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Short Report

Implementation of smoking ban: a survey in a public hospital setting

Rosastella Principe[1]*, Gregorino Paone[2]*, Salvatore Damante[3], Sergio Fuselli[4], Patrizio Palermo[5], Laura De Marchis[6], Simonetta Massafra[5], Piergiorgio Zuccaro[4]

1 Smoking Cessation Center, S. Camillo-Forlanini Hospital, Rome, Italy
2 Department of Cardiovascular, Respiratory, Nephrologic and Geriatric Sciences, Heart and Lung Institute 'Sapienza', University of Rome, S. Camillo-Forlanini Hospital, Rome, Italy
3 Associazione Aria-Ambiente, Rome, Italy
4 Istituto Superiore di Sanità, Rome, Italy
5 S. Camillo-Forlanini Hospital, Rome, Italy
6 Department of Radiology, Oncology, and Pathology, 'Sapienza' University of Rome, Rome, Italy

*Both authors contributed equally to the work

Correspondence: Gregorino Paone, MD, S. Camillo-Forlanini Hospital, Via Portuense 332, 00149 Rome, Italy, Tel/Fax: +39 06 55552553, e-mail: rpaone1023@yahoo.com

Smoking in hospitals is banned in most of European countries; nevertheless, implementing a total smoking ban is particularly difficult and policy breaches are frequent. Aim of our study was to monitor the compliance with the smoke-free policy within a hospital district by measuring particulate matters ($PM_{2.5}$). We designed an observational study and identified six sensitive locations within the hospitals: surgical units, administrative offices, hall, outdoor main entrances and as controls an outdoor and an indoor area. To rule out potential confounders we included in the evaluation the roadways surrounding the hospital district. $PM_{2.5}$ median concentrations observed in outdoor main entrances and in hall were significantly higher (16.4 and 13.4 $\mu g\,m^{-3}$), as compared with the other settings ($P < 0.0001$). This data warrant an implementation of current policies to protect patients, visitors and employees from passive second-hand smoke leading to a smoking prohibition in any hospital surroundings.

Introduction

Environmental tobacco smoke (ETS) is a complex mixture containing more than 4000 chemical substances, 42 of which are classified as carcinogens.[1] Increased levels of these products are found in the respiratory tract of passive smokers, and second-hand smoking has been associated with many adverse health effects such as lung cancer, cardiovascular and respiratory diseases.[2]

To protect non-smokers from the hazards of second-hand smoke (SHS), the World Health Organization (WHO) encouraged countries to implement smoke-free policies as part of the Framework Convention on Tobacco Control (WHO 2003).

On 10 January 2005, Italy became the third European country to ban smoking in all indoor public places. This legislation followed earlier restrictions in 1975 for hospital wards and schools and in 1995 for public administrations.[3]

Hospitals should be among the most influential settings in terms of controlling tobacco consumption and monitoring compliance with the law. However, smoke-free policies are not easy to implement and policy breaches remain frequent.

Particulate matters (especially $PM_{2.5}$) are the most commonly used indicators to evaluate ETS and although they are not always due to SHS, tobacco is considered their main source in the absence of other fonts of combustion.[4,5] Recently, the WHO has issued a global update of the air quality guideline and a annual standard of $PM_{2.5}$ levels of 10 $\mu g\,m^{-3}$ has been set for good air quality (WHO 2005) Air Quality Guidelines, Denmark.

Our study was aimed to monitor the compliance with the smoke-free policy within a hospital district of Rome by investigating SHS levels.

Methods

For this purpose, from October 2010 to March 2011, we designed an observational study to measure $PM_{2.5}$. We defined six sensitive locations within the hospitals: the surgical units, the administrative offices, the hall, the outdoor main entrances and as controls an outdoor location where smoking was not present (garden), an indoor area separated from the hall and located >10 m from the main entrance.[6] Halls were separated from outdoor main entrances by swinging glass doorways. Air conditioning systems in surgery units were set according with the law (DL no 81-2008).

Surgical units and the administrative offices were chosen with the aim to monitor the compliance of administrative employees, physicians and nurses with the smoking ban, while we analysed outdoor main entrances and the halls with the goal to investigate visitors, patients, health professionals and employees smoking ban accomplishment. We also included in the analysis an indoor control area to evaluate the outdoor SHS drifting to the halls and an outdoor control area, the garden, which was forbidden to trespass, to rule out any influence of air pollution to outdoor and halls measurements.

Furthermore, to examine traffic-related air pollution, we measured $PM_{2.5}$ concentrations in the roadways surrounding the hospital.

$PM_{2.5}$ concentrations were simultaneously measured in the monitored areas using precalibrated hand-held-operated monitor of particle size and mass concentration (Aerocet 531, Metone Instruments Inc., Grants Pass, OR, USA). According to previous reports in addition to the sensor manufacturer calibration, obtained by using polystyrene latex particles, we performed a re-calibration for ETS to overcome the possible differences in the

morphology, composition, temperature, humidity and optical characteristics of the aerosol which may lead to measurements errors.[7]

We also recorded indicators of tobacco smoking such as number of cigarettes lit in outdoor main entrances, the presence of cigarette butts and ashtrays.

The $PM_{2.5}$ measurements were carried out under stable weather conditions (humidity <85%, not rainy or windy days) and during day time (9 AM to 5 PM).

The local ethic committee consent was not required because the analysis did not involve interventions in humans but only environmental measurements in a public setting and the smoke-free hospital coordinator approved the design of the study.

Statistical analysis

Due to non-normal distribution of $PM_{2.5}$ concentrations, data are shown as medians, means, interquartile ranges (IQRs) and standard deviation of mean. Comparisons or correlations between variables were analysed using non-parametric tests (Kruskall–Wallis or Spearman Rank test). Statistical analyses were performed using Statistica 7 software (Stat Soft Inc., Tulsa, OK, USA).

