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Defining Health: Update From ASHRAE SGPC10 Committee, Interactions Affecting The Achievement Of Acceptable Indoor Environments

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ABSTRACT

Healthy Buildings has become the marketing focus, if not the goal, for an increasing number of projects and organizations in the past five years. The current COVID-19 pandemic has placed a new and compelling spotlight directly onto buildings of all types, whether offices, homes, retail, restaurants, hotels, or schools. The issues are no longer limited to the functional parameters of the building design, construction, maintenance, and use. Neither do the concerns remain within the legacy boundaries of the expansion from indoor air quality (IAQ) to indoor environmental quality (IEQ). The driving concern now is how the parameters of building functioning affect the occupants. To do so requires measurements for assessment followed by measurements for verification. Those measurements do not exist. The public health risk to occupants of buildings, prioritized by the COVID-19 pandemic and climate change, needs complex metrics, both theoretical and practical. The committee discussion and recommendations highlight why there is no operational definition of health, challenges in moving forward, and points to a conceptual and practical direction.

INTRODUCTION

ASHRAE Guideline 10, *Interactions Affecting the Achievement of Acceptable Indoor Environments* is based on health but does not include a definition of health. A broad review of sources by the ASHRAE SGPC10 committee in 2018 found only one definition of health – the World Health Organization. The research revealed that this definition has neither a broad consensus of use nor of applicability. Furthermore, the literature contained a caution that the definition may be counterproductive. Published calls for changes, updates, or major re-writes have accelerated since 2008.

CRITIQUE OF WHO 1948

The World Health Organization in 1948 defined health as:

"…a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO 1988).

This definition has been critiqued as an abstraction which has not proven to be useful for the identification of attributes, characteristics, or measurable metrics. Which means it cannot be applied to actual situations.

The failure of the WHO definition of health as an operational definition was highlighted by a 2008 nutritional study in the Netherlands. The researchers claimed that they failed to reach a conclusion because of "the lack of an operationalized definition of health." The British Medical Journal (BMJ) was contacted, resulting in an article later that same year titled, "How should health be defined?" (Jadad 2008)

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Discussion continued in the comments section of the BMJ for a while, followed by a literature search along with comments published on their blog site (Jadad 2008). The Lancet in early 2009 published their own views on the controversy, “What is health? The ability to adapt." (Lancet, 2009). While the WHO definition added the non-disease physical, mental, and social parameters to the definition, The Lancet added the criteria of biological adaptability of the animate within the inanimate environment.

The next significant change occurred at an international conference in December 2009. The Netherlands Organization for Health Research and Development and the Health Council of the Netherlands gathered 40 international experts and published the report, ‘Is health a state or an ability? Towards a dynamic concept of health.’ (Netherlands 2013). They criticized the WHO definition thusly: "Although, over the past 60 years, several alternative definitions have been proposed, none has been embraced in the medical discourse as a replacement for the first. The original definition has never been modified or replaced and is generally described as “honored in repetition, but not in application”. (Netherlands 2013)

Their contribution was to add a new conceptual framework because of "the need for a shift from defining health as a static concept towards a more dynamic and functional description or framework. Operationalization should be relevant to different stakeholders." Furthermore, they mapped the way forward with 20 elements of health and 8 contexts within which the discussion could continue.

Despite this more specific proposal, two years later the BMJ on 26 July 2011 published another analysis, "How Should We Define Health?" "The WHO definition of health as complete wellbeing is no longer fit for purpose given the rise of chronic disease.” Machteld Huber and colleagues proposed “changing the emphasis towards the ability to adapt and self-manage in the face of social, physical, and emotional challenges…Although the definition has been criticized over the past 60 years, it has never been adapted. Criticism is now intensifying, and as populations age and the pattern of illnesses changes *the definition may even be counterproductive.*”) [emphasis added] (Huber et al 2018)

Even stronger words came three years later by the Dean Emeritus of the Royal Society of Medicine, David Misselbrook, GP, in the November 2014 issue of the BMJ. "Although we are prepared to spend dizzying sums on health care no one seems quite sure what health is ... this utopian vision is an unattainable ideal, bearing no relation to the struggles of real people in an imperfect world." (Misselbrook 2014)

Misselbrook continues with:
"The WHO definition sees us as closed, knowable systems where imperfections should be fixed. Logically, as none of us is in this complete state of wellbeing, we are all in need of medical intervention to correct ‘abnormalities’. But should we view any deviation from perfection as pathology requiring treatment? (Misselbrook 2014)

A more recent review is by Alan J. Card, *Moving Beyond the WHO Definition of Health: A New Perspective for an Aging World and the Emerging Era of Value-Based Care* (Card 2017). Card provides an incisive and comprehensive review plus suggestions on how the definition could be expanded and individualized to include characteristics of the sociological and psychological attributes of health. Despite that, however, the definition of “health” is still dominated by medical authorities without considering non-medical disciplines such as those working with the built environment.

