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RADIATION PROTECTION IN HONG KONG A PERSPECTIVE BASED ON FIVE YEARS' TREND IN OCCUPATIONAL RADIATION MONITORING

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Introduction

Life on earth is exposed to ionising radiation from the natural environment everyday and everywhere. Apart from this background radiation, exposure may arise from various occupational activities in medical services, industry, research and other practices in which sources of ionising radiation are used in Hong Kong. While permitting the beneficial uses of ionising radiation, it is necessary to ensure that the working environment, conditions and procedures as well as the workers' training, practices and culture are adequately controlled so as to minimise the consequential potential adverse health effects to the workers and the general public. The radiological protection system of Hong Kong follows the basic principles of radiological protection promulgated by the International Commission on Radiological Protection (ICRP).[1]

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This paper introduces the regulatory control of radiation exposure in Hong Kong and the various radiological protection services provided by the Department of Health, with special emphasis on occupational radiation monitoring. At the end of the paper, the future challenges faced by the occupational radiation monitoring service are discussed.

Human Exposure to Ionising Radiation

Natural Sources of Radiation

Radiation is ubiquitous. Everyone is exposed to natural radiation. The natural sources of radiation are cosmic rays and naturally occurring radioactive substances existing in the Earth itself and inside the human body. A significant contribution to natural exposure of human is due to radon gas, which emanates from the soil and may concentrate in dwellings. According to the United Nations Scientific Committee on the Effects of Atomic Radiation Report to the General Assembly 2000 (UNSCEAR 2000)[2] the worldwide average annual effective dose from natural sources is 2.4 mSv[+], with a typical range of 1 to 10 mSv.

Radiation Arising from Human Activities

Human activities involving the use of radiation and radioactive substances cause radiation exposure in addition to the natural exposure. Examples are the mining and use of ores containing naturally occurring radioactive substances, nuclear weapons testing, nuclear energy production and use of radioactive substances in industry, agriculture and research. Such human activities generally give rise to exposures that are only a small fraction of the global average level of natural exposure [UNSCEAR 2000].[2]

Medical Use of Radiation

The medical use of radiation is the largest and a growing man-made source of radiation exposure. It includes diagnostic radiology, radiotherapy, nuclear medicine and interventional radiology. The average levels of radiation exposure due to the medical uses of radiation in countries with well-developed health care systems is equivalent to about 50% of the global average level of natural radiation exposure [UNSCEAR 2000].[2]

Radiation from Occupational Activities

Radiation exposure also occurs as a result of occupational activities, e.g. workers in industry, medicine and research using radiation or radioactive substances. The average level of occupational exposures is generally similar to the global average level of natural radiation exposure [UNSCEAR 2000].[2]

Health Effects of Radiation Exposure

Radiation exposure can damage living cells, causing death in some of them and modifying others. Most organs and tissues of the body are not affected by the loss of even considerable number of cells. However if the number lost is large enough, there will be observable harm to organs and may lead to death. Such harm occurs in individuals who are exposed to

[+] mSv is the symbol for the SI unit millisievert. It is a unit of effective dose which represents the total detriment to an individual resulting from an exposure to ionising radiation.

radiation in excess of a threshold level and is classified as a "deterministic effect".[2] Harm to different organs or tissues may exhibit different symptoms. These include erythema and ulceration of the skin, cataract, loss of fertility, depression of the immune system, and in the case of extremely large exposures, breakdown of gastrointestinal and central nervous systems. Deterministic effects are unlikely to occur at exposure levels below about 1 000 mSv.

Other radiation damage may also occur in cells that are not killed but modified. Such damage is usually repaired. If the repair is not perfect, the resulting modification will be transmitted to further cells and may eventually lead to cancer. If the cells modified are those transmitting hereditary information to the descendants of the exposed individual, hereditary disorder may arise. Radiation exposure has been associated with most forms of leukaemia and with cancers of many organs, such as lung, breast and thyroid gland. However, a small addition of radiation exposure would produce an exceedingly small increase in the chance of developing an attributable cancer. Moreover, radiation induced cancer may manifest itself decades after the exposure and does not differ from cancers that arise spontaneously or are attributable to other factors. According to ICRP[1], the risk of fatal cancer from exposure to ionising radiation is estimated to be about 5×10^{-5} per mSv of radiation exposure. Radiation-induced hereditary effects have yet to be detected in human population exposed to radiation, although they are known to occur in other species.

Principles of Radiological Protection

To enable the safe use of sources of radiation or radioactive substances for the benefit of mankind while minimising the potential health detriments to the affected individuals and the occupationally exposed workers, ICRP[1] recommends the following three basic principles of radiological protection.

(a) No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes. [Principle of Justification]

(b) The magnitude of individual doses in relation to any particular source within a practice, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account. [Principle of Optimisation]

(c) The exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. It is to ensure that no individual is exposed to radiation risks that are judged to be unacceptable from these practices in any normal circumstances. [Principle of Dose Limitation and Risk Constraint]

Control of Radiation Exposure in Hong Kong

Regulatory Requirements

To safeguard the health of workers and members of the public from deleterious effects arising from the use of ionising radiations in Hong Kong, the Radiation Ordinance (Cap 303, Laws of Hong Kong)[3]

was enacted in 1957 to control the import, export, possession and use of radioactive substances and irradiating apparatus.

Two subsidiary sets of regulation separately responsible for the control of radioactive substances and irradiating apparatus were subsequently enacted in 1965 to enable a complete system of radiological protection. The system follows the radiological protection principles promulgated by ICRP. In particular,

(a) The principle of justification of radiological practice is applied by means of a licensing system, which provides that subject to such exemptions as may be prescribed, no person shall, except under and in accordance with a licence issued under the Ordinance – manufacture or otherwise produce; or sell or otherwise deal in or with; or have in his possession or use, any radioactive substances or irradiating apparatus. Licence applicant is required to provide justifications for the introduction of a practice if it has not been justified by precedents or if variations from precedents exist.

(b) The principle of optimisation of radiological protection is applied by means of licence assessments, radiological protection requirements under the regulations and conditions of licence, such as safety of workplace, instruments, storage, use and disposal, and health surveillance of workers, etc.

(c) The principle of dose limitation is applied through a prescribed set of dose limits. For the general public, the dose limit is 1 mSv in any calendar year. For persons employed in radiation work, the dose limits are:

(i) 20 mSv in any calendar year in case of whole body, as a result of exposure of whole or part of the body.

(ii) 500 mSv in any calendar year in case of an individual organ or tissue other than lens of eye or any body extremity or area of skin averaged over any 1 cm^2.

(iii) 150 mSv in any calendar year in case of lens of eye.

(iv) 5 mSv in any consecutive three months interval in case of the abdomen of a woman with reproductive capacity.

(v) 1 mSv to the foetus during the pregnancy of woman in case of a pregnant woman.

Compliance with the dose limits for workers is enforced through the requirement of monitoring of radiation exposure of workers, under which the employers are bound by the duty of obtaining and providing radiation monitoring devices of a type approved by the Radiation Board and directing the wearing of these dosimeters by the workers during work.

Exposure to the natural environment and to medical irradiation is outside the jurisdiction of the Ordinance. In the case of exposure to radon in indoor environment, for which the source is amenable to control, the control is provided by the Environmental Protection Department. In the case of medical irradiation, protection of patient exposure

rests with the professionals, whose conduct is regulated under their respective professional registration and disciplinary regulations.

Radiological Protection Services Provided by the Department of Health

The Department of Health provides a spectrum of services to protect public health from exposure to permissible uses of ionising radiation through its Radiation Health Unit (RHU).[4] RHU serves as the executive arm of the Radiation Board which is the statutory authority established for the purpose of the Radiation Ordinance, to enforce the Ordinance and to provide licensing, advisory, health surveillance and monitoring services.

Licensing Service

RHU officers inspect and issue licences to applicants who apply licences for manufacturing, production, sale, dealing in or with, import, convey, possession or use of radioactive substances or irradiating apparatus.

Occupational Radiation Monitoring Service

RHU provides a centralised personnel radiation monitoring service to all radiation workers in Hong Kong. The service includes the provision, on a monthly basis, of radiation dosimeters to the workers who subscribe to the service; the maintenance of the dosimeters; assessment of radiation dose recorded on the dosimeters which the workers carried in the previous month, reporting on the doses and alerting the employer in the event of high doses. It provides a means to monitor the radiation exposure received by workers so that their overall exposure is not only kept within the limits prescribed by law but are maintained at a level as low as reasonably achievable. The details of the service will be discussed in the next section.

Health Surveillance Service

Radiation workers are required by the Radiation Ordinance to be certified fit for the work prior to the employment and subsequently in periods not exceeding 14 months by a Medical Panel of the Radiation Board. RHU coordinates the examination, processes the fitness certificates and maintains the record of these medical examinations.

Radiation Dosimetry Calibration Service

RHU provides standard calibration service for reference radiation dosimetry instruments in Hong Kong in accordance with applicable national/international standards at prescribed intervals so that these instruments will serve as reference instruments for other field instruments. This enables a proper chain of traceability in radiation dosimetry measurements.

