SPA RECREATIONAL WATERS AND WELLNESS: STATE OF THE ART AND NEW PERSPECTIVES FOR PUBLIC HEALTH.

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ABSTRACT:
It is since early times that hot spring waters have been used for recreational purposes or wellness applications. In Europe as well as other countries, thermal pools are diffused, providing a number of people with possible physical, mental or social benefits, but also exposing to possible chemical, biological or physical agents. As the sciences of epidemiology evolved, new tools became available to identify and prevent health risks, as well as to improve quality and safety of recreational waters.

In 1994, WHO promoted the development of Guidelines concerning recreational use of the water environment. This kind of documents mainly represents a worldwide consensus reference. The Guidelines for Safe Recreational water Environments were released as two volumes: volume 1 addresses coastal and fresh waters and volume 2 addresses swimming pools, spas and similar recreational-water environments.

Still, the recreational application of thermal waters involves different issues, mainly due to the peculiar composition of different hot spring waters. Based on the geological composition natural waters may be enriched with several salts and ions, such as: Sulphur, halogens from group 17 of the periodic table e.g. chlorine (Cl), bromine (Br), iodine (I), or alkaline earth metals comprising group 2 of the periodic table e.g. magnesium (Mg), or calcium (Ca). The peculiar and typical composition of thermal waters represents an interesting property, but may imply difficulties in management, treatment and monitoring.

The objective is to consider issues related to thermal pools within the field of recreational waters, showing homologies and differences from a public health point of view.

This presentation will evidence main critical points, briefly reporting the general frame related to national regulations, available epidemiological studies, rapid monitoring protocols, basic disinfection treatment procedures for management of thermal pools. Preliminary results on a new molecular approach for monitoring recreational waters will be introduced.

From a public health point of view, spa and thermal pools show several issues in common with recreational waters, including coastal and fresh waters. They represent a resource for wellness and rehabilitation application, and require appropriate hygiene management, depending also on the specific chemical composition and user typology. Several laboratory methods and management protocols are available based on different national regulations. Analysis of critical control points and establishment of appropriate monitoring strategies is a key issue for safety and quality. Additional documents and experimental data will be made available at www.bioigene.it/spa.

In conclusion, the recreational use of water represents a traditional as well as an advanced kind of technology. It may carry promising benefits for populations, including rehabilitation and adapted physical activity; however it requires modern and appropriate approaches to guarantee safety and quality, at a reasonable cost/advantage ratio.

Keywords	Thermal waters; monitoring; hygiene; disinfection; hot springs.

INTRODUCTION

The application of recreational waters in swimming pools, spa and wellness centres represents a renewed and promising tool for prevention, rehabilitation, and health promotion (1–2). However, since water can be a disease vehicle, any full exploitation requires high hygiene levels and effective monitoring systems. This is relevant not only for safety purposes, but also for quality, excellence and consumer satisfaction targets (3–6). Water is the essential tool for providing adjunct value to several different approaches routinely applied in wellness, including specific diet protocols, natural therapies, physiotherapies, adapted physical activities (7–10). Within this wide health-focused contest, SPA structures represent an ideal endorsement to implement individualised prevention actions. The presence of thermal waters -both for recreational or therapeutic purposes- is the specific and characterising natural element used in different European countries, since ancient times. Water requires appropriate management, not only for safety reasons related to microbial or chemical risks, but also for enhancing the benefits of thermal applications and assuring the quality of procedures and environments (11–17). Several lines of evidence support the importance of a successful, competent, effective and rationalized perspective in enhancing environmental hygiene achievements. Consequent advantages are not only direct and immediate, such as on SPA imagine, marketing or visitor perception, but also indirect such as in prevention of outbreaks, accidents, hazards for users as well as prevention of occupational risks (19–21). Several scientific evidences support the benefits of SPA structures on health and wellness, and a new role is associated to the integration of different strategies, including hydrotherapies and preventive and adapted physical activities in thermal pools (22–26). However, application of SPA water as a liquid matrix where perform movement -or simply bathing- needs different requirements respect to those traditionally used for drinkable waters. This can be due to specific chemical parameters -e.g acquae sulfureae- as well presence of characterising biological agents –e.g. algae or microflora- or physical properties such as pH, temperature, conductance/redox values. Moreover, environmental conditions -e.g. location in outdoor or indoor space- and the same presence of people in the pool represent additional important sources of contamination that have to be evaluated with a very different approach than respect to ordinary swimming pools (27, 28). Even disinfection and treatment cannot be applied following standard protocols, due to the interaction with the natural properties of thermal waters.

Several international guidelines, recommendations and regulations are available, and recently the diffusion of the World Health Organization Guidelines for Recreational Waters represents a milestone in the field, recently translated in Italian by SItI-GSM (29). In Italy, the Accordo Stato Regioni 16 gennaio 2003 is the main national reference for swimming pools, as well as other different laws for SPA structures (30-31). Even if SPA waters find their proper and specific rules within different guidelines and regulations -more related to a medical contest- general basic principles are the same used for drinkable, bathing, or recreational waters, as well as similar are the etiologic agents and the basic prevention strategies. A synthesis of available regulations in Italy is available in table 1, and involves recent as well as old original laws dated over a century ago. Regulations are available in different countries and several European standards have been agreed for pools.

