



Medical Astrosociology and Space Medicine: Bringing Together the Two Branches of Science

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Fundamentally, the social and behavioral sciences, humanities, and the arts dominate astrosociology. However, collaboration with the space-related natural and physical sciences also plays a crucial role in understanding space issues from a holistic perspective. This paper examines the potential links between the social sciences (that includes all of the “soft” sciences for brevity) and the physical/natural sciences. This unification of the two branches constitutes what is termed *medical astrosociology*. It does not delve into the biomedical issues directly, which is the realm of space medicine, but it does provide linkages between these issues and those related to the social sciences. While space medicine is valuable in itself, behavioral health has recently emphasized a much more inclusive approach, and medical astrosociology brings in the social and behavioral sciences into the mix, along with the humanities – something that is too often missing. The approach medical astrosociology takes has a long history within sociology and anthropology regarding terrestrial medicine. The two extra facets – social and cultural forces -- have implications for behavior beyond what physiology and psychology alone can explain. Because astrosociology is the study of *astrosocial phenomena*, which include the social, cultural, and behavioral patterns related to outer space, medical astrosociology covers the human dimension that becomes the target of inquiry on multiple levels: (1) physiology, (2) psychology, (3) society (including social forces), and (4) culture (both ideas and materials). In other words, medical astrosociology focuses on how space medicine is practiced (the physical) within the social, cultural, and mental dimensions in which the patient, third parties such as family members, and practitioners all live. It is quite clear that the best course of action medically is not always allowed to occur due to impediments that often have no direct relationship to the strictly medical decision making process. Sometimes, for example, ethical dilemmas force compromises by both the patient and physician or hospital administration. It occurs on Earth, so it will occur in space ecosystems as well, which often present additional unique challenges to the practice of space medicine due challenges presented by their extraterrestrial environments.

I. Introduction

MEDICAL astrosociology was created to supplement and enhance space medicine, and to augment strictly biomedical approaches. By bringing together elements of the STEM fields and disciplines in concert with the subfields of astrosociology, collaboration can occur in which biomedical and psychiatric knowledge can mesh with “the other branch of science” – consisting of the social and behavioral sciences, the humanities, and the various types of arts – traditionally downplayed within the space community and largely ignored by the social science communities (Pass, 2015). Medical astrosociology provides a complementary and collaborative foil to the normal approach taken to deal with what is too often viewed as strictly biomedical concerns. Bringing in the social sciences allows expanding the focus to include social and cultural forces normally absent in the treatment and projected treatment of diseases, illnesses, and injuries that occur in space ecosystems. Yet attempts to integrate the social sciences with space medicine is not new, as evidenced by an approach favoring “a sociology of space medicine” (Kotarba, 1983a). Unfortunately, past attempts have failed. Medical astrosociology represents the latest attempt to bring in the social sciences and humanities to augment space medicine, which is long overdue.

Space medicine traditionally has focused on the biomedical aspects of the effects associated with microgravity in the space environment most often focusing on astronauts living and working in habitats circling the Earth, and thus

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of a limited sample size, so consequently the importance of the social sciences has only had a limited opportunity to demonstrate itself as useful. However, a larger population situated in a more distant space environment would present quite a different set of issues that involve the strengths of space medicine, but also would require the expertise of social scientists. Because human beings live in groups, and social interaction is therefore inevitable, social and cultural forces will impinge on any attempts to practice medicine. The multidisciplinary approach is the best course of action during the practice of medicine in space, as has been demonstrated in Earth-based communities. Thus, it makes sense to believe that such is the case for space-based communities.

Precisely because astrosociology focuses on the human dimension of space, this approach generally encourages the collaboration between the two branches of science and thereby ties together two bodies of knowledge that tend to remain separate. Thus, incorporating medical astrosociology into space medicine research and education presents a challenge. The historical approach previously mentioned above has led many to believe that astrosocial phenomena are not important enough to worry about; that is, when they even recognize their existence. Even worse, many social scientists do not even recognize the importance of these phenomena to the complete understanding of how medicine is practiced in space even when they acknowledge it on Earth.