Congruent with the previous suggestions, the NIH-National Institute of Environmental Health Services views its roll and mission to, "reduce the burden of human illness and dysfunction from environmental causes by defining how environmental exposures, genetic susceptibility, and age interact to affect an individual's health." (NIEHS 2004)

Notable with these later efforts is the emphasis on the individual, which necessarily moves toward the position that “health” will evolve from its current position of static to dynamic.

COMMITTEE INPUT

With this background, the SGPC10 committee in 2018 solicited input from a group of nterested individuals. This was followed by a Forum during their regularly scheduled committee meeting at Atlanta in 2019 and again in Orlando in 2020. There were approximately 60 people in attendance for the two 90-minute meetings. Forum guidelines were strictly followed for the purpose of promoting and supporting open discussion without judgment or criticism and without individual identifications. Representative paraphrasing is presented as follows:

- Start from the WHO definition and adapt it so it is operational for commercial and residential buildings.
- Consider occupational health since it is closely tied to the built environment and that as designers, we may have the ability to change outcomes.
- The mechanisms of the bodily reactions to the different stressors and the interactions that occur both at the human and environmental levels. When it comes to a definition of health, it is important to address the situation (activities & time), the individual (preferences and needs), and which effect (disease, discomfort, symptom, etc.) is being addressed.
- Focus more on the condition of the process that maintains homeostasis and the stress that produces than on the homeostasis itself.
- A healthy building does not cause or aggravate illnesses in the occupants and assures a high level of comfort to the occupants in the performance of the designated activities (Quoted from the HOPE project 1992-1995).
- …a condition of an individual. Each of us can react differently to environmental stressors depending on our health condition but also on how we feel at that moment, what we do etc. We must take a human centric position. This is what is also done by the medical field in patient treatment.
- Philosophers engage in discussions of states of being (ontology), but biological systems are more about processes than states of being. If someone is healthy, a minor cut does not change their health, but it does change their state of being. It does not change one's health because their immune/repair systems are functional and adapt effectively to the challenge. If those processes are not working, a minor cut could kill. So, the processes are more determinant of someone's health than the cut itself.
- Humans, as with the original bacteria, have survived by altering their internal environment in step with their external environment (within limits) as evidenced by our continued existence. However, we have also developed intentional designs to alter and control our immediately proximate external environment through clothing, automobiles, and especially buildings. Neither these actions nor the requirements as such have yet been included in any known consideration of what "health" is. A wide range of multidisciplinary input for those alterations and controls – not limited to the medical - has not occurred. Perhaps they should.
- ASHRAE already has several resources on health. They are just not noticed, utilized, or cited. Such as Standards 55 for thermal comfort, 62.1 IAQ for commercial buildings, 62.2 IAQ for residential buildings, 188 for Legionellosis, and 190 for hospitals.

MOTIVATION FOR MOVING FORWARD

The comparison of the Forum comments with the published research is interesting and encouraging. Both have taken on an unanticipated prescience over the past year of COVID-19.

First, was the announcement of the 2019-2024 Strategic ASHRAE Plan, which for the first time officially includes an intent for "health." (ASHRAE 2019). But the latest, and perhaps more immediate, declaration of new territory was published in April, 2020, by Joseph G. Allen and John D. Macomber at Harvard University.

Companies are recognizing that there is value in not just a disease avoidance strategy for their employees but also a health promotion strategy. In academic and medical jargon, this is articulated as moving from studying pathogenesis, or the origins of disease, to studying Salutogenesis, or the creation and promotion of health. (The term "Salutogenesis" was coined by medical sociology professor Aaron Antonovsky). (Allen and Macomber 2020).

CONSIDERATIONS FOR MOVING FORWARD

Despite the hope, possibility, and interest in advancing the definition of "health," the major obstacle continues to be the automatic, or knee-jerk, response that the task is too complex and overwhelming to even be attempted. It is seen as impossible by many. Based on the history of the failure to define "health" such an assumption certainly appears accurate. This attitude is so pervasive that although the presentation of new possibilities at the second Forum in Orlando in January 2020 were accepted in principle, the need for action was discounted based on taking too long to accomplish. Perhaps this is true. But an initial exploration may be of interest to a few eventual champions.

The key framework under discussion is that traditional engineering applies physics and chemistry to the design, construction, and maintenance of buildings. The key characteristic is that buildings are measured and managed as if they were closed systems. Building operations are successful if specified parameters remain separate from outside influences. The difficulty occurs when events from outside the system intervene or interfere. A common example is the operation of mechanical heating and cooling systems in large buildings. The indoor environment meets all prescribed parameters of temperature, humidity, and air flow velocity – until the building is occupied by people, and especially if someone simply opens a window. System unbalance occurs.

When outside influences enter a closed system, desired operations cannot continue as designed unless those outside forces are additionally accounted for. In other words, closed system dynamics do not easily remain closed. Outside influences are prevalent and often unavoidable. This dynamic points to why "health" has been so difficult to define and why it has been given only "lip service" in most parameters of buildings, restricted to multiple references but no description or definition.