The whole of all this knowledge applicable to recreational waters has not been completely and specifically applied to the heterogeneous world of SPA structures and swimming pools supplied by thermal waters. A map of thermal waters springs and Spa in Italy and in Europe is reported in figure 1. The SPA point of view is projected toward the future of wellness, but maintains old and strong roots in the past: any new approach requires a process to individualise application to the specific SPA structure, considering the contest and tradition (32). This implies that any technical innovation will need to be supported by accompanying measures based on adequate information and formation processes. Managers, public health authorities, and consumers have a strong interest in an offer of effective and safe SPA. Based on evidences -and on advances from the hygiene, molecular microbiology and the water management fields- a new approach needs to be considered and adapted to local situations, to overcome limits related to valid, but obsolete, procedures.

An effective approach for improving SPA safety and quality and implement scientific knowledge on SPA environments, can succeed by transferring knowledge and technology from: i) the HACCP system adopted in food-hygiene, ii) the new assays of environmental microbiology, iii) recent achievements of

recreational waters hygiene (16, 33–35).

Molecular biology and bioinformatics have proved to be effective in analysis of biohazards (36–48). The basic principle is based on analysis of genome traces as epidemiological markers of microbial contamination. Molecular procedures allow accurate typing and detection. Advantages are related to quick, sensitive and simple assays and to the possibility to detect uncultivable microorganisms or unknown species. Limits involve information on microbial viability and infectious risk analysis. Optimisation and informatics support may open up new perspectives toward advanced monitoring systems, as "pilot" applications also in SPA. This pioneering approach is strongly requested in environmental microbiology issues, and it is justified by the specific structure of environmental microflora in SPA. It is essential to consider the several needs for developing new and appropriate criteria in evaluating safety and quality of waters. This requires considering the specific chemical, physical and microbiological behaviour of SPA waters, and their peculiar influence on the SPA environment.

Main limiting points in modern approaches are related to the local diffusion of new knowledge/technologies within very traditional assessments and to the prompt availability of appropriate simple tools within a reasonable cost/benefit ratio. For this reason, accompanying measures (educational), validation pilot studies (reference centres) and impact analysis (cost analysis studies) need to be considered. Application of advanced technologies to thermal waters and SPA represent a challenge that can provide new insights for addressing hygiene and safety performance in implementing safety, quality and other technical goals related to public health issues.

WORK DESCRIPTION

With the final objective to address state of the art in thermal-waters hygiene-management we have:

- set up a database containing all laws and regulations available in Italy, Europe and other countries regarding hygiene management of swimming pools and recreational waters, with special regard to natural thermal waters,
- defined basic indicators of microbial safety, collecting traditional protocols and developing new advanced protocols based on a bioinformatics and molecular biology approach,
- evaluated different disinfection procedures, comparing advantages and problems related to the different approaches. Tins point was flanked by studies on the microflora and ecosystem of indoor swimming pool environments,
- organised simple documentation to diffuse updated knowledge and technologies between spa personnel and users.

MATERIALS AND METHODS

- Research of documentation was performed by visiting institutional archives and/or querying on line databanks. – Based on international scientific publications and national regulations, we selected possible markers of microbial contamination, and laboratory protocols for their analysis. For molecular biology amplification protocols where applied, mainly based on real time pcr. sequence analysis was performed by using GCG wisconsin package, dedicated software provided by Caspur (Interuniversity consortium for supercalculation and research, www.caspur.it) and by a new tool designed for environmental microbiology: the GenEnv database (49).
- Disinfection procedures included chemical and physical based approaches (e.g. Clorine, Bromine, H_2O_2, UV, O_3). In addition, transversal measures to enhance water pool safety within spa structures where evaluated considering internal regulation for users and/or tools for reducing contamination related to wrong behaviours. The structure and variations in the ecosystem of indoor swimming pools was studied by air and surface sampling, and comparing the presence of different microbial species and relative strains.
- Booklets and CD where designed to update and diffuse correct management tools between personnel, and to inform users.

RESULTS

Based on the whole information acquired from scientific literature and national regulations, a molecular approach based on real time pcr was developed to monitor in a qualitative and quantitative way microbial safety. An example of output is shown in figure 2. This approach required the development of appropriate protocols for collection of bacteria from large volumes. Several protocols have been tested for bacteria collection and for DNA extraction after water sampling and filtration (Figure 3). Analysis of bacterial genomic sequences to be selected for laboratory analysis was performed by bioinformatics software and by the GenEnv databaSe driven system for environmental microflora. Analysis of air and surfaces in indoor swimming pools showed the presence of environmental species stabilised in equilibrium such as within an ecological niche. Thermal waters show specific microfloras, characterised by different growth conditions, including higher temperatures and presence of specific elements, such as Sulfur. Classical parameters reported for recreational waters and used for traditional swimming pools, may not be optimal for the heterogeneous and atypical situation of pools supplied with natural thermal waters.

Several tools are available to simplify the respect of hygiene procedures and behaviours, and higher compliance in their application is based on appropriate information of personnel and users.

Neither regulations on therapeutic application of thermal waters neither common regulations on swimming pools seem adequate for a safe and sustainable management of pools supplied with natural thermal waters.

CONCLUSIONS

Based on the geological and orographic structure of the area, natural thermal waters represent a diffused source of recreational waters in Italy and several European countries. Their chemical, physical, and biological properties often may be unsuitable for traditional hygienic management procedures. New and more appropriate solutions may be required. Based on WHO guidelines for recreational waters, national laws and European regulations, we developed protocols to apply molecular techniques to quantitative assessment of microbial indicators. This approach requires appropriate methods for collection of cells from large water volumes. Advantages are mainly related to rapidity and culture independent methods, but require optimised protocols, equipped laboratory and trained personnel. The same experimental approach revealed promising perspectives in monitoring disinfection activity and hygienic quality of pools. The presentation will introduce new perspectives for public health regarding the management of hygiene in SPA using natural thermal waters for recreational purpose.

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