Advisory Service

RHU stands to provide advice and services which would lead to an overall reduction in radiation exposure to workers and the public. Generally RHU advises on quality assurance and shielding of medical and dental X-ray installations, radioactive waste management and emergency response actions in radiological incidents. It also provides technical input in the production of public education material on ionising radiations and advises on radiation protection in relation to use of radioactive substances in everyday life.

Occupational Radiation Monitoring

Monitoring Requirements

Occupational radiation monitoring is a statutory requirement prescribed by the Radiation Ordinance. Employers of persons who are employed to work in the proximity of irradiating apparatus or to handle or transport unsealed radioactive substances are required to obtain and to direct the wearing of radiation monitoring devices of a type approved by the Radiation Board. Each and every party involved in the occupational radiation monitoring programme, including the employer, the employee and the approved laboratory that provides the monitoring device, should have the duty to ensure the integrity of the monitoring programme and the monitoring records, as these could be used as evidence in court as proof of compliance with the regulations. It is therefore required that the approved monitoring device should be reasonably inert to environmental conditions, such as temperature and humidity, suitable for the purposes of the measurement, accurately calibrated and preferably passive to the worker so that manipulation and interference could be minimised. The employer and workers should have the duty of ensuring that the devices are properly kept while they are not in use, properly worn when the workers are undertaking radiation work, and the allocation and other conditions affecting the chain of evidence are properly documented.

The Approved Type of Monitoring Device

RHU provides a centralised monitoring service in Hong Kong. The service is based on thermoluminescent dosimeters (TLD), which is a type of monitoring device approved by the Radiation Board. TLD works on the physical phenomenon that electrons produced by the ionisation of a crystalline media could be trapped in meta-stable energy states created by impurities in an imperfect crystal structure. Some of these trapped electrons would remain in the meta-stable state for a sufficiently long duration under suitable environmental conditions, and could be released by heating with the emission of light. The amount of light emission under a controlled process of heating after exposure to radiation can be calibrated to indicate the amount of radiation dose received.[5] The TL material adopted by RHU's Radiation Monitoring Service is lithium fluoride. It has the advantage of being almost tissue equivalent, quite stable under ambient conditions, reusable and thus cost effective and its performance is good in terms of dose-response linearity, relative energy dependence and sensitivity to low doses.[6,7] Under suitable conditions, radiation doses as low as 0.01 mSv can be detected with reasonable confidence. The dosimeter may comprise several detector elements in a holder that provides different shielding over different elements so that the energy of the radiation can be estimated based on suitable calibration and a dose assessment algorithm.

Compatibility with Dose Limits

There are various components in the statutory dose limits. They include limit on effective dose to the whole body, which limits the probability of long term health effects such as cancer induction; and equivalent dose limit to the extremities, which limits the occurrence of acute health effects, such as skin ulceration. For most work situations where high energy radiation is used or where the workers are likely to be exposed uniformly throughout the whole body, the wearing of a whole body dosimeter (WBD) as shown in Figure 1a will normally suffice.

In some special type of work situation in which the hands and fingers are more likely to be exposed than the body trunk, such as in the handling of low energy sources or collimated sources of radiation, monitoring of the finger dose by the wearing of an extremity dosimeter (ED) as shown in Figure 1b is appropriate.

WBD should be worn on the body trunk (between neck and waist) with the name tag facing towards the user.[4] In case that doses are likely to be significant, such as in interventional radiology, two WBD are sometimes used, one under the lead apron and the other outside. The outside dosimeter is to assess the contribution to the effective dose of irradiation of unshielded parts of the body. If doses are low and individual monitoring is only intended to give an upper estimate of exposure, single WBD may be worn outside the apron.[2] ED should be worn under glove to avoid contamination by the open source.[4]

Five Years' Trend in Occupational Radiation Monitoring

Choice of Period of Study

Occupational radiation monitoring has been available in Hong Kong since about 1966. The monitoring service was then provided by the Queen Elizabeth Hospital (QEH) and the radiation monitoring device was based on the film badge. RHU took over the running of the service from the QEH starting in August 1982 and migrated the monitoring technology to TLD in October 1984. The mainstream monitoring target has always been the whole body effective radiation dose received by workers. In view of the increasing trend in recent years of work involving the preparation and use of radiopharmaceuticals and practice of interventional radiology, cardiac catheterisation and other X-ray image guided surgery operations, whereby the hands and fingers of the practitioners are

Figure 1a

Radiation Dosimetry Elements in a Bar-coded Aluminium Frame for Individual Identification (left) and Holder with Filters (right) of Whole Body Dosimeter

Figure 1b

Extremity Dosimeter Elements with Bar-coded Identification in a Ring Holder for Measurement of Radiation Exposure at the Finger

more likely to be exposed to a much higher level of radiation dose than their bodies, RHU introduced the extremity radiation monitoring service in October 2003. Hence to take advantage of the availability of both whole body and extremity monitoring data since 2003, this study will examine the trend in the occupational radiation exposure in the years 2003 to 2007.

Number of Monitored Workers

The number of workers participating in the separate whole body monitoring (WBM) and extremity monitoring (EM) programmes in 2003 to 2007 is presented in Figure 2. It can be seen that in contrast to the ever increasing trend in the number of WBM workers in the pre-2003 era, there has been a decrease in the number of WBM workers until 2005 probably due to the recession in economy. A total of over 7 500 workers have been subscribing to the service. In contrary, the number of EM workers has been increasing all the time and the increase has been 139% from 2003 to 2007. A total of 153 subscribed to EM in 2007.

Measurable Dose

An analysis of the dose record shows that while every EM workers have a measurable extremity dose, only a small fraction of the WBM workers have actually received a non-zero dose. As illustrated in Figure 3, over 60% to 81% of the WBM workers in the period 2003 to 2007 did not have a measurable radiation dose. This is a reassuring finding, as the whole body dose is an indicator of the long term health effects to the workers. The large proportion of workers without a

Figure 2 **Number of Workers Subscribing to Whole Body and Extremity Monitoring**

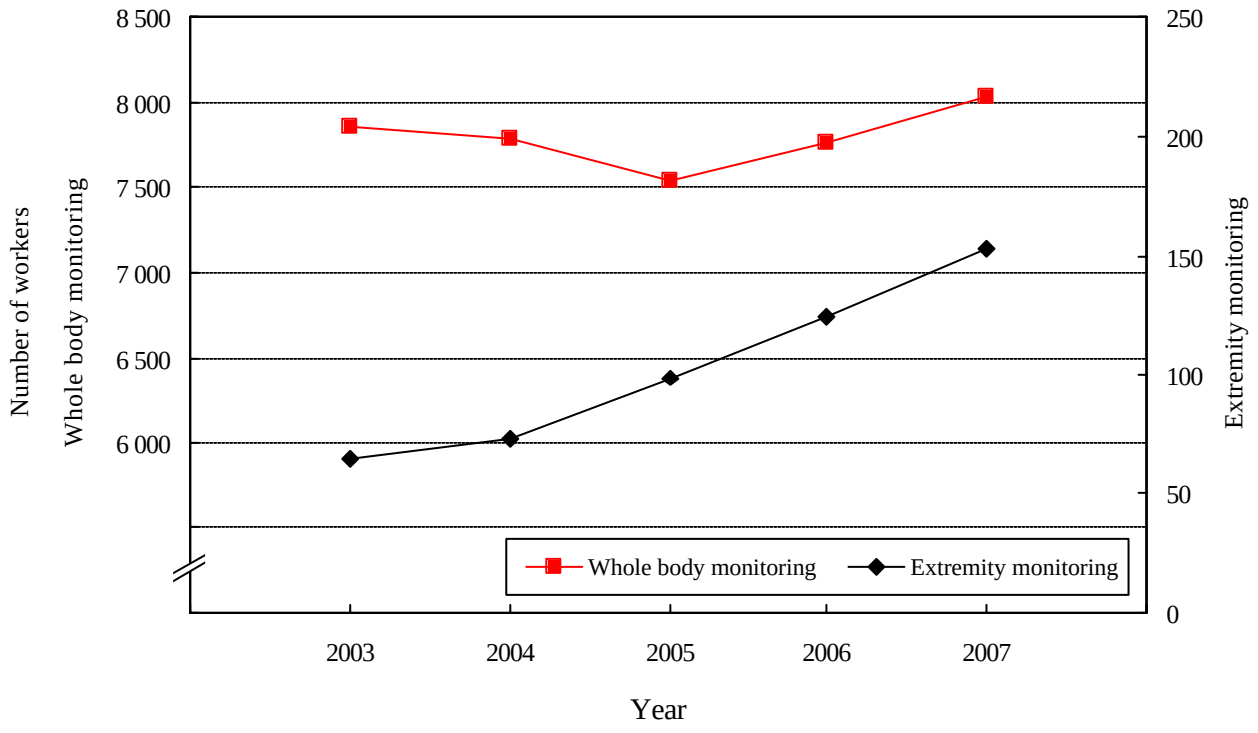


Figure 3 Number of Workers Receiving Whole Body Monitoring and Number of Workers Having a Measurable Dose

measurable radiation dose also reflects that the system of radiation protection has been effective in ensuring that the workers are not likely to be exposed during work. It also demonstrates that good practices have been maintained by the workers.