Terrestrial physicians have a much greater recognition and appreciation for the impact of social and cultural forces due to their interaction with social scientists in the fields of *medical sociology* – traceable to the first publication to mention it by name written by Charles McIntire (1894) – and modern *medical anthropology* – established in the United States during the 1960s and the 1970s (see Scotch (1963), for example). Though more limited than should be the case, experts working in space medicine are most knowledgeable only about pertinent psychological issues. Expansion of the typical limited approach is necessary, and the history of terrestrial medicine should serve as a blueprint for future progress. Medical astrosociology, like its terrestrial counterparts, can provide valuable collaborative knowledge that currently remains incomplete.

It is important to note that the social and behavioral sciences were acknowledged in the past in the context of space medicine, as Douglas (1979:239-240) mentions:

The life-science disciplines play an important role in many aspects of space settlement design and operations. The three major areas deal with physiological and biomedical design requirements, psychology and sociology, and all aspects of closed ecological systems.

However, such acknowledgments do not necessarily indicate that physicians and experts in the field of space medicine pursued a truly interdisciplinary approach with any great sense of commitment or widespread acceptance. Medical astrosociology exists to encourage change in which the social sciences and humanities gain a much more respected and contributory place in research and education regarding the planning of medical institutions and providing input into the practice of medicine in space ecosystems.

It is well documented that the space environment, with diverse combinations and severities of conditions in different specific locales, is generally unhealthy for spacecraft and humans. Regarding the latter, negative effects of microgravity and varying gravity fields, impacts on the Circadian rhythms, different types of radiation, bone density loss, and muscle atrophy have received quite a bit of attention (see, for example, Pass, 2008 and Williams et al., 2009), which is not the focus of this more general discussion. Living in dangerous space environments requires the input of all types of scientists, be they “hard” scientists or so-called “soft scientists.” Each branch has important contributions to make, and together they can gain insights that neither branch alone could muster.

II. Space Medicine and Medical Astrosociology

In 2003, Williams (2003:254) argued that “although space medicine has been practiced for more than half a century, it is nascent relative to the clinical capability and knowledge required for long-duration space flight.” In comparison, astrosociology and its subfields are only a little more than eleven years old. Similar approaches that focus on psychological, cultural, and social patterns have addressed practical matters relating to crew performance, health, and safety for astronauts during relatively short missions, mostly in low Earth orbit (LEO). Understanding the challenges spacefarers will face during truly long-duration expeditions that traverse extrasolar space are much more serious and understudied, and so they will require more broadly defined inquiries and expertise from diverse scientists working in collaborative efforts that space medicine alone cannot provide.

Again, combining space medicine with medical astrosociology provides a holistic framework that creates a much more inclusive collection of concepts and variables. Biomedical, psychosocial, and sociocultural forces all impact on how successful medical interventions become in the end. Excluding the concerns of medical astrosociologists can only result in a continuation of the status quo in which only part of the social reality receives attention; a situation that will only reduce the quality of health care in space ecosystems. Health, whether traditional or digital in nature, involves much more than one often realizes. Politics, economics, religion, family, law and justice, morality and ethics – as some major examples of social institutions and standards of behavior that impact any health care system

and its operations – impinge constantly in ways that are both foreseeable and unpredictable. Space medicine without medical astrosociology fails to identify forces that reduce the health status of any given population, wherever it may reside beyond Earth. In an isolated and confined *social* space in *outer* space, this approach can quickly lead to disaster for everyone. The anxiety and stress related to the confinement and isolation alone can impinge upon the anxiety and uncertainty of suffering from an illness or injury even without other outside space-related dangers. When adding the other possible contributing factors of the space environment to the mix, the situation can worsen.

Any astrosociological approach involves theoretical and empirical work related to the relationship between space and society. In other words, the human dimension in a societal context is the focus. While medical treatment is a personal experience most obviously, the human dimension also refers to larger social and cultural patterns that involve interactions among people from different statuses including family members, friends, physicians, and various institutional decision makers, among many others. Space medicine does not address these aspects of medical care often enough or thoroughly enough, even though they impact on the quality and success of health care delivery.

The obvious component to the practice of medicine in space involves the biomedical focus. However, the fact that humans represent the target of medical practice in itself places limits on the ability for pure medical practice based exclusively on biomedical solutions to always solve the crises at hand. In other words, the social sciences are relevant because humans are involved. Because astrosociology generally focuses on the human dimension, medical astrosociology analyzes medicine in the context of society where human beings, being social animals, live.

