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Issue 5



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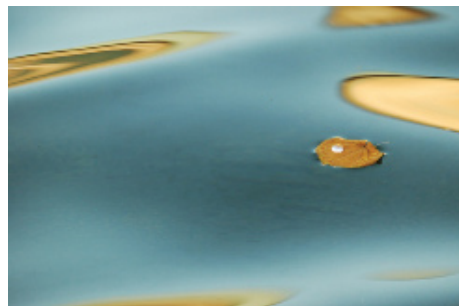
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Inside this Issue



From the Cover

This image was a submission to the University of Michigan Library Photo Contest. It is of a leaf floating on the water of a fountain near Duderstadt Center

Image courtesy of Jeongdae Im, 2nd year PhD candidate in Civil and Environmental Engineering.

Campus

1 Engineering In Action: Follow up with the Michigan Mars Rover Team
Kohei Fujimoto

Interview

2 Dr. Arul Chinnaiyan: The Michigan Research Experience
Nirmish Singla

News Briefs

3 Recent Research at the University of Michigan
Jane Xiao

Viewpoint

4 HIV Transmission and Peer Influence on Female Sex Workers in India
Sara Baumann

Review

5 Orofacial Anomalies and Treatments in People with Down Syndrome
Christiana Markova

Report

6 Enhancing the Understanding of Anatomy Through the Coloration and Plastination of Anatomical Specimens
Adriane Marchese

Research Article

7 The Effect of Time and pH on Hemolysis During Cardiopulmonary Bypass
Ankush Bansal

8 Exploring how Culture Influences Religious and Spiritual Beliefs in the Indian Health Care Setting
Christopher Aten

Engineering in Action: Follow up with the Michigan Mars Rover Team

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Background

The Michigan Mars Rover Team was created in March of 2000 with two main goals: to design, build, and test prototypes of a pressurized Mars rover for a human mission to Mars and inspire and educate students about space and Mars exploration.

Since its creation, our team has conducted research on a conceptual pressurized Martian rover, and an analog prototype based on a U.S. Army flatbed cargo truck. In 2005, we participated in the Revolutionary Aerospace Systems Concepts Academic Linkage Forum conducted in Cocoa Beach, Florida. We presented our research, “Universal Chassis for Modular Ground Vehicles,” and won 2nd place in the undergraduate category. Since then, the team’s focus has shifted to making this abstract concept into a concrete engineering design. We are currently working on a test bed for control systems and dynamics evaluation.

For a more detailed description of our team’s history and past research, please refer to “Opportunities at Michigan: The Michigan Mars Rover Team” by Matthew Van Kirk in the 2006 issue of UMURF.

The Universal Chassis Concept

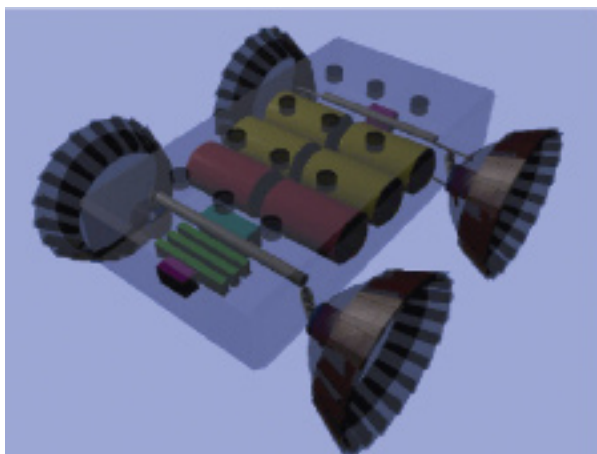


Figure 1: Image reprinted from *UMURF: Winter 2006*, System diagram of the universal chassis concept.

Lunar and planetary exploration is the next frontier in human space exploration. In 2005, the United States Congress authorized a vision for space exploration, which in-

cludes goals such as returning to the moon by no later than 2020, extending human presence across the solar system and beyond, implementing a sustained, affordable human and robotics program, and developing innovative technologies, knowledge, and infrastructures.

The development of highly advanced exploratory rovers is crucial to the success of such missions. The Mars Exploration Rover Mission rovers, although state of the art technology, run at a top speed of 0.18 km/h and have a payload of 45 kg. Rovers necessary for human exploration assistance would require speeds of 20 km/h and a payload capacity of 3000 kg. Furthermore, with the current approach of rover design, multiple rovers for each specific mission would have to be designed from the start thereby inflating budgetary and time requirements.

The universal chassis concept offers a solution to these problems. This method allows for a chassis that would support multiple payload modules through leveraging automotive technology and developing standard components for a universal chassis design. The chassis comes in three classes, the largest one holding up to 3000 kg of payload at speeds of 20 km/h.

When analyzing the long-term requirements for surface mobility, new ground vehicles will likely be developed and deployed every few years over the next several decades. The universal chassis concept avoids the need for development of multiple specialized vehicles and the need for a complete vehicle redesign every few years. It supports all surface mobility with one development program.

Increased mission efficiency can be achieved through the use of a modular rover design. A single base chassis would provide the mobility and power generation requirement that every mission needs. Different modules could be mounted on the chassis using standardized connectors to specialize the rover for the particular expedition it would be making on any given day. For example, one day the rover could be used as an all-terrain vehicle to provide quick transportation to a research site with a seat and steering module installed on top. The next day it could be outfitted with a high resolution camera, a digging tool, a spectrum analyzer and a computer interface to act as a mobile research station that could follow a team of astronauts as they explore a point of interest.

Current Research

Current research on the universal chassis can be divided into two categories: control system programming and fabrication of a half-scale model.

In February 2007, we began constructing a test bed to help integrate software control into the drive, user interface, and cornering portions of the chassis design. Experimentation with these aspects of the control algorithm allows us to develop software more efficiently. The test bed was initially a very simple setup, with electric wheelchair motors connected directly to batteries. In March, a microcontroller was installed, along with H-bridges to control current into the motors electronically. This



Figure 2: Team members working in the mechatronics lab at the Wilson Student Team Project Center.

enabled us to commence actual software development. We added more hardware during the fall 2007 semester, including a joystick input device and optical encoders. Software to run and control the new hardware was developed simultaneously. Most notably, the optical encoders opened doors to feedback loop control, and the ability to track the motion of the testbed.

Another important aspect of our current research is the construction of a half-scale mechanical model of the small chassis class. The dimension of the model will be approximately 1.0 x 0.5 x 0.3 meters and will be made of DOM steel. We began working by creating an initial CAD (computer aided design) model in early 2007. It was intended to clarify design constraints such as size, weight, cost and ease of fabrication. We concluded that a box-frame design was the most feasible, and also the easiest to expand to accommodate for future features.

Throughout the previous semester, we practiced fabrication techniques required for the project and familiarized ourselves with the machines in the Wilson Student Team Project Center. We also started machining some of the simpler components of the chassis, such as the box frame and encoder disks.



Figure 3: Team member working on a CAD model of the mechanical model.

Future Plans



Figure 4: Team members with the control systems test bed.

In the coming months, we plan to add environmental sensing capabilities to the test bed by means of inertial measurement units (IMUs) and infrared sensors. This will enable us to add autonomous features. For example, combined with direction sensing of a radio signal, the test bed can be expanded to follow an astronaut around while avoiding obstacles at the same time. As for the half-scale model, we plan to finish building the main frame by the end of the winter 2008 semester. We will then go back to the CAD model to design further details such as the suspension and wheel/in-hub motor systems. Optimization techniques such as finite element analysis will also be incorporated in order to minimize weight and material costs.

Our ultimate goal is to integrate the efforts of the control system test bed and the half-scale mechanical model by the end of winter 2009. Then, we can start research on particular modules that we can attach to our model. Incorporation of fuel cells is also another important of the Universal Chassis concept that can be investigated at this

point. The project will become ever more interdisciplinary, branching throughout the engineering disciplines from chemical to mechanical to computer science.