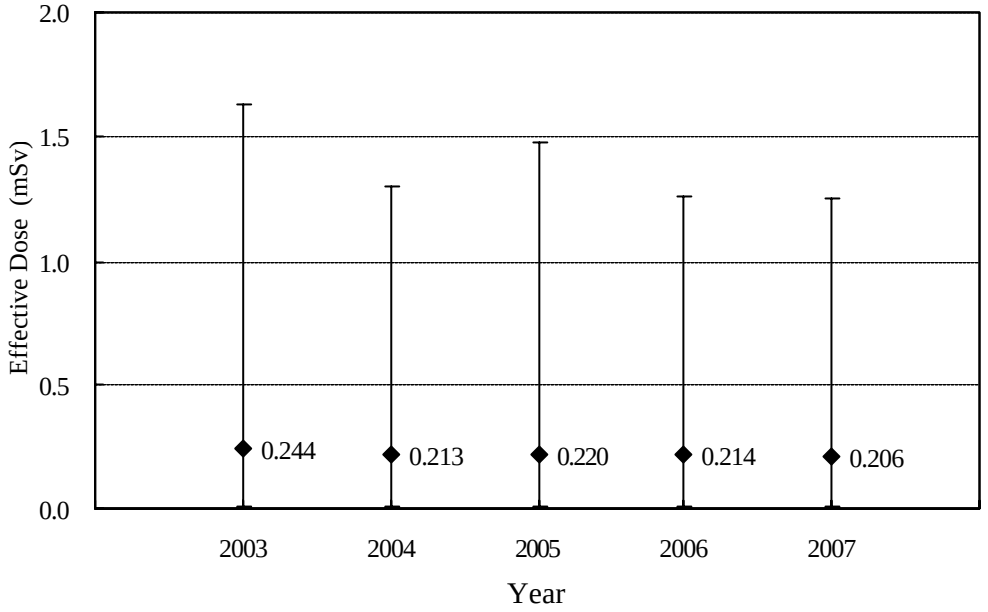
Average Annual Measurable Occupational Dose per Worker

For those workers with measurable annual radiation exposure in the period 2003 to 2007, their overall average annual effective dose to the whole body and average annual equivalent dose to the extremities are presented in Figures 4a and 4b respectively. It can be seen that the average annual effective whole body dose has been decreasing from 0.244 mSv in 2003 to 0.206 mSv in 2007. The overall average effective dose over the period 2003 to 2007 was 0.220 mSv. This is comparable to the dose level of Australia[^] (0.274 mSv), and lower than the level of other countries, such as Canada[^] (1.470 mSv), USA[^] (1.117 mSv) and China[^] (1.592 mSv). This average effective dose to the whole body is also well below the corresponding limit of 20 mSv prescribed by the Radiation Ordinance.

The behaviour of the average annual equivalent dose to the extremities was more erratic. However, it can be observed

[^] The data of Australia, Canada and China are averaged over 1990 to 1994 while data of USA is averaged over 1985 to 1989. These occupation dose values include those from medical uses, industrial uses and miscellaneous uses only except that data of miscellaneous uses for China is not available. Dose contributed from nuclear fuel cycle, natural sources and defence activities are excluded for easy comparison with the corresponding value of Hong Kong, source of data come from UNSCEAR 2000 Report to the General Assembly, Vol. 1, Annex E.[2]

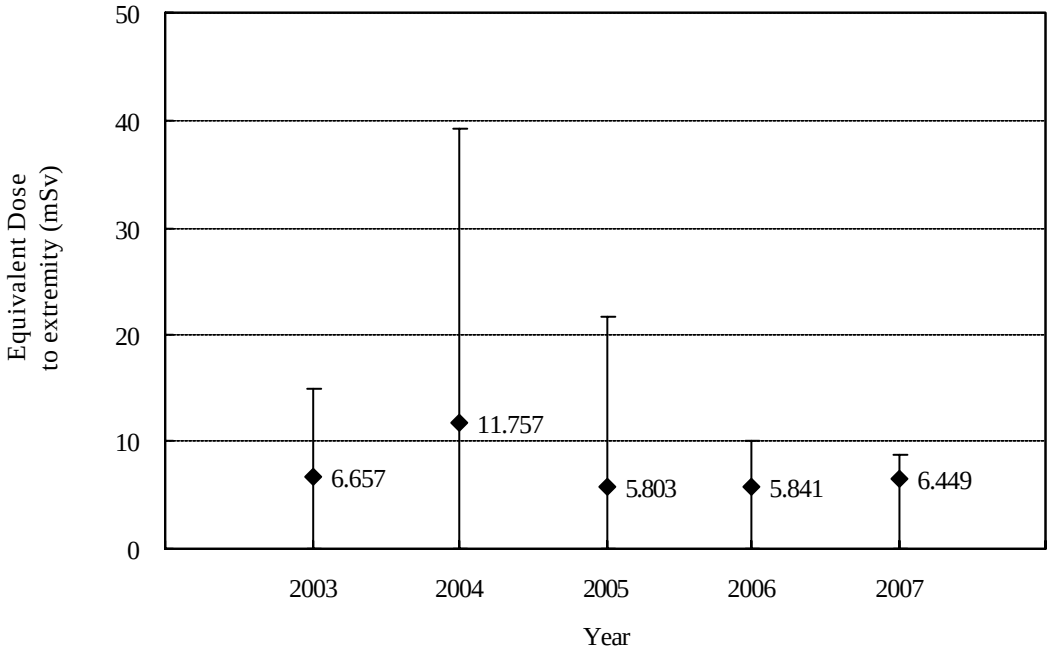
Figure 4a Annual Average Measureable Dose for Whole Body Monitoring



Average dose over five years = 0.220 mSv

Note: The straight line bar represents the range of effective dose among the middle 95% of the monitored group who get a measurable whole body dose.

Figure 4b Annual Average Measureable Dose for Extremity Monitoring



Average dose over five years = 7.301 mSv

Note: The straight line bar represents the range of equivalent dose among the middle 85% of the monitored group who get a measurable extremity dose. A smaller range is taken as compared to Figure 4a to take account of the smaller population size of the group.

that in general, the average extremity dose varied from 5.803 mSv to 6.657 mSv only with the exception of 11.757 mSv in 2004. The exception in 2004 was caused by two extreme dose values in a small population of 73 monitored workers. The overall average equivalent dose to the extremities in 2003 to 2007 was 7.301 mSv. Comparable extremity monitoring information is not available in other countries. Nonetheless it is reassuring that the average equivalent dose to the extremities has been small compared with the corresponding limit of 500 mSv prescribed by the Ordinance. Given the fact that professionals in medical services have to work with their hands sometimes in close proximity to radiation fields and that the extremity dose, being an indicator of acute effects, actually confirms that such effects should have been totally avoided, the result has been reassuring. The remaining consideration is whether this extremity exposure has been optimised or whether further reduction can be achieved under the overall optimisation framework and the prevailing social economic conditions.

Dose Distribution

An analysis of the distribution of effective whole body dose and equivalent extremity dose in representative dose ranges over the period 2003 to 2007 is presented in Figures 5a and 5b respectively. For the average effective whole body dose distribution, it can be seen that above three-quarters of the workers' population have kept their dose consistently at or below 0.2 mSv or 1% of the statutory limit. At the other end, only less than 1% of the workers' population has received an annual dose exceeding 6 mSv, which is the dose