Results

We obtained 418 measurements within the six sensitive areas and in the roadways encircling the hospital. Table 1 provides a summary of the collected data and shows the $PM_{2.5}$, average concentrations in the different locations. We obtained 67 measurements in the administrative offices, 60 in surgical units, 63 in the hall, 67 in main entrances, 57 in indoor control area, 72 in outdoor control location and 32 in the roads around the hospital. The overall median $PM_{2.5}$ concentration was 7.3 $\mu g\,m^{-3}$ with half of measurements between 4 and 13.4 $\mu g\,m^{-3}$. The $PM_{2.5}$ median concentration observed in outdoor main entrances was similar to that found in the hall (16.4 and 13.4 $\mu g\,m^{-3}$, respectively, $P = 0.3$), while the $PM_{2.5}$ levels observed in these two areas were significantly higher as compared with the other settings ($P < 0.0001$). $PM_{2.5}$ median concentration measured in the roadways was 7.65 $\mu g\,m^{-3}$.

There was a significant correlation between the average $PM_{2.5}$ levels recorded in the hall and $PM_{2.5}$ concentrations measured at outdoor main entrances (Spearman's rank correlation rho = 0.38, $P = 0.002$).

During the period of measurements, the average number of individuals who stood nearby outdoor entrances was 32 with a mean of 13 lit cigarettes.

Discussion

In our study we found an overall compliance with the smoking ban in the administrative and surgical areas while a significant increase of particulate levels was observed at main entrances and in the hall of the hospital with concentrations which were considerably above the annual value of 10 $\mu g\,m^{-3}$ that WHO has set for good air quality.

Table 1 Medians, IQR arithmetic mean ± standard deviation of the mean of $PM_{2.5}$ concentrations in the examined areas

Location	*n*	Median (IQR) ($\mu g\,m^{-3}$)	Mean (±STD) ($\mu g\,m^{-3}$)
All	418	7.3 (4–13.4)	9.56 (±7.29)
Main entrance (outdoor)	67	16.4 (12.1–19.1)	15.11 (±6.87)
Main entrance (indoor)	63	13.4 (9.6–16.5)	13.75 (±6.93)
Indoor control	57	7.3 (3.8–8.6)	7.35 (±4.23)
Outdoor control (garden)	72	4.7 (3.7–6.4)	6.79 (±5.87)
Surgical units	60	5.65 (3.2–8.25)	7.4 (±8.51)
Administrative office	67	4.9 (3.4–8.3)	7.82 (±7.26)
Roadways	32	7.65 (4.8–8.4)	7.4 (± 3.00)

Interestingly we found a significant increase in $PM_{2.5}$ levels in settings (hall and outdoor entrance) where the presence of indicators of tobacco smoking was evident (e.g. ashtrays, cigarette butts, smokers and tobacco smell). Indicators of tobacco smoking including cigarette smokers were observed in most of the main entrances while taking the measurements, regardless the banning of smoking in those areas. These observations should encourage reinforcement of tobacco control measures, placement of more warning signs and even implementation of fines.

The high correlation observed between $PM_{2.5}$ concentrations detected in hall and main entrances indicates that a significant source of pollutants measured immediately inside the hospital was due to the outdoor smoking. In line with this observation we observed a significant decrease in $PM_{2.5}$ levels measured in the indoor control area.

Our study has a potential shortcoming because the analysis was limited to only one hospital district (although one of the largest in Italy, accounting for more than 320 000 hospital/accesses in the last 3 years). Another potential limitation of the study is that we did not control for the wind conditions. To overcome a potential bias we excluded from measurements windy days and we performed evaluations in different hours and days during the study period.[6]

On the other hand, we believe that our report has several strengths: first, to date few studies have monitored smoking ban implementation in hospital settings, second, to the best of our knowledge, this is the first study that includes indoor and outdoor controls in a hospital district and third, differently from recent reports we did not need a previous approval from the smoke-free hospital coordinators and the day of measurements were not known. Therefore, we can rule out that any foreknowledge may have misled our analyses and our should be considered a real-life, real time study which mirrors every day smoking behaviour and second-hand smoking exposure in a hospital setting.[8–10] Finally, SHS is not the only source of $PM_{2.5}$ because particles can also be due to traffic-related air pollution, in our study the presence of significantly lower particulate levels in the outdoor control area allowed us to exclude car exhausts as relevant contributors to the observed $PM_{2.5}$ concentrations.

Although revealing an overall compliance with the smoking ban in most of the analysed areas, the present findings point out a potential drifting from outdoor settings to adjacent indoors, probably because banning smoking inside hospitals, but not in the surroundings areas, leads people to smoke just in front of the main entrances. Furthermore, many smokers use to discharge cigarette butts just before entering inside the hospital holding in the lungs smoke chemical compounds and breathing them out as soon they enter in the building. This data warrant a prompt implementation of current policies to protect patients, visitors and employees from passive SHS leading to a smoking prohibition in any hospital surroundings and promoting totally smoke-free hospital campuses.

Key points

- An overall compliance with the smoking ban was observed in most of investigated areas, a significant increase of particulate levels was measured at main entrances and in the hall of the hospital.
- The high correlation observed between $PM_{2.5}$ concentrations measured in hall and in main entrances suggests that a significant source of pollutants measured immediately inside the hospital was due to the outdoor smoking. In line with this finding we detected a significant decrease in $PM_{2.5}$ levels in the indoor and outdoor control areas.
- Our data point out the need for a prompt implementation of current policies to protect patients, visitors and employees from passive SHS promoting totally smoke-free hospital campuses.

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