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Dr. Arul Chinnaiyan : The Michigan Research Experience

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Dr. Arul Chinnaiyan is an S.P. Hicks Endowed Professor of Pathology and Urology at the University of Michigan Medical School. He received his B.S. in cellular and molecular biology from the University of Michigan in 1992 and his M.D. and Ph.D. in pathology from the University of Michigan Medical School in 1999. He is a recipient of the 2006 Burroughs Wellcome Fund Clinical Scientist Award in Translational Research and of the 2007 Ramzi Cotran Young Investigator Award from the United States and Canadian Academy of Pathology. He was awarded the 2005 AM-GEN Outstanding Investigator Award from the American Society for Investigative Pathology and most recently earned the 2007 American Association for Cancer Research Team Science Award for his groundbreaking discovery of gene fusions in prostate cancer. He was appointed as a prestigious Howard Hughes Medical Institute investigator in 2007, an honor granted only to the 15 top physician-scientists in the nation per year.

Currently, Dr. Chinnaiyan is the Director of the newly instituted Michigan Center for Translational Pathology (MCTP), whose mission is to gain a more comprehensive and systematic understanding of the molecular basis of cancer and to analyze tumors of different cellular origins in order to chart repeating gene rearrangements and gene fusions. The ultimate goal of the MCTP is to aid in the diagnosis, prognosis, and treatment of men with prostate cancer and to extend their findings to cancers of other organs, including the breast, lung, colon, and skin.

As a UROP Biomedical and Life Sciences Summer Research Fellow in the MCTP, I had the privilege of interviewing Dr. Chinnaiyan to gain insight into his own development as a young scientist and to hear his thoughts regarding research opportunities available to undergraduates today

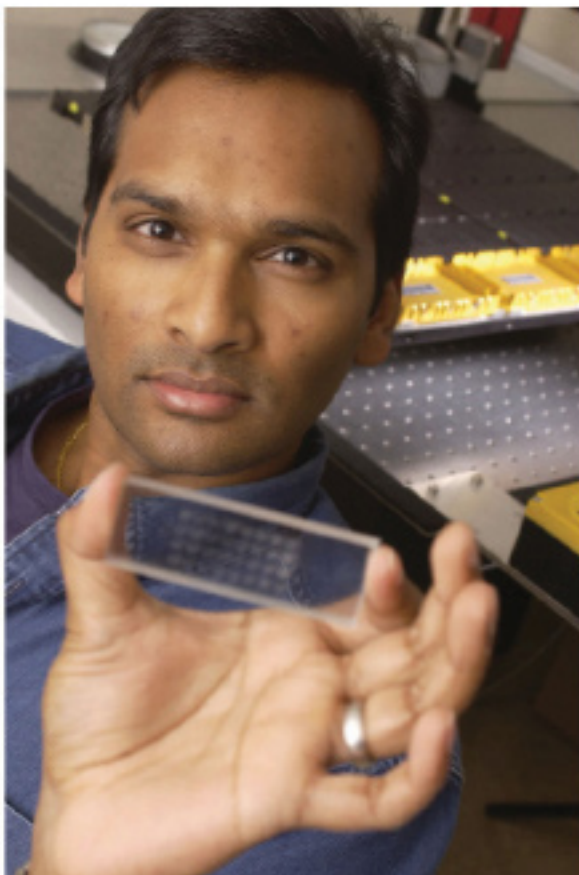


Figure 1: Image courtesy of the University of Michigan Health System, Dr. Arul Chinnaiyan

Could you talk a little bit about when you started your initial research career and how you got involved?

Since high school I've been really interested in biology in general. I think my first research experience was in the laboratory of Steven Weiss, who's actually at the Life Sciences Institute here. I did a summer rotation with him as an undergraduate and pretty much stayed in his lab all the summers as well as part of the time during the year. I was an Honors student in LSA in Cellular and Molecular Biology, and you had to find somebody to do an honors thesis, so Steve was the person that I worked with.

Do you feel that your initial experiences were crucial in determining where you are today?

Yes, definitely. It gave the foundation and impression to move in that direction where the dedicated research that I did during my undergraduate time had a huge impact on the next lab that I selected for my graduate work—it sort of colored what I was moving towards.

In terms of the opportunities and resources available to you at Michigan as an undergraduate, how do you feel the resources and opportunities have changed today, and are there any areas that you would like to see improved?

I don't exactly know what there is today relative to back then, but I believe that there are more resources available now, and there's certainly more of an organized program to encourage students to go into research. It certainly was there when I was doing my undergraduate, but I think it's much more organized, and it's important to continue to invest more resources in that area because that drives things forward in the future. I think it's really the training of individuals at this level that will be a payoff down the road.

Did you find that you had ample resources in terms of scientific publishing/writing and the ability to gain skills in presenting at conferences/poster presentations?

I think the main things that I learned during my research experience were critical thinking—how to think about scientific problems—how to further develop the writing skills that I had, and to some degree, presentation skills, but that probably wasn't emphasized as much. Those are certainly things that one should try to get from their undergraduate research experience.

Have you found that staying in Michigan throughout your entire postsecondary education career has benefited you?

I think it has. It's really given me a head start at each transition where I already had a network of individuals that were allies—or mentors—at each stage that I could rely on for different advice on different things. Initially I was hesitant to doing that, because at each stage I was looking at other places to move on to, but I think that it certainly has helped me move forward at the pace that I have. Possibly relative to others, I think it has given me some advantages that I didn't necessarily know were there, but I would say that is the case.

What initially encouraged you to pursue both an M.D. and Ph.D., as opposed to one or the other?

I think it was really my undergraduate research experience, which was at the University of Michigan. I did about four summers of research in the lab and some research during the year, and that really inspired me to do biomedical research. I didn't want to be only a physician; I wanted to be involved in cutting-edge research at the same time, and that was, I thought, the best venue to make that happen.

Have you found that having both an M.D. and Ph.D. have benefited you in any way?

Yes, definitely, because you get respect in both camps—in the Ph.D. camp, which is more basic-oriented, as well as in the clinical camp with M.D.'s. You can work in this middle-point or gray-zone of translational medicine, which is basically trying to translate discoveries from the basic end to the clinical end. I think that's really where the M.D./Ph.D. helps.

What advice would you give to students who are unsure if a dual M.D./Ph.D. is the right path to follow?

I think one thing is that they would have to be really passionate and interested in research, in doing whatever type of research that might be. That would certainly be an important requisite. You probably don't want to do it if

you're not interested or if research is not fun to you; then it's probably not the best strategy to take so many years dedicated to doing that. I think that's the main question: if they love to do research then it's a great opportunity to do it.

What do you feel is the university's greatest asset in its research? Federal funding, faculty, its size, or perhaps another factor?

I would say that the major asset is really the faculty—the graduate students, the undergraduate students. The M.D./Ph.D. students are especially very valuable in driving some of the biomedical research, but I think that composite is really the asset. And the fact that I think they all are pretty collegial in nature is a major asset here at the University of Michigan that potentially distinguishes us from other equivalently high-profile places.

How do students fit into the university's research framework?

Students certainly are here to get interested in science, get inspired by science, and really develop an initial foundation or framework to take the next steps in their career. I think that's really ideal.

Do you have any advice or words of wisdom for upcoming scientists?

The main piece of advice is to have fun with what they're doing—to be passionate about the research problem that they're tackling. I think that's the main piece of advice. If that's there, everything else falls into place.