Figure 5a Distribution of Average Effective Whole Body Dose in 2003 to 2007

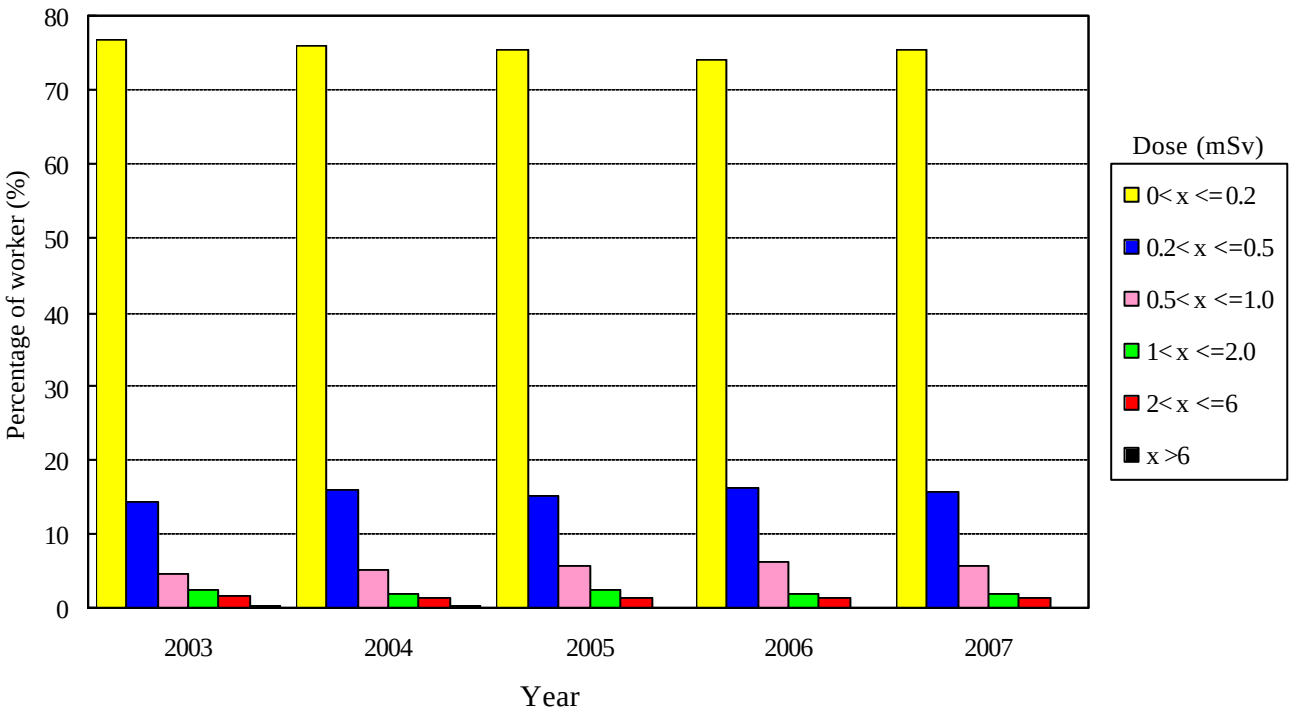
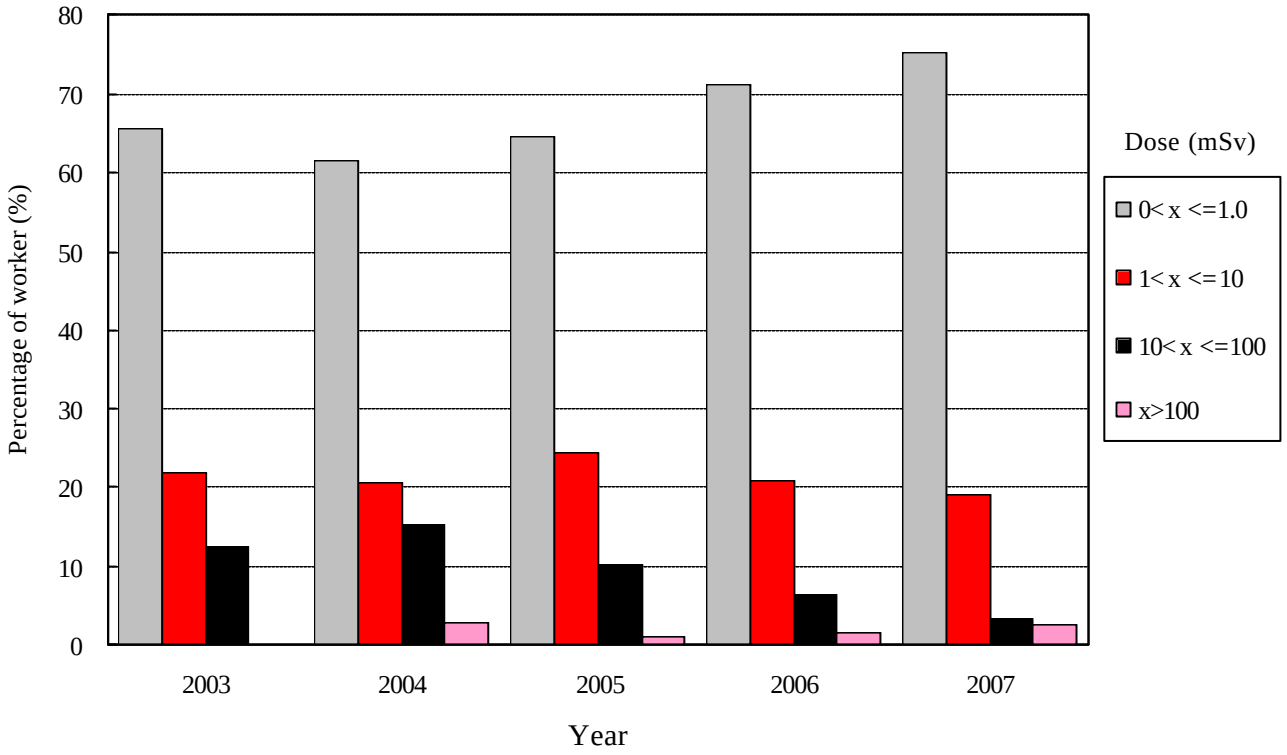


Figure 5b **Distribution of Average Equivalent Extremity Dose in 2003 to 2007**



level indicative of the requirement of health surveillance. For the average equivalent extremity dose distribution, it can be seen that over 60% of the workers' population have kept their dose consistently at or below 1 mSv or 0.2% of the statutory limit. Less than 3% of the workers' population has actually received an annual dose exceeding 20% of the limit. The increasing demand of the service also indicates that provision of the service by RHU is necessary and should be continued.

Future Challenges

Meeting the Demand for Extremity Monitoring

Notwithstanding the fact that significant effort has been given to automation of dosimeter processing and dose analysis, the processing of extremity monitoring dosimeters is still an extremely labour intensive operation. It is also technically challenging to ensure the high level of accuracy and to maintain the integrity of the monitoring programme. On the other hand, it is evident that the use of advanced medical imaging and treatment modalities has called for a wider application of radiation and radioactive substances in medical services so that the demand for extremity monitoring will continue to rise in the foreseeable future. Every effort would be given to ensure that the increasing demand will be adequately met so that every worker who is eligible for the monitoring service is provided with the service.

Updating the Monitoring Technology

Ever since 1982 when RHU took over the radiation monitoring services, RHU has

been vigilant of international developments in the field of monitoring technologies. This has resulted in the replacement of the film badge with TLD as the monitoring device in 1984 ahead of many countries including Singapore and UK. Although other comparable monitoring technologies, such as optically stimulated luminescent dosimeters, have been available in the market, TLD is still considered as a cost-effective, reliable and proven technology for occupational radiation monitoring purposes. Nonetheless RHU will maintain a vigilant eye on international developments and assess the suitability of the various technologies for the best interest of the workers who are subscribing to the service.

Optimisation of Protection

Given that the introduction of radiological practices are required to be properly justified and the dose to the affected workers are subject to limits, the main thrust of radiological protection efforts is to be given to the optimisation of protection, with social and economic considerations taken into account. Occupational radiation monitoring results will continue to serve as one of the major indicators for the assessment of the effectiveness of the optimisation efforts.

Conclusion

Ionising radiation has useful applications in our daily life. Radiation protection becomes one of the important aspects in occupational safety. Apart from providing sufficient protection measures to the workers, routine monitoring of the personal dose and cumulative dose also help to safeguard the workers' health. Until the end of 2007, there were more than 8 000 workers in Hong Kong subscribing the monitoring service from RHU. The annual average measurable dose over the past five years is 0.22 mSv which is a relatively low level when compared with other countries like Australia, Canada, US and China.[2] For several sporadic cases with reported dose as high as 6 mSv or above, their levels are still well below the occupational dose limit of 20 mSv. However, precaution should be taken to ensure that occupational exposures are kept to "as low as reasonably achievable".

References

1. International Commission on Radiological Protection. 1990 Recommendations of the International Commission on Radiological Protection. ICRP Publication. Vol. 21, No. 1-3. (Oxford: Pergamon Press) (1990).
2. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and effectives of ionizing radiation. United Nations Scientific Committee on the Effects of Atomic Radiation, 2000 Report to the General Assembly, with scientific annexes, Volume I, United Nations Sales Publication (NY: United Nations) (2000).
3. Radiation Ordinance (Chapter 303, Law of Hong Kong).
4. Radiation Health Unit, Department of Health. Online at: *www.info.gov.hk/dh-rhu*.
5. K Mahesh, P S Weng, C Furetta. Thermoluminescence in Solids and its Applications. Nuclear Technology Publishing. UK. (1989).
6. International Atomic Energy Agency (IAEA). Practical radiation technical manual – individual monitoring. Vienna. (2004).
7. Nondestructive Testing resource center. Online at: *www.ndt-ed.org/EducationResources/CommunityCollege/RadiationSafety/radiation_safety_equipment/thermoluminescent.htm*.

PROMOTING ORAL HEALTH IN ADULTS 2003 TO 2008

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Background

The most prevalent dental diseases in man are dental caries (tooth decay) and periodontal disease (gum disease). Dental caries is the dissolution of minerals from the tooth by the plaque acid. This acid is the metabolic product of dietary sugar by the plaque bacteria adhered on the tooth surfaces. However, mineral repair of caries can be promoted in a fluoridated oral environment maintained by low level of fluoride.[1] Hence, the caries process is a dynamic see-saw between acid dissolution and repair. The reduction of frequency of dietary sugar in snacks and beverages may be sufficient to enable repair to prevail over acid dissolution, especially if fluoride from water and/or toothpaste is available.[2] Periodontal disease is the destruction of the supporting tissues of the tooth by the toxic products of the plaque bacteria around the gingive (gums). Such destruction is initially manifested as gingivitis (gingival inflammation) which, if unattended, can progress to the loss of the supporting bone forming a periodontal pocket. While gingivitis can be reversed by effective oral hygiene, bone loss can only be retarded by a combination of personal hygiene and professional treatment.