Humans as the focus of medical practice also implies that practitioners are also human. This means that the health care system is inherently imperfect. The human dimension demands social scientific investigation by its very definition, whether the topic is medical practice in space or any other human activity, and wherever it may occur. It simply makes logical sense to involve social scientists to study similar issues that they have studied for over two hundred years in terrestrial communities.

III. Behavioral Health and Medical Astrosociology

Space research has in fact expanded beyond space medicine. The emergence of behavioral health as a framework to analyze the behavior and performance of space-based crewmembers and persons who may go to space social environments as well as analog social settings seeks to add behavioral analysis to the research methodology and knowledge base. The objective is to treat the entire scope of issues facing the crewmember: mind, body, and society.

NASA defines *behavioral health* as “the relationship between an individual’s behavior and the well-being (psychological and physiological) of the whole person (spirit, body, and mind) within his/her environment (cultural, vocational, social, and physical) (Shea et al., 2012:4). For NASA, the concerns associated with behavioral health include the following criteria (Shea et al., 2012:4):

1. “**Cognitive Performance** – An individual’s ability to utilize mental processes including memory, attention, and executive functioning within his/her environment.
2. **Psychosocial Adaptation** – Goodness of fit between an individual’s psychological strategies and the social exchange conditions of space flight environments.
3. **Task Performance** -- The effectiveness with which individuals perform goal-directed activities or provide needed materials or services that contribute to mission success.
4. **Teamwork** -- The level of effective coordination of team members’ cognitive, verbal, and behavioral activities to organize task work and achieve collective goals that contributes to mission success.”

Behavioral health tends to emphasize determining what affects the well-being of astronauts and crews (small social groups) and how to minimize the negative effects so that required tasks can get accomplished. The model is still based on the limited crew model rather than on a more broadly defined societal model that represents the approach taken by medical astrosociology.

The behavioral health approach, like medical astrosociology, requires formal interdisciplinary collaboration so as to achieve a much broader, more holistic orientation.

We can see the preliminary outlines of a comprehensive and continuing program in spaceflight behavioral health. A comprehensive program in spaceflight behavioral health will have to be broad-based; be interdisciplinary; and address issues at the individual, small-group, and organizational levels. It will require multiple, convergent methods including archival research, field observations, and both field and laboratory experiments (Harrison and Fiedler, 2011).

While psychologists and social psychologists are most likely to be involved in behavioral health research, a greater inclusion of different types of social scientists and humanists would prove much more beneficial.

The relationship between behavioral health and medical astrosociology presents an interesting reality. In a sense, the behavioral health approach takes a more practical and limited focus that deals with completing the goals of human missions with the least amount of astronaut harm possible. While inclusive, it remains small scale at the moment. In contrast, medical astrosociology focuses on a grander scale that looks at conducting medical practice in

a societal context, preparing for the eventual construction of space societies/settlements in which a large population will demand a formal medical institution. In the meanwhile, the two approaches have much in common, and experts in behavioral health and medical astrosociologists can, and should, work together to improve medical practice in space ecosystems. Performance during space missions is an important factor, and medical astrosociologists can contribute here, but maintaining health for indefinite periods in future space societies requires larger-scope research that only begins with behavioral health as it currently exists.

IV. Moral and Ethical Considerations

A good example of how social and cultural forces impinge on strictly biomedical concerns relates to the various moral and ethical issues that may arise while treating patients. They also have consequences for larger segments of the population and potentially the integrity of the spacecraft or habitat. Medically related social patterns in a space society affect the patient and those around him or her, but also the larger society. At micro and middle levels of analysis, moral and ethical considerations impact on how medicine is delivered directly to the patient and how persons close to the situation are affected. Additionally, at the macro level, improper decisions may create larger dangers that threaten the health and safety of non-patients beyond the immediate circle of actors and even the entire population (e.g., epidemics and life support or spacecraft/habitat integrity failures). Thus, moral and ethical considerations require investigation by social scientists in conjunction with medical personnel and scholars.

For the purposes of this brief discussion, there is a difference between morals and ethics that complicate a person's decision making and behavior even though each one relates in its own way to standards of right and wrong. *Morals* are defined here as a person's internal compass for determining right from wrong. Morals are internalized during the socialization process from significant others, or those individuals most important to the person including parents, siblings, and peers. These individuals have the greatest effect, as they impact on a person's emotional state, his or her behavior, and even that person's sense of self – that is, they shape who they are.