Recent Research at the University of Michigan

Lung-on-a-chip yields new information about respiratory “crackles”

Researchers at University of Michigan have designed a small chip device that mimics *in vivo* conditions, allowing cells to behave and function as they would in the smallest air passages of the lungs. The quarter-sized device consists of a porous, polyester membrane sandwiched between two sheets of etched rubber, forming essentially two chambers. One chamber contains lung cells cultured within the device and the other chamber simulates the airway of the lungs. Researchers used this device to study how the cells are affected when respiratory crackling occurs. Crackling sounds have been thought to be symptoms of diseases such as cystic fibrosis, asthma, or congestive heart failure. They occur when patients with these lung diseases inhale, bursting the thick fluid plugs that clog the small airways. By generating plugs within the device and bursting them, researchers observed that bursting these plugs produced strong and focused shockwaves that quickly killed many of the once-healthy lung cells. Crackling, assumed to be a symptom of lung diseases, is now thought to also be one of the causes of lung damage. Findings were published in November 2007 in the *Proceedings of the National Academy of Sciences*.

Discovery of Psoriasis Susceptibility Gene PSORS1

After 30 years of searching for a gene associated with psoriasis, an inflammatory skin disease, scientists have finally identified a major contributor to this multi-factorial disease. Rajan Nair, Ph.D., the first author of this study, identified the first genetic cause of psoriasis, PSORS1 (psoriasis susceptibility 1), in what is considered to be one of the most comprehensive studies on the inflammatory system gene. However PSORS1 is only one trigger of many other genetic contributors to this disease, which is also thought to be caused by certain environmental signals as well. Scientists used haplotype mapping to find this susceptibility gene. This discovery has the potential to lead to improved treatments for psoriasis.

Touch Screen Voting Equipment

A new study by the Universities of Michigan, Maryland, and Rochester finds that voters place more importance with the voting experience than the security of the ballot they cast – the opposite view of most election officials. Voters favored systems that were the simplest to use and took the least amount of effort. Researchers found that voters tend to vote with greater accuracy on the paper ballot/optical scan systems and standard touch screen systems. However the paper ballot/optical scan systems did not allow voters to easily change a vote or cast a write-in vote. Findings were published in the book “Voting Technology: The not So Simple Act of Casting a Ballot.”

Spooky Action-at-a-Distance

Scientists have taken the next step towards the existence of what could one day be a quantum ‘super-fast’ internet. Researchers used light and fiber optics to “entangle” two atoms separated over a meter apart. Theoretically the atoms could remain entangled even if on opposite sides of the world according to Dr. Christopher Monroe, the principal investigator who did this research while at the University of Michigan. These entangled atoms could be used to store bits of information just like a conventional computer, as a 0 or 1. But the entangled quantum bits of information are special because they always mimic each other; when one atom is 0, the other turns into a 0. This would allow a future “quantum internet” to transmit so fast that current encryption machines would become obsolete. The findings were published in the September 2007 edition of *Nature*.

Americans and Prescription Drugs: Paying more but Taking less

A new study shows that American dialysis patients are more noncompliant with their medication. Researchers from the University of Michigan School of Public Health collaborated with the Arbor Research Collaborative for Health, and other university health departments to look at drug costs and adherence in hemodialysis patients in 12 countries. Dialysis patients were chosen as the study population because of the uniformity of treatment approach in all countries. Although patients in America have the highest out-of-pocket costs, this only partly explained the noncompliance. It was suggested that reducing co-payments for some subpopulations would be most effective for improving compliance. Findings were published in *Health Affairs* in January 2008.

Belly Fat Linked to Heart Disease

Scientists from the University of Michigan Cardiovascular discovered the link between inflammation around belly fat cell deposits and atherosclerosis, hardening of the blood vessels near the heart, from mice experiments. Although the correlation between being overweight and high risk of heart attacks has long been accepted, the exact link between the two has, until now, not been clearly elucidated. Daniel Eitzman, M.D., and his team had been trying to transplant fat clusters from normal mice into mice lacking leptin (the hormone produced by fat cells that controls appetite) when unexpected results led them in a new direction. It was observed that mice with belly fat transplants developed atherosclerosis at an accelerated rate, indicating a connection between macrophages causing the inflammation and atherosclerosis.

After using the anti-inflammatory drug pioglitazone to reduce the number of macrophages, atherosclerosis was reduced in the transplant mice. Findings were published in the February issue of the journal *Circulation*. Future research will be directed towards looking for what might cause macrophages to attack a certain area to cause inflammation.

-Jane Xiao

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HIV Transmission and Peer Influence on Female Sex Workers in India

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Abstract

This initial project was designed to become acquainted with the lifestyles, issues, and concerns of female sex workers in Vadapalani, Anna Nagar, Saidapet and Thyagaraya Nagar regions of the city of Chennai, India in order to determine whether or not peer influence is a central reason that women enter the sex work industry. It is known that many women enter the commercial sex business to support their families, and provide for their children's needs, but the extent to which the female sex workers are influenced by others to enter this field of work is unknown. The study contains 20 personal interviews with women from these areas ranging in age from 26 to 52 focusing on how female sex workers come to enter this field, the influence that women in sex work have on each other to enter the field, the pressures that are produced by certain groups in society to enter this field, and from whom these pressures arise. Results indicated that the highest influential factors on these women to enter the sex work do in fact come from the pressure and influence of others including friends, family members, and neighbors. The study also assessed how different women respond to stigma, and how women from different backgrounds feel about their work. Additionally, I asked questions regarding HIV/AIDS to gauge concerns about HIV and the ease with which women can access HIV tests. Overall, I found that meeting family economic needs are the biggest reason women enter this field, and 95 percent of the women claimed that they discussed, were pressured, or influenced to enter the sex work field by another person.

Introduction

It is believed that HIV/AIDS entered India for the first time through sex workers in the late 1980's, but the HIV virus in India was not diagnosed as such until 1986.⁵ Dr. Suniti Solomon and her team were the first to diagnose HIV at Madras (now called Chennai) Medical College when testing the blood samples of 100 arrested prostitutes.² The Center for South Asian Studies at the University of Michigan sponsored my study under the topic of female commercial sex workers and HIV transmission in Chennai, India allowing me the privilege of working in Dr. Solomon's organization, YRG Care, Center for AIDS

Research and Education, in the city where the virus was first diagnosed.

Aims and Objectives

This study was designed to understand the extent to which peer pressure affects women's entrance into sex work, particularly that from friends, neighbors and/or family members. The study aims to understand how female sex workers personally feel about their work and the stigma associated with their job by asking questions relating to outsiders knowledge about their work. I also focused on HIV transmission and the concerns of female sex workers about HIV/AIDS by asking questions in regards to HIV testing, test accessibility, and the status of the test. This research study offers data about many of the feelings of stigma, HIV, and peer pressure in the commercial sex business for females in Chennai. This research may help develop more sustainable programs in HIV/AIDS education and women's rights/ roles and help support women coping with the stigma associated with sex work and/or HIV/AIDS.

Study Design and Method

A questionnaire was conducted with 20 voluntary female participants in the commercial sex business who utilized the YRG Care Community Research Facility for alternative studies and services, such as regular HIV testing, HIV education programs for women, maternal health testing, domestic violence education and empowerment programs. Although two of the women in the sample work for a brothel, in all of the cases they were not physically forced into their work, but made the decision based on many outside factors. In this study, every woman except one mentioned that they entered either because of a suggestion from a friend or by contacting someone close to them that was in the sex work field or had knowledge about how to enter it.

The study also contained a group of randomly selected volunteers from a cruising venue in Vadapalani, Chennai. The questionnaire (supplementary information) was conducted and audio recorded by a native English speaker with translations completed by two native Tamil speakers. For each participant informed consent was taken and each interview was confidential. Depending on the responses received, each interview took between 15 and 30 minutes.