Daily toothbrushing and flossing of teeth significantly decrease the abundance of microbial species associated with periodontal disease and dental caries.[3] As most people are unable to achieve adequate plaque control by brushing once daily, therefore, toothbrushing twice daily is recommended.[4] The dental plaque can become calcified to form calculus causing plaque stagnation. Regular professional teeth cleaning of these disease sites is necessary.[5] Annual dental check-up for early detection and treatment of diseases is also advisable. In sum, dental caries and periodontal disease, though prevalent, are preventable by maintaining simple oral care habits. Of these reduction of snacking frequency, adequate oral hygiene comprising toothbrushing with fluoridated toothpaste and flossing; and annual check-up with professional teeth cleaning are of paramount importance.

Oral Health Survey 2001

In Hong Kong, according to the Oral Health Survey 2001[6], there had been marked caries reduction since the introduction of fluoride use.[7-9] However, the periodontal condition of the adults still needs improvement. Only 0.7% of the Hong Kong adults aged 35 to 44 had healthy periodontium. Thirty-nine percent of them had shallow periodontal pockets of 4 to 5 mm deep and 7% had deep pockets of ≥6 mm. Most of them did not have proper oral care. Only 26.3% of them visited dentists regularly. Though around 99% brushed their teeth daily in the morning and 75% did so before bed, only 10.7% used dental floss daily, denoting that majority of the population left out half of their tooth surfaces not cleaned. This was

For toothbrushing and flossing techniques, please visit *www.toothclub.gov.hk.*

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compatible with the fact that one third of them did not know any preventive methods of periodontal disease. In order to reach the adult population in an efficient manner, publicity campaigns were utilised as the intervention measures. Publicity campaigns through mass media had been found effective in arousing awareness and enhancing knowledge in tobacco control[10], community antibiotic use education[11], and dental health education.[12]

Love Teeth Campaigns

Annual publicity campaign named Love Teeth Campaign has been carried out since 2002/03 aiming to improve the periodontal condition in the adult population aged 15 to 64. Its primary objective was to promote the use of dental floss and secondary objective, to educate them on the preventive measures for periodontal disease.

The six campaigns since 2002/03 focused on increasing the awareness that everyone is at risk of getting periodontal disease, creating an attitude of care towards healthy gums and teeth in the prevention of periodontal disease, promoting the use of dental floss and increasing the utilisation of dental service.

The campaigns were executed in two distinct bursts of mass media publicity activities. The first burst was usually a high profile launch of the new theme in September to October. In this phase, Announcements in Public Interest of 30-second duration were broadcasted in all TV and radio channels, and sometimes in Mass Transit Railway (MTR) trackside TV, Roadshow or M-channel TV screens. In three years, celebrities were endorsed to appear in the APIs. Large poster sites of the public buses and railway lines were employed to create awareness. In some years, a one-off 30-minute TV and radio programmes had been sponsored to help launch the campaigns. They are then followed by some low profile maintenance activities which included posters in residential blocks, public libraries, clinics, and supermarkets; newspaper advertorials, leaflets directly mailed home or distributed through various outlets, VCDs distributed at supermarkets, and webpage with and without online game. The campaigns were normally concluded with a high profile closing in February to March of the following year.

Campaigns Evaluation

Cross-sectional telephone interview surveys were conducted to evaluate the effectiveness of the Love Teeth Campaigns. Each year, three surveys were carried out: a pre-campaign baseline survey and two post-campaign surveys corresponding to one month after the two high profile bursts. For each survey, telephone calls were made to households whose telephone numbers were randomly generated. At least 1 000 adult subjects aged 15 to 64 with their last birthdays closest to the date of interview were recruited to successfully complete a pre-set questionnaire by trained interviewers. The response rate ranged from 54% to 81%. The content of the survey included information on the awareness of campaign and campaign messages, the respondent's oral care habits, their knowledge and attitude on periodontal disease and dental caries, their dental service utilisation habits and their demographic background. Data of each survey were analysed with demographic background as the independent variables. Data of the three surveys within the year were compared to demonstrate the Campaign effectiveness. Longitudinal tracking of data on oral care habits and

knowledge of periodontal disease was also carried out using the same questions throughout the six campaigns.

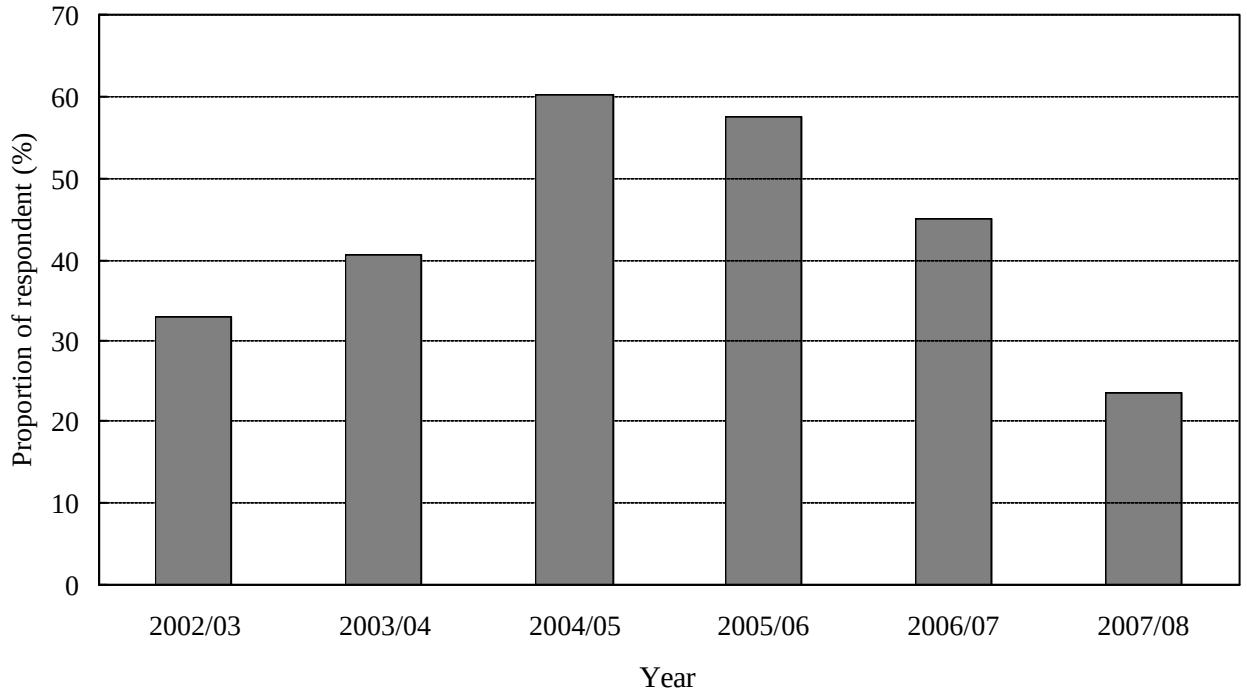
Effectiveness of Love Teeth Campaigns

Six years of evaluation data have provided indicators of campaign effectiveness in terms of behavioural and knowledge changes achieved. Information on the trends and media strategies were also available.[13-18]

Awareness of Campaigns

There had been good awareness of all the Love Teeth Campaigns. Despite the variation year by year, the respondents indicated that they had heard or seen the campaign materials released by the Department of Health, disregarding the channels of communication (Figure 1) ranged from 24% to 60%. The apparent downward trend in awareness in the last three years was worthy of further investigation. However, it was interesting to note that the endorsement of celebrities did not necessarily enhance the awareness of the campaigns, which was contrary to the popular perception. Majority of the respondents (60% to 80%) thought that their knowledge on the campaign objectives was enhanced, and that it was worthwhile for the government to organise these campaigns. Many would like to have more oral health promotional activities.