In contrast, *ethics* refer to external standards of behavior that one internalizes from outside sources. Ethics come from culture and generalized others who consist of people unknown personally and organizations in the form of rules and regulations. Generalized others teach a person what to expect from people with whom they interact.

The interplay between morals and ethics has implications for the health status of the population as well as health and safety conditions in a spacecraft or habitat. Medical practitioners in space societies must take moral and ethical contributing factors into account in order to gain a complete understanding of the situation. The patient's expectations as the receiver of medical attention are always affected by internalized standards that result from internal moral standards and external ethical dictates. How a patient reacts to medical care depends on how he or she resolves any conflicts between the two.

V. Treating the Patient

When treating a patient, whether in space or on Earth, it becomes apparent that he or she is incapable of carrying on with the normal activities and duties when not suffering from an illness or injury; and therefore, the patient is viewed as deviant. The inability to act normally costs society. Talcott Parsons (1951), an American sociologist, defined what he termed "the sick role" based on several tenets, which describe the role set of the patient while their master status becomes that of a sick or injured person. Parsons was a functionalist who viewed society as an interrelated system of parts, much like a thermostat. It always attempts to reach an equilibrium, or normal state, so that any deviation from that normative level is harmful and must be corrected to restore the balance. Therefore, sick and injured people are dysfunctional for society because they fail to contribute to its wellbeing.

Parsons (1951) argued that the institution of medicine is empowered by the state to regulate illness as a potential threat to the stability of the social system. Parsons conceptualized illness as a form of deviance because it can interfere with the performance of normal role obligations and place undue stress on other social institutions, especially the economy and the family. Through the fiduciary role of the physician, medicine regulates the extent of illness by limiting access to the sick role to those who are legitimately ill and by returning sick people to normal performance levels as quickly as possible. Parsons illustrated his model through an analysis of the solo-practitioner, fee-for-service style of medical practice that was prevalent in his time (Kortarba, 1983b:275-276).

Of course, things have become more complicated since Parsons performed his analysis.

The sick role includes specific characteristics. Patient rights include the understanding that he or she is excused from normal social roles and not responsible for the condition suffered. On the other hand, there are also obligations including the expectation that they should endeavor to return back to a healthy state and should seek assistance from medical professionals to do so. Problems with the sick role include the failure of the sick person to adhere to the sick role as defined by Parsons. Nevertheless, a benefit of the sick role model is that everyone understands what is expected of the patient and the medical institution.

Within NASA, astronauts are treated very well. A holistic approach, as much as possible without adequate numbers of social scientists, ensures that an astronaut's health is among the highest of any workforce (Kortarba, 1983b). However, contrarily, what happens to spacefarers who do not reside for most of their lives on Earth or work for NASA? For those who reside in a different space environment and in a far-flung space society, the health care system on Earth cannot help. The treatment of patients will have to be based on self-sufficiency, which could lower the health status of the residents of these extraterrestrial locales. Social science research will be invaluable.

VI. Health and Safety Violations

In the area of health and safety violations, deviance is taking place. In fact, an important area of theory and research involves a type of deviance associated with health, illness, injury, and potential death caused by actions, whether purposeful or accidental, by citizens of the space society that violate health and safety regulations. This implies, of course, that these regulations must exist for the protection of individuals and facilities aboard spacecraft and within habitats.

Social control exists to regulate individual and group behavior so as to encourage conformity. The enforcement of health and safety regulations contributes to social order, but it also reminds people of the need and importance of the rules. A space habitat, like any other human ecology, relies on rules to define acceptable risks versus unacceptable ones. Enforcement of formal rules is vital in order to maintain an acceptable level of risk while simultaneously allowing for the completion of sometimes dangerous tasks.

There is often a balancing act between defining acceptable risk and necessary risk (Pass, 2011:354).

Acceptable risk is defined here as that which is dictated by official health and safety rules and regulations. Necessary risk, on the other hand, involves taking chances that violate either the spirit or the letter of regulations in order to gain some type of advantage or benefit. It represents a violation, but one worth the risk according to the violator of the rule.

Additionally, a supervisor or higher manager may pressure workers to violate acceptable procedures in order to expedite repairs, for example. Falling behind schedule can place pressures on upper management to increase the level of risk. In such circumstances, health and safety violations are forced upon the worker who often has no recourse but to carry out the overly risky repair or procedure. Does the system provide the worker with options that allow him or her to disobey superiors? If so, what are the repercussions?