Since many of the questions in this study are considered personal questions, the voluntary participants had the opportunity to refuse to answer any question, or stop the study at any point in the interview. After the interviews were completed, participants received compensation of 50 rupees for their time and effort.

The data was transcribed from audio to an excel matrix questionnaire in order to quantify their answers.

Results

Overview of Sex Work

From my observations, sex work and prostitution in India is distinct from other developed countries. Not only does India “lack the scientific laboratories, research facilities, equipment and medical personnel to deal with an AIDS epidemic, [but there are also extremely high] cultural taboos against discussion of sexual practices”.⁵ When women enter sex work in India, it is typically due to a financial struggle to support themselves and their family, but they cannot discuss their sex work freely with anyone. It is a topic that is pertinent to the spread of HIV, but it is also a difficult topic to discuss with Indian women because it is a “cultural taboo” in India.⁵

All the women I spoke with indicated that they are in the business because of financial struggle and need to pay for a good life for their children. Unlike the United States and other developed countries, and due to cultural differences between the role of men and women in society, it is very difficult for women to find an adequately paying job, let alone to find a job at all in India. The majority of women in India do not work for pay; they are stay-at-home wives and mothers who take care of all the housework. Additionally, many marriages in Chennai are arranged marriages and may lead to unhealthy marriages, or a feeling of unfairness among the women.⁴ A high rate of domestic violence within these marriages in Chennai slums affects “women’s ability to protect themselves from HIV/AIDS”⁴ and may also be a reason that women turn to sex work to escape this lifestyle.⁴ All of these factors – arranged marriages, difficulty for women to find work, and needing to support a family – are reasons that many women have turned to find work in the sex business in the slum areas of Chennai.⁴

There are many different aspects to sex work in India and all over the world. Specifically in India, sex work is very high in the four largest cities of Delhi, Mumbai, Calcutta, and Chennai. However, the mode of sex work varies in each of these cities. There is a brothel type of sex work where women are often forced into sex work by a relative or friend and they typically pay commission to the owner of the brothel. “Although sex work is not strictly illegal in India, associated activities- such as running a brothel- are”. It is more difficult to study brothel types of sex work because it tends to be very secretive, so we cannot estimate its prevalence. Then there is the cruising venue sex work, which is the majority of sex work that we know about in Chennai.

This includes women finding their clients at different venues around the city. There are 5 different zones in Chennai, and in each zone there are different locales that a female may go to meet a client. These cruising venues typically include bus stands, but now also include many cinema theaters. Lastly, there is also a market for prostitutes in the university student population.¹ Moni¹ states that:

Some findings indicate that a sizable proportion of unmarried students visit prostitutes. For example, a survey conducted in a red-light area of Calcutta found that eight per cent of the customers of prostitutes were students and another survey in a Bombay red-light area found the corresponding figure as high as 30 per cent.

In addition to the modes of sex work that characterize Indian cities, it can be difficult to obtain a sample of female sex workers in India because they do not visually stand out the same way as prostitutes stand out in many other countries, such as the United States. In the U.S., sex workers are often seen wearing a certain type of clothing that distinguishes them as a sex worker, but in India the women are dressed and conduct themselves in the same manner as many other women. It is difficult to distinguish female sex workers in the communities unless you spend enough time in the community, getting to know the families and the roles of different community members. By spending time in the community a researcher can establish relationships that allow discussion of difficult topics, specifically relating to the area of sex work. Fortunately, YRG Care has established relationships in the communities of the women that I interviewed, so the sex workers in these communities were easily identifiable with the assistance of researchers that had been working in this field.

Reason for Entering Sex Work

One woman aged 46, who has been in sex work for 12 years, said she initially worked in a plastic company before coming to sex work, but she was harassed as a woman in her workplace so she left her job. She didn’t want to enter the field of sex work but she had no other option. Additionally, she only found out about the risks of HIV/AIDS and other STDs after having entered the field.

Another woman explained, “I went seeking for a job, and the person said ‘Why are you coming to this job, I will introduce you to a better job’”.³ My interviewee stated that such brokers are making huge commissions via innocent women, upwards of 500 rupees (\$12.50) per client, which in many cases could be close to 100 percent of the female sex worker’s earnings per client, so they are left with barely enough to get by. Although she wishes she didn’t choose sex work, this woman thinks that she would have joined it sometime in the future even if she had not met the two women in her workplace (who were recruiting and helping women find clients in order to make commission), because it is the only job that she

has found that can meet her financial needs.

These examples reiterate that the reason most of these women have entered the sex work field is because of the money. This was voiced by a 40 year old woman that has been in the business for 10 years. She explained that after having two kids, they were the reason she came to this work after her husband left her. In Chennai, entering sex work has a focus beyond the prostitute's individual needs, but it is, about being the support that a woman's family deserves. In other places around the world, sex work is sometimes perceived by certain women as a means to luxuriously support oneself, in Chennai, these particular sex workers are striving to make enough to support their families. Many of these workers are able to make much more than they would in a more formal job. For example, one woman who entered the field 20 years ago explained that making 1500 rupees (\$37.50) per month at an ordinary job was "simply not enough", and the only other option to make enough money to make ends meet was by working in the sex work field. Now she is making upwards of 2000 rupees (\$50) a day, and has the economical means to support herself and her family. As one woman told me, "I am only happy about my work because I am solving my family problems".³ Further, another woman entered the field of sex work after her late twenties because her child was having liver problems and her family was facing many medical expenses. During this time her husband was not working, he was only staying around the house and he would beat her. The woman claims that she had no other choice but to seek out a job in order to pay for her child's medical expenses.

Sometimes the women I interviewed had to take action even when their husbands did have jobs. One 30 year-old woman lived with her three children and her husband, a cycle rickshaw driver but her husband had failed to work recently, and they lost the ability to send their children to school. Sometimes even when a woman's husband is working, he may only be making a meager income, as little as 100 rupees (\$2.50) a day and only providing the woman with 20-30 rupees (50-70 cents) per day to take care of the family. In other instances, when women are widowed they are left with few options but to enter the field of sex work. Three women I interviewed sought work in a different sector such as the construction field or a plastic company, but either the job did not provide enough income or they were pressured by someone at that job to go into the sex work.

Finally, there are other cases in which women just get thrown into sex work. These women are vulnerable and tired of searching for other options, and when someone gives them an opportunity they take it. Many times it may start off as simple as a neighbor's offer, "Come with me I will take you to a place where you can make a lot of money".³

Summary of the Mode of Entry into Sex Work

For a quarter of my sample, it was typical for a neighbor to introduce the women to one client and get feed-

back from the woman about her independent decision to do this kind of work. It is not difficult for the woman to then find more clients, but sometimes the neighbor will assist in getting them started. In one instance, a male friend referred his friends to a woman as clients, but in other cases the neighbor or friend will take the women to a cruising venue in the city and stand with her while clients approach her in order to introduce her to the business.

In other cases, interested women will go straight to individuals that they know are involved in the sex work business to find out how to start their work in the business. I talked with one woman who sought out the sex work field on her own because she was facing financial difficulty. She went to a meeting where a Non-Governmental Organization (NGO) was conducting an awareness program, she utilized the meeting to meet more people and find out about the field. At this meeting, women currently involved in sex work would not actually help the woman interested to find clients, but the interested woman was able to gather information about the issues and concerns that the sex workers face.

Finally, women can become involved via brothels as well. One woman was approached by her neighbor who asked her why she was going for work outside of the home because she could earn a lot more money if she worked for her brothel. What happened in this case was that the woman running the brothel introduced a prospective sex worker to a client and sent the woman and the client to one of the rented houses in the brothel system. As a result, the woman turned to sex work because it offered better financial choices, and she was not warned about the risks. In the second case involving a brothel the husband of a woman was running a brothel in their home without her knowledge. The woman did not know about the brothel until after her husband passed away. After her husband died she was left with nothing and she took over the business, and thus entered the field.