Figure 1 Awareness of the Love Teeth Campaigns 2002/03 to 2007/08



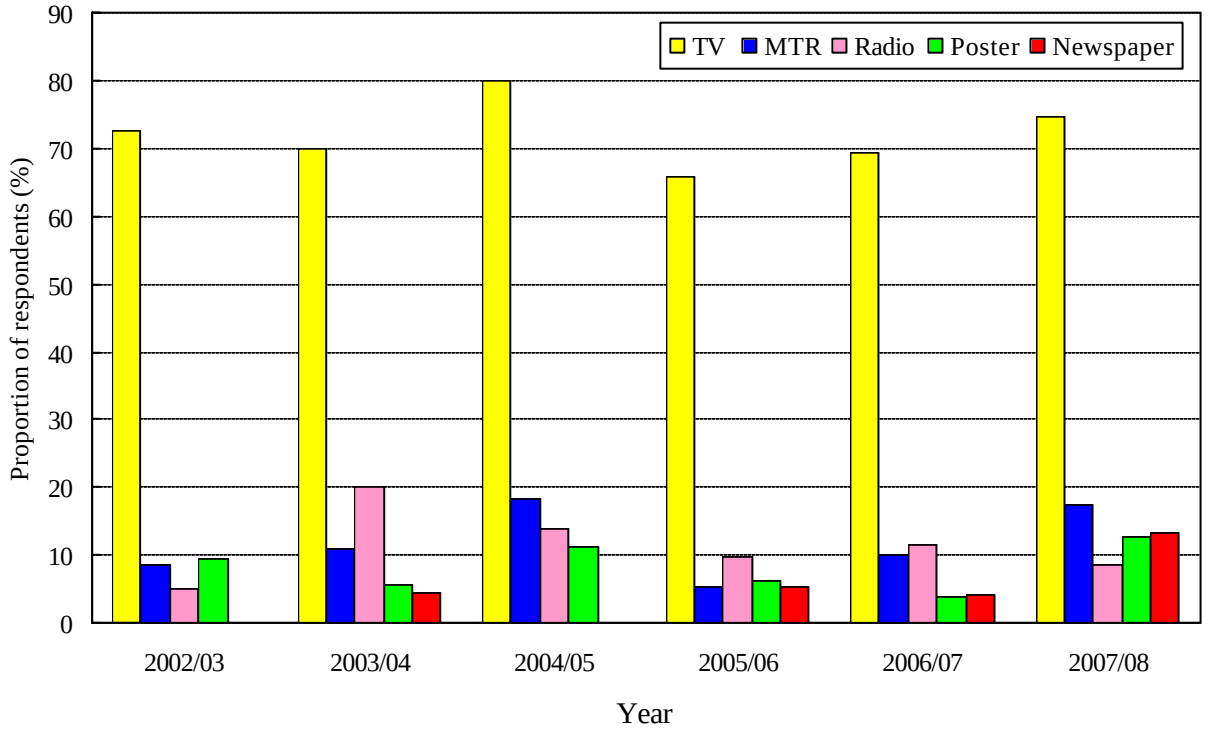
Awareness Channels

Figure 2 shows the top most popular media by which the Campaigns were recalled. They were TV, MTR, radio, posters and newspapers. TV was clearly the single medium of communication with the most effective reach. Throughout the years, 65% to 80% of the surveyed subjects recalled that their awareness of the Love Teeth Campaigns was through the TV channel. Though MTR and radio ranked second, their reach (10% to 20%) was unparallel to that of TV. On close examination, MTR was slightly better than radio as an advertising channel. The free newspapers was found to be one of the effective channels of communication for the adult population.

Knowledge Change

Efforts in educating the public on the knowledge about the causes, signs and symptoms of periodontal disease, and its preventive measures had been variably accomplished. Though not all messages on knowledge were conveyed through successfully in the Campaigns, the proportion of people mentioning signs of periodontal disease were: red and swollen gum margins increased by 18% ($p<0.001$), gums bleed easily on toothbrushing by 11% ($p<0.001$) and bad breath by 3% ($p=0.02$); noticing that accumulation of dental plaque could cause periodontal disease increased by 16% ($p<0.001$) and knowing the use of dental floss as a preventive measure of periodontal disease

Figure 2 Top Five Media by which the Love Teeth Campaigns were Recalled 2002/03 to 2007/08



increased by 26% ($p<0.001$) over the six years (Figure 3).

Behavioural Change

Three oral care behaviour conducive to the prevention of periodontal disease were promoted and tracked longitudinally. They are the daily use of dental floss, toothbrushing and annual dental check-up/ professional teeth cleaning. All these behaviour were demonstrated to have an improvement over the past six years.

Use of Dental Floss Daily

The use of dental floss has steadily increased from 13.7% to 22.8% ($p<0.001$) over the years (Table 1). Female, middle-aged, highly educated and high income people were more likely to adopt the daily flossing habit. More people had tried to use floss, and fewer said that they had never flossed their teeth (35.6% in 2007/08, as compared to 71.8% in 2002/03).

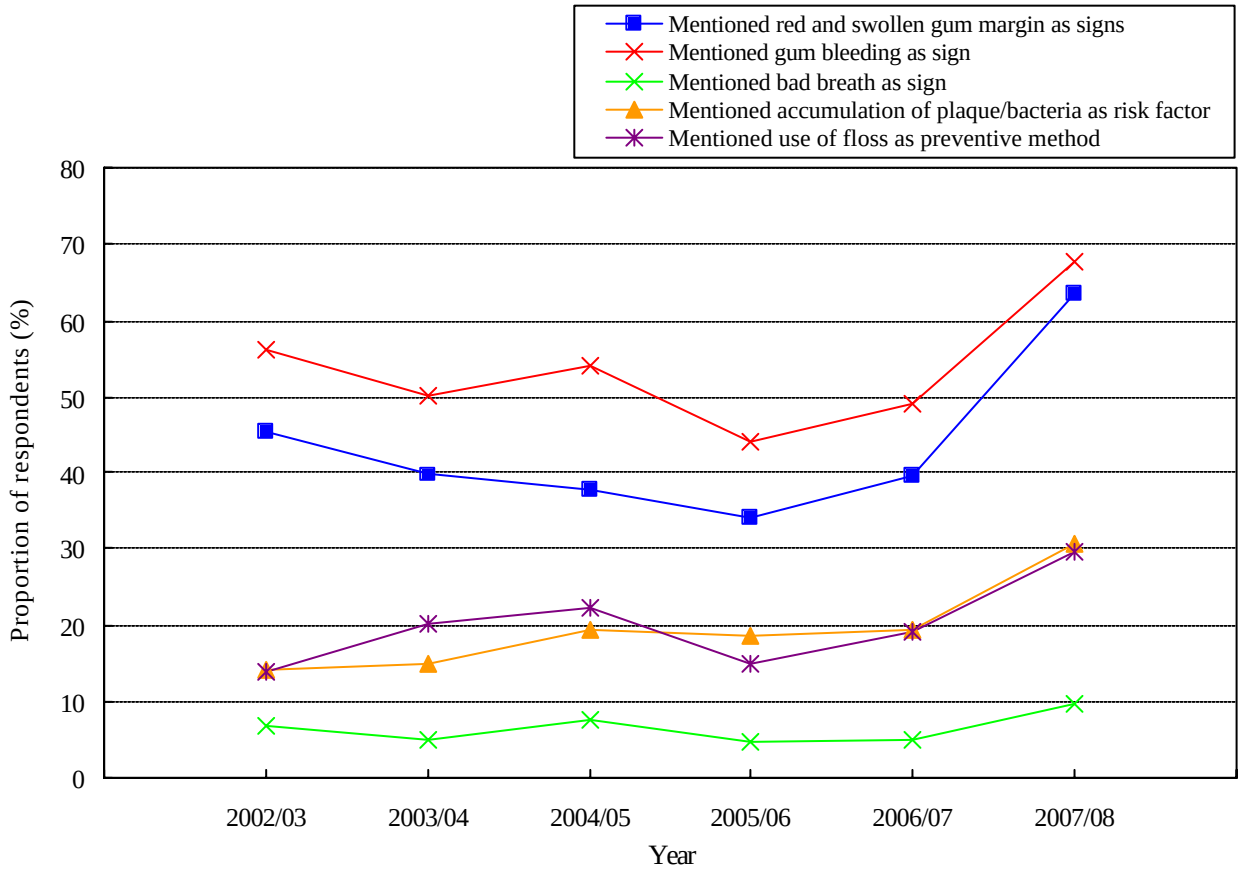
Toothbrushing Twice Daily

There was a significant increase in the proportion of adults brushing twice or more daily from 88.8% in 2005/06 to 93.0% in 2007/08 ($p<0.01$) (Table 1).

Annual Dental Check-up/Professional Teeth Cleaning

Respondents reported to have sought regular annual dental checkup/professional

Figure 3 Proportion of Adults with Appropriate Knowledge on Signs, Risk Factors and Prevention Method of Periodontal Disease 2002/03 to 2007/08



teeth cleaning had increased from 37.7% in 2002/03 to 53.8% in 2007/08 (Table 1). This is more than double the regular visitors among the 35 to 44 years-old group (<25%) in 1994.[19] This behaviour shift was significantly found among the middle-aged, highly educated and high income groups.

Insights

The Love Teeth Campaigns were evidently effective in giving knowledge and shaping behavioural change over a medium long period of six years. Overall, over 40% of the population was aware of the campaigns with all three parameters of oral care behaviour showed increased uptake. Careful study of the data revealed that the early adopters of behavioural change in flossing and annual dental check-up/ professional teeth cleaning were the middle-aged with high education and high income. This group of people was known to have high health awareness. These results are pioneer findings in oral health promotion through mass media campaigns. Up until 2000, mass media programmes had not been shown effective in promoting oral health though they were recognised to cause some knowledge gain.[20]

Despite the positive changes in awareness, knowledge and behaviour over the years, there was a relapse observed in the baseline data every year. These data were collected after a 6-month silent period following the second campaign burst of the previous year. It is obvious that the public needs to be reminded repeatedly. The Love Teeth Campaigns needs to continue in order that the changed behaviour be sustained.