Any deviance requires social control, as stated above. Thus, punishment represents one option to deal with violations of health and safety regulations. The type and severity of punishment will depend on a number of different factors, including how important it is to keep a violator on the job due to the scarcity of replacements.

VII. Conclusion: Two Branches, One Tree

The two branches of science each possess their own advantages and shortcomings. Each one can address certain types of issues, though not all of them. While the "hard" science branch characterized by STEM subjects has rightly received the greatest level of attention and utilization, it is not enough as humankind moves forward in its exploration of space. The other, less utilized – and perhaps largely rejected – branch of science that was allowed minimal participation by the space community for social and behavioral scientists and humanists is becoming increasingly important. While the two branches have received uneven acceptance within the space community in the past, it is important to keep in mind that science is best represented as a tree with two major branches. A holistic approach remains the best approach for the future, and thus collaboration among scientists from both branches is vital for the practice of medicine in other space environments beyond from Earth's atmosphere.

Keeping with the same theme, space medicine traditionally focused on biomedical and physiological issues in a near vacuum. Impinging social and cultural forces were downplayed and even ignored, which was possible to a large extent involving small crews working under a quasi-military structure isolated from terrestrial societies. Astronauts and cosmonauts were confined with few distractions to interfere with their duties. This will change as they move farther from the control of superiors located on the Earth's surface.

Still, even during the recent past, problems developed, especially when conditions worsened – such as aboard the Mir space station aboard which fire, collision, and depressurization incidents occurred – and other problems developed such as overwork and relatedly too little leisure time, unrealistic timelines, and the development of too much stress (Dudley-Rowley, 2016). The results of such problems manifested as poor crew interaction, isolation, and psychological impairment. The one traditional branch of science equipped to handle physical problems was unable to cope with biological incapacity caused by psychosocial and sociocultural forces. In contrast, the social and behavioral sciences had already researched and developed knowledge concerning such matters within terrestrial societies. Valuable research findings and theoretical models exist that can be adapted to space ecosystems.

Additionally, past social-scientific investigations can inform researchers to ask new questions that fall outside the purview of the physical and natural sciences.

Human beings living in confined and isolated social environments will inevitably develop social and psychological problems to one extent or another. They are separated from Earth, which is unnatural based on their roots as Earthlings. Problems worsen if they remain for extended periods or permanently. Moreover, different groups of individuals living and working together will develop their own unique sets of problems.

Thus, each branch of science addresses a different set of issues related to the health and vitality of humans living in space, but they also overlap and interact. To reiterate, the physical/natural and social/behavioral sciences represent different branches of science, but they both belong to the same tree that we call “science.” They are two sides of the same coin, to use another popular metaphor, and together they can address and cope with health, illness, injury, and dying in a holistic and more comprehensive manner. Convergences in science and technology represent the future, and the most profound outcomes will potentially come from interdisciplinary exercises between the two branches of science (Pass and Harrison, 2016). Medical astrosociology encourages interdisciplinary approaches to understanding and reacting – even preventing – medical crises in the context of a larger social system with social and cultural forces. Medical astrosociology also addresses larger social and cultural patterns in a larger societal context beyond specific patients, such as inequality in the health care system and other macro-level patterns.

Application of the *astrosociological imagination* is crucial for the astrosociologist. The ability to identify and analyze astrosocial phenomena in the context of space-based medical practice is a crucial skill that must be developed. When space medicine focuses exclusively on the traditional biomedical issues, it cannot take into account all aspects of treating a patient or the larger societal and cultural forces that surround treatment decisions. Family members and other significant persons in a patient’s life, as well as influences from larger society, affect that patient’s behavior and decision making process. It is important to remember that medical personnel do not make decisions alone, as they do not live and work in isolation. Thus, social-scientific issues impact on medical practice. Moreover, social patterns exist in any society that combine biomedical issues with other facets of society and culture. Formal collaboration is vital.

Medical astrosociologists need to work with those involved in behavioral health research, partly because many of them work for or with NASA and other space agencies. New aerospace companies will soon send tourists, scientists, and others into space for various durations, so it will be important to work with them as well. The importance of medical astrosociology will only increase as we move forward.

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