Overall, it is women who are in financial trouble that are sharing information about this type of work with a close friend, relative or neighbor, and through them the option of becoming a sex workers arises and entices the women to join. Frequently, it is only after a discussion with another person that they decide to start this work.

Unfortunately, only once did a woman tell me that her friend told her about HIV/AIDS and to use a condom when entering this field. For the most part the women learned about the risks of HIV/AIDS after entering the field, and learned about condom use through NGOs. For this reason many of them now realize the impact of HIV/AIDS and how important it is to use a condom. Now many of these women from the previous generations in sex work are informing future sex workers about the risks and how important it is to use a condom because of the importance of taking precautionary measures to limit exposure to STDs.

Peer Influence

I asked the women I interviewed: "If another woman approached you asking for help in joining the sex work profession, would you help them?" One woman replied: "Definitely I will help them. If they are willing to join I will specifically tell them about HIV/AIDS".⁴ In contrast, another woman replied "Definitely not, I would feel too shy and embarrassed so I will not tell them to do this work. I would offer them housemaid work".³

In most instances, women found out about this field because of someone in their support group. Women within small villages live as a part of a close knit and intimately interactive community. These women often confide in their neighbors about personal issues such as family and financial problems. Women often discuss means of making extra money. Interviews revealed that 19 out of 20 women did not actually decide to enter into sex work until after consulting with neighbors, friends and family members in their support system.

Over half of the women interviewed have not had a chance to have any influence on others, but 40 percent of the women responded that theoretically they would help others enter the business if they were given the chance. "I would just help them to solve their financial problem, that is all. Once they start in the field I would not really be in touch with them".³ On the other hand, 60 percent of women said that they would never tell other women to enter this field. Overall, most of the women expressed that it was important to present the risks involved with entering the field, and leave the final decision up to the women.

Only two out of twenty women I talked to expressed strong feelings against women entering the field of sex work. "I would never advise anyone to go into this field. It is a bad field; you can go to any other job" (52 year old, retired female sex worker). Another woman said that when other women approach her she will hand them whatever money she had, and tell them to go another way and say, "I am facing a lot of problems, you do not want to join this work".³ Another woman expressed that she advises others against the sex work industry as she would to her own children. For instance she would say:

*Why don't you go work in a company? I have three children who have studied up to undergraduate level and if any girl like my daughter approached me I would look at them like my daughter and would advise her as such and tell her she wouldn't want to join [this job]. I think I need to play a parental role and give good advice [to women].*³

Interactions outside of sex work- Stigma:

For the most part, these women do not ever share all their concerns with one another. Many self-help groups exist within communities in Chennai, especially for women in the sex work field, but the subject is never explored in much depth among sex workers nor with women outside women face when talking about their work with others:

"I feel guilty that I am going the wrong way".³ These women fear others will form a poor opinion of them. The more people that are aware of an individual's involvement in the sex industry, the more opportunities there are for complications in the future.

For example, one woman claims, "I don't tell the neighbors because at any moment, if we have a fight, the women will tell my husband that I am going for sex work".³ Moreover, another woman who says that she helped three other women enter the field says that if she helps many people, too many people will come to know that she is in this field. Therefore, some women may choose to help other women facing financial difficulty enter the field but thereafter, these women typically limit their interaction with each other because they do not want their involvement in sex work to be discovered.

Some women share the knowledge of this private work with their family. However, most keep it a secret. Often times, families, especially children, would be devastated if they were to uncover this secret. I listened to the concerns of woman who feared that her children would find out. In contrast, I saw some female sex workers bring their children to our NGO educational meetings. The woman's willingness to share information about her profession varies greatly depending on whether the woman feels ashamed that their families find out about their work. One woman told me, "If [my children] come to know I will tell them frankly, I would try to explain to them [my work]. Otherwise if my children found out I would tell them that I would leave the job, but at the same time I would still have to go out for this work".³

Some women will go so far as to tell others that they are going outside the house during the day for housework. For example, during the day after the children leave, the mother will also leave to meet clients, but will hide it by informing very few people. Community members often wonder where the family is getting the money to provide for its expenses, but because the information on personal finances remains undisclosed, they often assume that it comes from friends or relatives.

Although most of the women are confident, many of them still have a strong underlying fear of being found out as a sex worker in their communities, so they cover it up in order to continue to make the money to make ends meet.

Commission

Some women enter the sex work field through a third party who charge a certain percentage on each client that the woman services. Many times commission is only charged in the beginning when the women are first introduced to the field and do not have any of their own clients. But there are still other cases where some women who are in brothel sex work are still charged a certain amount on each client. Therefore, when these women recruit other women to the industry, they charge them commission on their clients, and assume a percentage of their income. In many cases it is the women sex workers

themselves who are perpetuating the sex services business by encouraging its expansion and increasing their own profits. "I want to help women to join so I can make more money. I can make more commission from helping other women find clients".³ I talked with one woman who showed more than five women their initial clients in the sex work business, but she said: "Only if they give commission I will help, otherwise I can't give [them a] client."³ This woman asked a minimum of 50 rupees (\$1.25) per client.

Conversely, there are other women who are completely opposed to charging commission on clients to new women entering the field. One woman states, "I will not get money from them because they are also coming because they have a problem. This would be like a robbery".³ Another woman says, "I will not get any money. They have a problem and I am getting an opportunity to help them".³ Overall, there was a difference between the women running the brothels who were not actual sex workers themselves, but organized the clients and therefore had to make a profit somehow, and that is why they charged commission. The majority of the female sex workers decided not to charge commission because they were already making enough money through their clients. This was an individual choice and varied throughout the sample.

Social Support System in Sex Work

In Chennai, the evidence I found for a social support system between females in sex worker was surprisingly low. All 20 of the women stated that they did not have a strong support system between the female sex workers in Chennai- they were not looking for support but they were looking for a source of income despite the social costs. Women are not usually encouraging one another to join this work to build a stronger network; they just share a mutual understanding of the financial bind that many women face in Chennai. Many women said, "If more people come to join me, it will not affect me".³ The women believe that the effect of having many more women join the sex work industry is not going to have any implications on availability of clientele for the current sex workers, nor is it going to help them improve their social status or support network.

Although it appeared as though current sex workers should have been affected if more women joined them at the bus stands where they pick up clients and that there should have been more competition and hostility when it came to picking up clients the women said this was never a problem, that there would always be enough clients to meet everyone's financial needs. The women do not compete for clients at cruising venues; in fact they attested that this is rarely a problem. It seems that this is due to the large market for sex workers, and because the women expressed that their clients are so disposable suggests that despite the number of sex workers present, there will always be a demand as long as they are in the business. Additionally, many women do not use the cruising venues

to find clients; they may find new clients through existing clients, friends, and word of mouth.

HIV/AIDS

All of the women in the sample had been tested for HIV and were currently HIV negative. In Chennai, government hospitals, YRG CARE and other NGOs give free tests, so HIV testing is both available and affordable. Most of the women I spoke with were regularly using condoms and were educated about the risks because of all the efforts of local NGOs targeting their population in Chennai. Most of the women stated a belief that they definitely were not at risk for contracting HIV because they are regularly using condoms and getting tested regularly. But it is important also to realize that there were a small number of women who still have a fear of contracting HIV, despite how many safety measures they take. A long time veteran of sex work said, "People have been talking about having sex with many people [and how it] will lead to HIV/AIDS and I am scared about that. Once I tested negative I left the job".³

Many of the women I spoke with were educated about HIV/AIDS since almost all of them were involved with a YRG Care program, and many claimed that they failed to compromise when it came to unprotected sex. This is a difficult subject because many of the clientele will not accept sex with a condom because the men prefer sex without. Many of the clients will tell the women that they will pay them much more money if they choose to have sex without a condom. Therefore, women must decide whether a risk of HIV/AIDS contraction is worth the extra money.