The Love Teeth Campaigns were shown to have effected a push factor for the improvement in the uptake of toothbrushing, flossing and annual dental visit/professional teeth cleaning. Though our adults' oral hygiene habits are generally better than those of Denmark[21], they are about the 1994 Canadian level[22]

Table 1 Proportion of Adults with the Habit of Toothbrushing Twice or More Daily, Using Dental Floss Daily and Annual Dental Checkup/Professional Teeth Cleaning 2002/03 to 2007/08

	Year of Survey					
	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Toothbrushing twice or more daily (%)	-	-	-	88.8	92.3	93.0
Use of dental floss daily (%)	13.7	18.0	-	20.1	24.2	22.8
Annual dental checkup/ professional teeth cleaning (%)	37.7	45.3	-	46.5	52.5	53.8

(Table 2). There is a 14 years gap to catch up. The poor use of flossing and annual dental check-up should be our particular focus.

On the other hand, whether the behavioural changes have brought about positive impact on oral health is not known. The Love Teeth Campaigns evaluation was limited to the measure of habits change but not the periodontal health impact. Any measurement of oral health impact will have to wait until the next territory-wide oral health survey. Table 3 shows that although our adult periodontal status is not as severe (7% with deep pockets) as the rest of the world, we are among the group with 90% suffering from the mild (50% with bleeding and calculus) and moderate (39% with shallow pockets) forms of periodontal disease.[6,23] This figure alone warrants many more years of promotion work or rather many years of concerted effort of the dental profession in order to make a significant health impact.

Conclusion

The Love Teeth Campaigns demonstrated their worthiness in achieving positive behavioural and knowledge changes in the target. They also shed light on what communication channels are appropriate to reach the adult population. We should keep the Love Teeth Campaigns in momentum and our experience has given us the confidence to continue successfully. The campaigns aim to increase the oral health knowledge and behaviour further. They must also carry the mission to meet the greater challenge of producing oral health gain in our adults.

Table 2 Comparison of Oral Health Habits among Adults in Canada, Denmark and Hong Kong

	Canada (North York)	Denmark	Hong Kong
Year published	1994	2003	2008
Age of subjects	≥18	≥16	15-64
Toothbrushing once daily (%)	96	100	-
Toothbrushing twice daily (%)	-	68	93
Flossing daily (%)	22	11	23
Annual dental visit (%)	69	-	54

Table 3 Periodontal Status of 35 to 44 years-old Population of Hong Kong and Worldwide

	Hong Kong (%)	Worldwide (%)
Bleeding and calculus	50	30-60
Shallow periodontal pockets	39	26-40
Deep periodontal pockets	7	10-15

References

1. World Health Organization. Fluorides and oral health. WHO Technical Report Series No. 846. Geneva: World Health Organization, 1994.
2. Levine R, Stillman-Lowe C. The scientific basis of dental health education. A Policy Document. Health Education Authority, UK 2004.
3. Corby PM, Biesbrock A, Bartiizek R, Corby AL, Monteverde R, Ceschin R, Bretz WA. Treatment outcomes of dental flossing in twins: molecular analysis of the interproximal microflora. Journal of Periodontology Aug 2008; 79(8): 1426-1433.
4. Attin T, Hornecker E. Tooth brushing and oral health: how frequently and when should tooth brushing be performed? Oral Health and Preventive Dentistry 2005; 3(3): 135-140.
5. Brothwell DJ, Jutai DKG, Hawkins RJ. An update of mechanical oral hygiene practices: evidence-based recommendations for disease prevention. Research Journal April 2008; 64(4): 295-306.
6. Department of Health. Oral Health Survey 2001. Hong Kong: Department of Health; 2002.
7. Wong KK. Report on a dental survey in Hong Kong 1968. Hong Kong: World Health Organization and Hong Kong Government, 1968.
8. Lind OP, Holmgren CJ, Evans RW, Corbet EF, Lim LP, Davies WIR. Hong Kong survey of adult oral health. I. Clinical findings. Community Dental Health 1987; 4: 351-66.
9. Lo ECM, Schwarz E. Tooth and root conditions in the middle-aged and the elderly in Hong Kong. Community Dentistry and Oral Epidemiology 1994; 22: 381-5.
10. Bala M, Strzeszynski L, Cahill K. Mass media interventions for smoking cessation in adults. Cochrane Database Systematic Reviews 2008 Jan 23; (1): CD004704.
11. Gonzales R, Corbett KK, Wong S, Glazner JE, Deas A, Leeman-Castillo B, Maselli JH, Sebert-Kuhlmann A, Wigton RS, Flores E, Kafadar K. "Get smart Colorado": impact of a mass media campaign to improve community antibiotic use. Med Care. 2008 Jun; 46(6): 597-605.
12. Mlrtensson C, Söderfeldt B, Andersson P, Halling A, Renvert S. Factors behind change in knowledge after a mass media campaign targeting periodontitis. International Journal of Dental Hygiene 2006; 4(1): 8-14.
13. Oral Health Education Unit. A survey of Effectiveness of Oral Health Publicity Campaign 2002/2003. Hong Kong: Quality Evaluation Centre, City University of Hong Kong; 2003.
14. Oral Health Education Unit. A survey of Effectiveness of Love Teeth Campaign 2003/2004. Hong Kong: Quality Evaluation Centre, City University of Hong Kong; 2004.
15. Oral Health Education Unit. Love Teeth Campaign 2004-05 Effectiveness Evaluation Survey. Lau JTF, Centre for Epidemiology and Biostatistics, School of Public Health, Faculty of Medicine, The Chinese University of Hong Kong; 2005.
16. Oral Health Education Unit. A survey of Effectiveness of Love Teeth Campaign 2005-06. Hong Kong: Quality Evaluation Centre, City University of Hong Kong; 2006.
17. Oral Health Education Unit. A survey of Effectiveness of Love Teeth Campaign 2006-07. Hong Kong: Quality Evaluation Centre, City University of Hong Kong; 2008.
18. Oral Health Education Unit . Survey on the Effectiveness of Love Teeth Campaign 2007-08. Lau JTF, Centre for Epidemiology and Biostatistics, School of Public Health, Faculty of Medicine, The Chinese University of Hong Kong; (in press).
19. Schwarz E, Lo ECM. Use of dental services by the middle-aged and the elderly in Hong Kong. Community Dentistry and Oral Epidemiology 1994; 22: 374-380.
20. Kay E, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. Community Dental Health 1998; 15(3): 132-144.
21. Christensen LB, Peterson PE, Krustrup U, Kjrller M. Self-reported oral hygiene practices among adults in Denmark. Community Dental Health December 2003; 20(4): 229-235.
22. Payne BK, Locker D. Preventive oral health behaviors in a multi-cultural population: the North York Oral Health Promotion Survey. Journal of Canadian Dental Association February 1994; 60(2): 129-130, 133-139.
23. Peterson PE, Ogawa H. Strengthening the prevention of periodontal disease: the WHO approach. Journal of Periodontology December 2005; 76(12): 2187-2193.

NEWS IN BRIEF

Health Care Voucher Scheme

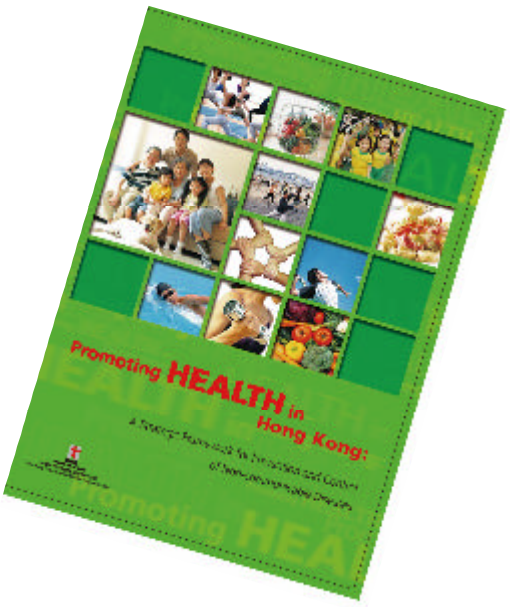
The Government will launch the Health Care Voucher Scheme on 1 January 2009. The Scheme aims at providing additional choices for elders on top of the existing public primary healthcare services with a view to enhancing the primary healthcare services for the elders. Under this Scheme, the Government will provide five health care vouchers of $50 each to elders aged 70 or above annually to partially subsidise their use of private primary care services. The Scheme will first run as a pilot for three years. From

1 January 2009 till 31 December 2011, eligible elders may use their health care vouchers at any enrolled healthcare professional. The vouchers will be issued and used through an electronic platform called eHealth system. There will not be any physical voucher. Eligible elders just need to bring along their Hong Kong Identity Card or Certificate of Exemption, and express their intention to use the voucher(s) when making payment.

