present where universal precautions and better education should have eliminated such beliefs.

## CONCLUSION

Analyses from this study suggest that the dental infection control knowledge and practice varied widely across the eight countries of interest. Many of the countries were found to have barriers in accessing infection control materials and equipment. Results indicate that all eight countries could have used improved education standards for universal precautions. Also, a mandatory vaccination program for dental healthcare workers was deemed beneficial by respondents, if resources made available. It is apparent that respondents from some Asian countries were deficient in knowledge about infectious diseases, had inadequate access to materials, reprocessing equipment, sterilizable instrument, and had poor vaccination coverage.

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