I talked with another woman who has been in the field of sex work before HIV/AIDS was a known concern in India. "In 1989 there is not much information about HIV/AIDS available".³ Now she has come to know about the HIV problem and about STDs and that they cause a problem in the body, but only because many NGO's have heavily targeted their community in the past few years. In fact, another woman told me that she has heard a lot about HIV/AIDS because of a media awareness program that they were doing three years ago. "There was a lot on TV about HIV/AIDS awareness".³

Overall, there has been much progress in the area of awareness specifically with female sex workers in India. In fact, "between 1992 and 1995, condom use among sex workers rose from 27% to 82% and by 2001, it was 86%".¹ The impact of this awareness on HIV transmission among this population has been substantial, but in the future it will be additionally important to reach the women who do not believe they are at any risk for HIV.

Only once did a woman tell me that she had been informed by a friend of the risks of HIV/AIDS in the sex industry, and that using a condom could curb these risks. For the most part the women learned about the risks about HIV/AIDS after entering the field, and learned about condom use through NGOs during their involvement in the profession. For this reason many of them now realize the

impacts of HIV/AIDS first hand, and fathom the importance of using a condom. Now, many of these women from the previous generations in sex work are informing future sex workers about the risks of HIV/AIDS contraction, the importance of protection and the importance of using a condom.

Conclusion

Through my interviews with sex workers, it is apparent that sex work in India is incredibly dynamic and complex. Since the motivation for entering sex work and modes for perpetuating it are so diverse, the alternatives are even more challenging to get across to the women most at risk. Poverty and social stratification are issues that make it difficult for women to explore many other options of economic support. For a woman growing up in India, it is not easy to explain that there are alternative pathways to support a family especially if one is uneducated and part of the large population that is considered lower class. Understanding the financial burdens that Indian women are facing in Chennai, the constant stigma around topics of gender issues and HIV/AIDS, the influence of peers- the highest influential factors on these women being friends, family members, and neighbors- in propagating the sex work industry can help us in the future to prevent and limit misconceptions about the industry that often mislead young women into less than desirable circumstances.

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Orofacial Anomalies and Treatments in People with Down Syndrome

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Introduction

Down syndrome (DS) is a genetic disorder resulting from overexpression of genes on the twenty-first chromosome. In 95% of the cases, this is caused by an extra chromosome on the 21st pair. The rest of the cases are due to a translocation of part of chromosome 21 to another one, usually chromosome 14, or post-fertilization non-separation of chromosomes resulting in mosaicism (the 21st chromosome is not found in all cells). DS is one of the most common genetic abnormalities, affecting approximately 1 in 700 to 800 live births. Despite the development of prenatal diagnosis, the incidence of DS births is predicted to remain stable or even to increase.¹

Care for DS can be complicated and involves a myriad of acute and chronic medical problems and psychosocial issues. Some of the medical problems include congenital heart defects, gastrointestinal defects, global muscle hypotonia (a decrease in muscle tone), loose joints/ligaments, upper respiratory infections, various orthopedic problems, and endocrine disorders (particularly hypothyroidism). Many of the medical and physiological characteristics of DS have direct consequences on the oral health of people affected and indirect consequences on the quality of life of persons with DS and their caregivers. This article aims to give an overview of the current literature concerning the orofacial, or mouth and face, motor anomalies in persons with DS and their implications, and to explain the available treatment options.

Orofacial Structural Anomalies

The different anatomical aspects of DS have been well described in the literature and form the basis of the orofacial problems experienced by this population. The primary skeletal abnormality affecting the orofacial structures is an incomplete development of the midfacial region.^{2,3} The bridge of the nose and bones of the midface and upper jaw are relatively smaller in size.³ This underdevelopment of the midface results in reduction of the width and depth of the palate.⁴ The muscles of mastication and facial expression are hypotonic, and there may be laxity of the temporomandibular joint ligaments.⁵ The reduced muscle tone in the lips and cheeks contributes to an imbalance of forces on the teeth, with the force of the tongue being of greater influence.³

Soft-tissue features include a fissured and protrusive tongue that often rests between the dental arches and high against the palate.^{2,5} The tongue appears macroglossic, or enlarged, due to the relatively small size of the oral cavity.^{2,3,5} Tongue protrusion and thrusting during drinking, eating, and speaking is reported in the presence of a hypotonic tongue.² Several occlusion elements are noticed: higher frequency of malalignment², malocclusion, and anterior/posterior cross bite.^{2,4} There is often a severe, Class-III malocclusion^{3,4} which contributes to an anterior open bite due to abnormal tongue position. These classically described features vary significantly between individuals despite the typical faces of DS.

Functional Implications

The functional manifestations of these abnormalities are directly related to the underlying structural defects. Abnormal oral structure and physiology compromise the development of feeding, chewing, swallowing, and speech capabilities.

Feeding

Studies have shown that children with DS take longer to develop the motor coordination necessary for normal feeding.⁵ A retrospective chart review of 49 DS children showed that 80% had problems related to food or feeding.⁶ The literature suggests that the development of oral-motor function in children with DS not only lags behind intellectually but also follows an irregular pathway.⁷ Since numerous feeding problems occur in infants, studies addressing the variety of emotions experienced by caregivers indicated that feeding therapy and counseling were required. Because of the different conditions underlying the feeding problems of infants, a comprehensive approach, including therapeutic and medical intervention, is necessary.⁸ Interdisciplinary intervention programs have proven successful, as most of the nutritional, behavioral, and environmental problems surrounding food previously encountered in children with DS were prevented or remedied.⁶

Chewing

Several studies have found that persons with DS are not able to produce normal chewing movements. Specific aspects of tongue and jaw function were impaired along with problems in initiating and maintaining a smooth sequence of feeding actions.⁷ In particular, Hennequin, et

al. investigated differences in chewing indicators (masticatory time, number of masticatory cycles, number of open masticatory cycles, chewing frequency, and number of food refusals) in a group of 11 adults with DS and compared with a control group. With the exception of puree, DS persons had significantly lower mean chewing frequency than the reference group and were unable to eat all foods presented.⁸ Another study investigated nutritional status and age of introduction of solid food. It concluded that DS delays the age at which solid foods are introduced, which can be deleterious to oral motor development, and recommended pre-speech therapy.¹⁰ Video recordings of 4- to 5-year-old children with DS eating a standard sized meal show that DS children were characterized by a forward placement of tongue in the mouth and the absence of normal maturational changes in the oral cavity.¹¹

Swallowing

Swallow function in children with DS has been assessed using video fluoroscopy in conjunction with foods of different texture. Frasier, et al. reviewed swallowing behavior of 19 children with DS and identified abnormal pharynx movements during swallowing, with aspiration occurring in 10 of the 19 children studied. Silent aspiration was shown to be a problem among this population with liquid or semi liquid food. Recurrent aspiration contributes to high incidence of pulmonary infection.¹²

Speech

Kumin collected data from 937 parent questionnaires regarding intelligibility of speech in children with DS and found it to be a widespread problem.¹³ Parents reported evidence of difficulties classified as oral motor skills, motor programming skills, and specific speech skills. Children experienced greater difficulty with reciting sentences and engaging in conversation than with reciting single words. Intelligibility problems were more frequent when the child was conversing with unfamiliar adults.¹³ Another study found that one of the factors that affected speech intelligibility of children with DS was difficulty with voluntarily programming, combining, organizing, and sequencing the movements necessary for speech. Historically, this difficulty, childhood verbal apraxia, has not been identified or treated in children with DS but recent research has documented that symptoms of childhood verbal apraxia can be found in children with DS. Results indicated that children with DS who have clinical symptoms of childhood verbal apraxia have more difficulty with speech intelligibility, i.e. there was a significant correlation between childhood verbal apraxia and parental assessment of intelligibility ratings. Children with apraxia often do not begin to speak until after age five.¹⁴