The following healthcare professionals who are registered in Hong Kong may participate in the Scheme: western medicine practitioners, Chinese medicine practitioners, dentists, chiropractors, registered nurses and enrolled nurses, physiotherapists, occupational therapists, radiographers and medical laboratory technologists. Eligible healthcare professionals who are interested in participating in the Scheme are required to enroll with the Department of Health in advance. Enrollment has commenced since 30 September 2008, and will be ongoing throughout the Scheme period. Interested healthcare professionals can visit the website at *www.hcv.gov.hk* to submit the enrollment application electronically or download the enrollment forms for submission by post.

Strategic Framework for Prevention and Control of Non-communicable Diseases

The Government launched a strategic framework on 28 October 2008 to prevent and control non-communicable diseases (NCD) in Hong Kong.



The framework, entitled Promoting Health in Hong Kong: A strategic Framework for Prevention and Control of Non-communicable Diseases, was developed by the Department of Health with input from experts of various disciplines and making reference to the WHO's guiding principles in disease prevention and health promotion. The overall goal of the strategy is to improve the health and quality of life of people in Hong Kong, which in turn help lower their chances of having NCD.

To achieve the goal, six strategic directions have been identified. These are:

1) supporting new and strengthening existing health promotion and NCD prevention initiatives or activities that are in line with the strategy;
2) generating an effective information base and system to guide action across the disease pathway;
3) strengthening partnership and fostering engagement of all relevant stakeholders;
4) building capacity and capability to combat NCD;
5) ensuring a health sector that is responsive to the NCD challenges and to improve the system of care; and
6) strengthening and developing supportive health promoting legislation.

A high-level Steering Committee, chaired by the Secretary for Food and Health, Dr York Chow and comprising representatives from the Government, public and private sectors, academic, professional bodies, relevant industries and other key partners, has been set up to deliberate on and oversee the overall roadmap for implementation. To tackle imminent problems caused by the leading risk factors of overweight and obesity, heart diseases and diabetes mellitus, an Expert Working Group on Diet and Physical Activity will be firstly set up to advise on priority actions, draw up targets and action plans.

A copy of the framework document can be found at the DH website: *http://www.dh.gov.hk*.

Number of Registered Deaths by Ten Leading Causes of Death, 2001 to 2007

(Ranking according to 2007 Data)

Rank	Detailed List No. ICD 10th Rev.	Disease Group	Number of Registered Deaths						
			2001	2002	2003	2004	2005	2006	2007
1	C00-C97	Malignant neoplasms	11 406	11 658	11 510	11 791	12 310	12 093	12 316
2	I00-I09, I11, I13, I20-I51	Diseases of heart	4 703	4 969	5 311	5 866	5 868	5 619	6 372
3	J12-J18	Pneumonia	3 026	3 194	3 877	3 676	4 291	4 201	4 978
4	I60-I69	Cerebrovascular diseases	3 130	3 218	3 462	3 416	3 434	3 302	3 513
5	J40-J47	Chronic lower respiratory diseases*	2 114	2 075	2 102	2 123	2 261	1 924	2 096
6	V01-Y89	External causes of morbidity and mortality†	1 844	2 068	2 044	2 243	2 150	1 961	1 854
7	N00-N07, N17-N19, N25-N27	Nephritis, nephrotic syndrome and nephrosis	1 053	1 055	1 184	1 182	1 261	1 287	1 347
8	A40-A41	Septicaemia	424	467	572	615	701	676	737
9	E10-E14	Diabetes mellitus	676	574	783	728	602	511	506
10	K70, K73-K74	Chronic liver disease and cirrhosis	378	345	339	329	373	364	401
		All other causes	4 551	4 693	5 239	5 352	5 432	5 477	5 843
		All causes	***33 305***	***34 316***	***36 423***	***37 321***	***38 683***	***37 415***	***39 963***

Notes : * Chronic lower respiratory diseases has been included as a disease group for the purpose of ranking the causes of death since 2001.

† According to the ICD 10th Revision, when the morbid condition is classifiable under Chapter XIX as "injury, poisoning and certain other consequences of external causes", the codes under Chapter XX for "external causes of morbidity and mortality" should be used as the primary cause of death.

HIV/AIDS Surveillance

	2008 Quarter 2	2008 Quarter 1	2007 Quarter 2	2008 Quarters 1-2	2007 Whole Year	Cumulative total since 1984
HIV	121	89	111	210	414	3 822
AIDS	15	17	18	32	79	966

Contact Numbers for Prompt Notification

Infectious Diseases other than Tuberculosis	Fax No. (Form DH1(s))	Tel. No.
Central Notification Office	2477 2770	2477 2772
Duty Medical Officer (for urgent notification during weekends, public holidays or after office hours)	-	7116 3300 call 9179

Tuberculosis	Fax No. (Form DH1A(s))
Tuberculosis and Chest Service	2834 6627 2574 2439

Number of Notifications of Infectious Diseases

Disease	Jul 2008	Aug 2008	Sep 2008	Oct 2008	Jan - Oct 2007	Jan - Oct 2008
1) Acute Poliomyelitis	-	-	-	-	-	-
2) Amoebic Dysentery	1	-	-	-	4	4
3) Anthrax*	-	-	-	-	-	-
4) Bacillary Dysentery	11	7	27	15	56	135
5) Botulism*	-	-	-	-	-	-
6) Chickenpox	667	327	351	658	14 524	7 100
7) Cholera	-	-	2	2	2	5
8) Community-associated methicillin-resistant *Staphylococcus aureus* Infection†	37	24	34	23	143	222
9) Creutzfeldt-Jakob disease*	-	-	1	-	-	1
10) Dengue Fever	3	9	4	5	52	36
11) Diphtheria	-	-	-	-	-	-
12) *Escherichia coli* O157:H7 Infection*	1	-	-	-	-	1
13) Food Poisoning:						
- Outbreaks	107	82	85	48	560	563
- Persons Affected	398	328	333	161	1 795	2 291
14) *Haemophilus influenzae* type b Infection (invasive)*	-	-	-	-	-	-
15) Hantavirus Infection*	-	1	-	-	-	1
16) Influenza A(H2)*, Influenza A(H5)‡, Influenza A(H7)§ or Influenza A(H9)§	-	-	-	-	1	-
17) Japanese Encephalitis‖	-	-	-	-	2	-
18) Legionnaires' Disease	4	1	1	1	10	13
19) Leprosy	2	-	-	-	-	3
20) Leptospirosis*	1	1	-	-	-	2
21) Listeriosis*	-	3	3	4	-	10
22) Malaria	2	4	6	4	24	22
23) Measles	9	11	7	3	73	66
24) Meningococcal Infection (invasive)	-	-	-	-	1	-
25) Mumps	8	12	25	10	146	121
26) Paratyphoid Fever	2	3	3	4	21	23
27) Plague	-	-	-	-	-	-
28) Psittacosis*	-	-	-	-	-	-
29) Q Fever*	-	1	-	-	-	1
30) Rabies	-	-	-	-	-	-
31) Relapsing Fever	-	-	-	-	-	-
32) Rubella and Congenital Rubella Syndrome:	6	2	2	4	35	35
- *Rubella*	*6*	*2*	*2*	*4*	*35*	*35*
- *Congenital Rubella Syndrome**	-	-	-	-	-	-
33) Scarlet Fever	27	10	14	10	160	206
34) Severe Acute Respiratory Syndrome	-	-	-	-	-	-
35) Smallpox*	-	-	-	-	-	-
36) *Streptococcus suis* Infection¶	-	1	2	-	6	5
37) Tetanus	-	-	-	-	-	-
38) Tuberculosis	626	517	557	525	4 688	5 164
39) Typhoid Fever	2	6	2	2	44	35
40) Typhus and other rickettsial diseases**:	5	6	7	6	17	31
- *Scrub Typhus*	*4*	*3*	*4*	*3*	*14*	*20*
- *Urban Typhus*	-	-	-	-	*3*	*1*
- *Spotted Fever**	*1*	*3*	*3*	*3*	-	*10*
41) Viral Haemorrhagic Fever*	-	-	-	-	-	-
42) Viral Hepatitis:	23	21	17	15	176	206
- *A*	*8*	*5*	*6*	*6*	*56*	*59*
- *B*	*7*	*11*	*7*	*8*	*63*	*63*
- *C*	*1*	*1*	-	-	*1*	*2*
- *E*	*7*	*4*	*4*	*1*	*56*	*82*
43) West Nile Virus Infection*	-	-	-	-	-	-
44) Whooping Cough	2	-	1	1	26	23
45) Yellow Fever	-	-	-	-	-	-

Notes : * Notifiable since 14 July 2008
† Notifiable since 5 January 2007
‡ Notifiable since 30 January 2004
§ Notifiable since 31 December 2004
‖ Notifiable since 16 July 2004
¶ Notifiable since 2 August 2005 and cases prior to this date were voluntarily notified.
** "Typhus" has been revised to "Typhus and other rickettsial diseases" which includes spotted fever since 14 July 2008.