Physics and chemistry govern closed systems, or rather, systems that are predominantly closed. Analysis is by the principles of Reductionism. Reducing the mechanism to its constituent parts to be observed, measured, reassembled, and observed to further reveal the principles and functions. (Stanford 2008)

Biology – living organisms such as people – are not closed systems and cannot be disassembled to the constituent parts for the purpose of observing, measuring, reassembling, and further observing the functioning of the organism. Because the immediate result of disassembly is the removal of the precise essential characteristic under scrutiny - Life. Humpty Dumpty cannot be put back together again.

Including People in Buildings

The move from Indoor Air Quality (IAQ) to Indoor Environmental Quality (IEQ) inherently includes people, therefore requiring the addition of the methodology of biological open systems. Conditions and relationships include: current and potential IEQ influences of the COVID-19 pandemic; prevention of Legionnaires' disease from closed buildings (AIHA 2020); potential dampness and mold growth from extended non-operation of mechanical systems (ASHRAE, 2020) reported by those with even minor SARS-CoV-2 infections (Garner 2020; Yong 2020).

The Public Health mandates generated by the COVID-19 pandemic compels the inclusion of people in buildings, therefor requiring also the methodology of open systems. Allen and Macomber argue that including the health of people in building design and operation can improve productivity and the bottom line. Their argument was made in a pre-COVID-19 world. Now, the need for designing indoor spaces to protect and optimize human health has an increasingly, but necessary, imperative to protect and sustain the bottom line of businesses.

BACKGROUND OF STARTING POINTS

Starting points for pursuing open system methodologies are available. Although an in-depth citing and comprehensive development are beyond the scope of this paper, an outline of the history and the possibility of useable metrics for health in buildings is presented.

The history is extensive, and it begins with Erwin Schrödinger, of the Schrödinger's Cat thought experiment in quantum mechanics. He was a strict reductionist who attempted to apply physics and chemistry to the biological realm of the material world. After much struggle he concluded in 1943 that a "new physics" that was not reductionistic would be needed (Schrodinge 1943).

Others advanced his writings, culminating in the mathematical formalization of Relational Theory by Robert Rosen in 1991 (Rosen 1991) and continued by his daughter, Judith Rosen (Rosen 1999). A parallel effort was by Blanchard, who published *Systems Engineering Management* (Blanchard 2004), which was based on previous work by EIA (EIA 1998), and the US Defense Department (DOD 1969).

Contemporary works include *Interactomes, manufacturomes, and relational biology: analogies between systems biology and manufacturing systems* (Rietman 2011). Rosen included mechanistic controls in his work, developing detail on how a simple thermostat was not a totally closed system after all (Rosen 1999). Berlin published a medical application with *Systems Medicine-Complexity Within, Simplicity Without* (Berlin 2017). Bridging research to practice relies heavily on Science and Systems Thinking. John Kineman posted a YouTube of his lecture on organisms v machines (Kineman 2020).

The works involving health most directly related to ASHRAE and buildings, which are developed from the Systems Engineering by Blanchard, are the two books by Philomena Bluyssen (Bluyssen 2009; Bluyssen 2014). Professor Bluyssen has a working lab for evaluating and measuring human responses to varying indoor environmental conditions, including training occupant awareness (Bluyssen 2020).

The most practical and immediate possibility, however, is the recent work by Allen and Macomber in *Healthy Buildings: How Indoor Spaces Drive Performance and Productivity* (Allen and Macomber 2021). They combine Key Performance Indicators (KPI) of buildings with Health Performance Indicators (HPI) of people who occupy those buildings. They advocate for real-time monitoring of environmental parameters and a focus on the leading HPIs: Building design, certification and continuous commissioning, enhanced ventilation and filtration. They argue that the cost is outweighed by the added productivity and reduction of healthcare, absences, and employee turnover.

The most forward integrated systems approach to buildings and people include ASHRAE's *Damp Buildings, Human Health, and HVAC Design* (ASHRAE 2020), by integrating buildings and people through the relationship of epidemiology: Bluyssen's updated integration model, *Towards an integrated analysis of the indoor environmental factors and its effects on occupants* (Bluyssen 2020); and, the detailed delineations of multiple interactive relationships of the Holon by Kineman in *A Guide to Systems Research* (Edson et al. 2017).

CONCLUSIONS

The path forward can be identified with the following conceptual sequence:

- Buildings are closed systems of material reality. Their characteristics and operation are identifiable, measurable, and manageable in accordance with the Reductionism principles of physics and chemistry.
- People are open systems of living biology. Their characteristics and functioning extend beyond the physical functioning of material systems to the relational complexity of biological life.
- The closed systems of unoccupied buildings become open systems when occupied by people.
- If "health" and "buildings" are to be combined, then the open systems of the biological world and the closed systems of the material world must be accounted for.
- "Health" applies to people, not to buildings. Creating optimal indoor environmental conditions for the health of building occupants should be a fundamental goal of building science and ASHRAE's Strategic Plan.
- The integration of people and buildings requires additional conceptual structures and operational methods. Some currently exist and need further development, but are conceptually outside of the ASHRAE milieu.

Historical reductionism has brought us to the modern world of increasingly Smart Buildings. But has, as yet, been unable to bring us closer to buildings healthy for occupants. The concepts and structures of biological open system outlined above hold the potential for moving us toward those final steps of defining "health" and developing health-in-buildings.

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