Prevention and Therapeutic Options

Different therapies to correct orofacial problems can be grouped into four categories: neuromuscular stimula-

tion, behavior modification, orthodontic intervention, and surgical intervention. Orofacial therapy of neuromuscular stimulation has been studied extensively. It includes physiotherapy of the oral structures and an appliance to stimulate the lips and tongue. The appliance is a palatal plate designed according to Castillo-Morales. The main goal is to increase muscle tone around the mouth and enhance the development of oral function.⁵ It is accomplished by establishing a resting position for the tongue behind the front teeth, leading to improvement in swallowing, chewing, and articulation. Multiple studies concluded that early intervention methods employing a combination of Castillo-Morales therapy and his palatal plate could significantly improve orofacial function, facial appearance and speech, as well as prevent dental diseases, malocclusion, and open mouth. Early therapy is recommended, starting at age 6-8 months.^{18,19,20} The effects of the Castillo-Morales stimulating plates were followed by a longitudinal study up to 53 months after the end of treatment, and long-term results showed improvement in orofacial appearance- even when the plate was not in place, the result remained stable in 65.8% of the patients.¹⁵ Hohoff, et al. studied the effects of the palatal plates on speech development, and demonstrated an enhancement of DS children's oral motor capacity and initial speech development.¹⁶ Methods of behavior modification include parental reinforcement of the desired behavior and the use of tactile or audio cueing aids.⁵ Functional orthodontic therapy is also useful but highly dependent on the full cooperation of the child. The use of surgical modalities, including glossectomy (removal of part of tongue), tonsillectomy (removal of tonsils), and plastic surgery, are controversial. Few studies have evaluated the esthetic appearance and intelligibility of speech after partial glossectomy and found no significant difference in acoustic speech intelligibility; in some patients, there was an esthetic improvement during speech.¹⁷

Conclusion

Children affected with DS display a variety of orofacial anomalies that influence their feeding, chewing, swallowing, and speech. Children diagnosed with DS should be exposed to early interdisciplinary intervention therapies, which include behavior/speech therapy and neuromuscular/orthodontic treatment in an effort to minimize the effects of the anomalies. A team of medical specialists should regularly work with the caregivers and the child to identify and prevent functional problems.

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Enhancing the Understanding of Anatomy through the Coloration and Plastination of Anatomical Specimens

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Abstract

Gross anatomy is a difficult subject for medical school students to learn on a three-dimensional level. Through the use of plastination, organs can be dissected and positioned to display specific structures, and then can be preserved in silicone casts. These three-dimensional specimens serve as useful study aids for students as they help them to visualize and gain a better understanding of the structures and functions of the human body. In attempts to enhance the educational efficacy of plastinated specimens for medical students, a branch of research has been devoted to the coloration of finished plastinated specimens. When painting the specimens, vessels and nerves are color coordinated to provide better visuals for the students. Using colored specimens, a student cannot only view the anatomy three dimensionally, but they can also better distinguish specific structures of the specimens. In the past, specimens that were plastinated and colored by conventional application of acrylic paints showed a significant deterioration of paint following continued handling over time. This was because the paint did not adhere well to the silicone surface of the specimen. After testing several paints, solvents, and primer coats, we found that by using the acrylic paint applied to the specimen prior to catalyst and with ethyl silicate (Silbond-40®) coated on top of the paint followed by a final coat of lacquer after the catalyst was applied, the new application demonstrated more paint durability that withstood vigorous handling.

Introduction

Plastination is a process that was invented in the mid 1980s by Dr. Gunther von Hagens,¹ and it is a method used for the preservation of tissues, organs, and entire bodies. Students have demonstrated that anatomy is a difficult subject to learn since pictures and plastic models do not convey the proper spatial relationships that a real model or cadaver can display. Implementation of plastinated specimens into medical education is very helpful for students to understand and learn this complex field. It provides them with real specimens of human anatomical dissections that can be handled by the students. To provide more helpful displays of anatomical structures, colors are added to highlight specific features of the spec-

imen. Handling tests were conducted by unbiased medical students to assess which types of paints were most durable. These tests were designed to determine which paints best adhered to the neurovascular pathways, and whether these paints would adhere better before or after the application of catalyst to the specimens.

The validity of colored plastinated specimens in facilitating anatomy education was previously assessed through surveys administered to first and second year medical students. The results showed an overall acceptance of colored plastinated specimens as being a beneficial addition in their learning of human anatomy.²

Thus, the goal of our research was to find a coloring method that would better adhere to the specimen in order to make them more useful learning tools.

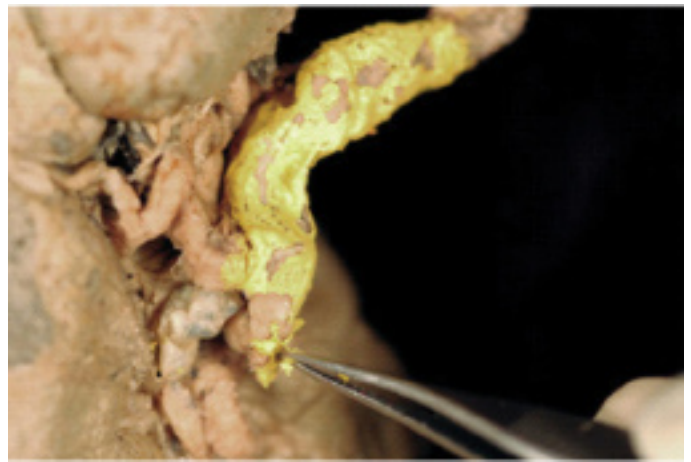
Materials and Methods

All specimens used in this work were carefully dissected to display neurovascular pathways before undergoing the process of plastination. Specimens were first placed in an acetone bath for several days for dehydration. Specimens were then placed into a low-pressure chamber where acetone was boiled out of the specimen and Silicone PR-10® and Cross-linker CR-20® was forced in to permeate the tissue.³

A variety of paints and coloring materials were tested on neurovascular human tissue, including Createx Pure Pigment®, Lukas® powder pigments, American Tradition® plastic enamel, American Tradition® enamel, Jacquard® dyes, and Winsor Newton® acrylics. Each of these materials was treated equally and individually, and was subjected to the same trials described below.

In the first stage of experiments, all paints were tested on a completely finished plastinated specimen in which the silicone had been cured. First, simple application of all paints on the surface of neurovascular tissue was tested to compare the quality and brand of these new materials to the original Tamiya® Acrylic paint. A Winsor Newton® brand gloss lacquer was applied on top of the paints to test if it prevented the acrylics from sustaining damage.

Specialized paints were created to induce silicone compatibility. They were made by individually mixing the coloring materials previously mentioned with silicone based or silicone compatible chemicals. For these silicone bases, we had to find chemicals known for strong



Clockwise from upper left **Figure 1:** After one coat of liquid pigment paint, the renal artery painted unevenly. It requires several coats to maintain an even coloring.

Figure 3: After the catalyst is applied, the enamel paint remains incompatible to the silicone specimen. **Figure 4:** Post catalyst method: lacquer primer on a catalyzed specimen before acrylic paint is applied. **Figure 2:** After one coat of enamel paint, the paint coalesces into patchy areas.

adhesion to silicone surfaces. According to “The Artist’s Handbook of Materials and Techniques” by Ralph Mayer, ethyl silicate is used in silicon based paints for outdoor murals and is a substance that can withstand a great deal of weather and chemical abuse. Silbond-40®, a commercially available equivalent of ethyl silicate, was used for these testing methods. Other chemicals used were Silane Z-6040® and the combination Silicone PR-10® with Crosslinker CR-20® which was the same chemical combination used in the plastination process. Each coloring material was tested with these bases in a variety of combinations and applied to neurovascular pathways. Paints and materials were mixed with the bases before application and were made with concentrations near the consistency of a viscous acrylic paint to insure the ease of the paint’s application. Paints and chemicals were also applied in layers upon the specimen, first applying the paint followed by a silicone topcoat.

Another alternative was tested to overcome silicone repulsion; application of paint was incorporated into a step during the plastination process, a step which would chemically cure the paints and the specimen itself at the same time. Once a specimen had been infused with silicone, each coloring material was applied onto neurovascular tissue. After the paint had dried, Silbond-40® was applied onto each coloring material. Catalyst CT-32® was then applied to the colored specimen for curing.

Lastly, in order to test the various coloration methods that were attempted, unbiased second-year medical students were given the tasks of testing the paint’s durability. While wearing latex gloves, the students rubbed the painted areas of the specimen with their fingers as well as with a probe. These students then recorded how durable the painted areas of the specimens were. This test was done in order to give us an idea of which painting method would best withstand the handling of specimens by students.

Results

From all of the coloring materials listed above, the use of Windsor Newton® acrylic paints resulted in the most durable paint application on neurovascular tissue. All other materials were eliminated when they were observed to be difficult to apply (Fig.1), patchy in the coloring of the nerves and vessels (Fig. 2), and incompatible with silicone (Fig. 3). Most of the problems encountered were a result of water-based coloring materials being incompatible with silicone-based products. Water-based materials were unable to dissolve in silicone-based chemicals, and they also tended to bead on the surface of the silicone infused specimens. Though acrylics contain some water, they are thick enough to maintain cohesion on specimen tissue yet viscous enough to be applied easily.

Of all the methods of applications tried, two procedures produced the most considerable improvements from the original based on the second-year medical student's handling test. These methods are the application of a lacquer primer on a cured specimen prior to painting and the application of acrylic paint prior to the specimen curing (Fig. 4). The first of these can be used at any point in time after a specimen completes the plastination process. This requires that all areas desired to be painted receive a coat of Windsor Newton® gloss lacquer on the surface of the specimen, and, after that has dried, acrylic paint may be applied. The durability of the paint improved significantly with these methods, and the specimen was able to withstand excessive handling without the paint coming off.

Further Direction

In attempting to enhance the education of medical students using plastination, another branch of research has been devoted to dying muscle tissue in order to enhance the appearance of the tissue and thereby create a more life-like model. Dyes are preferred over paints when coloring muscle tissue due to the ability of the tissue to absorb dye. Paint would coat the muscle tissue and detract from the texture of the tissue. The goal is to maintain a lifelike appearance when dyeing muscles, while coloring neurovascular pathways is not intended to be lifelike but rather to make vessels more distinguishable. Also, when working with such a large surface area, as with muscles, dyes help to preserve the important surface characteristics of the muscle tissue. For example, a dye will not interfere with a student viewing the striations of a skeletal muscle or the transition from muscle to tendon. Paint on the other hand will cover the striations, making it harder to distinguish between and gain an appreciation for the different types of muscle tissue. The dye also makes the task of identifying muscles easier because it allows the student to not only see the muscle shape more clearly, but also locate the origin and insertion.

For these procedures, both liquid and crystallized textile dyes were tested in the same way as the paints on the neurovascular pathways. All materials were subjected to the same trials and combinations of mixtures before being applied by brush to both cured and un-cured specimen. After the dyes were applied they were sealed with Silbond-40® and cured with Catalyst CT-32®.

In the coming months we plan to apply these dye techniques to a full human cadaver and assess how well the dye can withstand handling by the students. We will also conduct surveys to determine if the dye adheres to the specimen and to see if students are better able to understand the anatomy.

Conclusion

The two methods discussed above have shown the improvement of the durability of the paint is considerable. The methods have demonstrated that the specimens are

able to withstand student handling without the paint coming off. One method involves applying a base coat of lacquer, which acts as a primer for the acrylic paint on the plastinated surface. The second method combines the painting process with the plastination process. With these new coloration processes, paint can be applied that can withstand handling, allowing the neurovascular structures to be emphasized. Another promising development in the process of producing effective educational models is the use of dye on muscles. Dyes can help distinguish particular muscle groups and also bring a more realistic quality to the specimen. The hope is to provide students with a specimen that will aid them in the rigors of learning human anatomy and physiology, as well as a specimen that accurately models the patients that they will one day be treating.

Acknowledgments

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The Effect of Time and pH on Hemolysis During Cardiopulmonary Bypass

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Abstract

Objective: During cardiopulmonary bypass (CPB), the breakage of red blood cell membranes (hemolysis) and activation of humoral components (i.e. enzymes) in the blood can occur. Hemolysis and humoral component activation can lead to multiple post-operative complications (i.e. renal and lung failure). The purpose of this study is to investigate the causes of hemolysis during CPB. We hypothesize that blood damage during CPB is caused primarily by exposure of the blood to air and negative pressure during cardiotomy suction, which is used to collect blood that is lost during the operation. **Methods:** An in-vitro model was used to investigate the role of time and pH on hemolysis during the application of negative pressure and an air-blood interface. In the time experiment, ovine blood was exposed to pressure of -600 mmHg and room air-flow of 50 mL/min at increasing times (1, 5, 10, 15, and 30 min). In the pH experiment, ovine blood was exposed to a negative pressure of 600 mmHg, and 50 mL/min of either 25% CO₂ or room air-flow (approximately 0.038% CO₂) for ten minutes. Twenty-five percent CO₂ was used to mimic normal physiological pH. Citrate and heparin anti-coagulants were used to prevent clotting in both experimental groups. **Results:** Red blood cell lysis increased linearly with the time that the blood was exposed to negative pressure and air. In the pH experiment, there was no significant difference in hemolysis between the room air group and the 25% CO₂ group. **Conclusion:** Hemolysis during CPB is time-dependent when exposed to negative pressure and an air-blood interface. Rapid changes in blood pH do not contribute to this hemolysis.

Introduction

Cardiopulmonary bypass (CPB) is performed nearly one million times annually for cardiovascular surgery. During CPB, hemolysis (red blood cell membrane rupture) and blood component activation are prominent. This can lead to numerous postoperative complications including renal and lung failure. Compared to other forms of extracorporeal life support, CPB introduces the blood to an interface of air and negative pressure through cardiotomy suction. Typically, cardiotomy suction can expose blood in the surgical field to negative pressures ranging from

-50 mmHg to -100 mmHg, but often times the suction becomes occluded decreasing pressures as low as -600 mmHg. Cardiotomy suction involves the process of mixing blood from the surgical field into an oxygenation circuit in order to restore lost blood. This avoids the use of human donors, which is expensive and runs additional transfusion risks. Previous research has shown that a combined negative pressure and air interface, similar to that of cardiotomy suction, can cause elevated levels of hemolysis¹ (Fig. 1). This study was designed to determine the effects of blood pH and time on hemolysis levels during the application of a combined negative pressure and air interface.

Methods

Researchers developed an in-vitro model capable of simulating and controlling conditions observed during cardiotomy suction in the clinical CPB. The model consists of a sealed test chamber with access ports for applying controlled levels of suction, or a controlled air-blood interface, or any combination (Fig. 2).

Ovine blood was filled into a 60 mL syringe containing 6 mL of citrate and 1 mL of heparin (anticoagulants), at latest 48 hours prior to experimentation. Five mL blood aliquots were distributed into experimental and control test tubes. In the time experiment, 5 mL of ovine blood was exposed to a pressure of -600 mmHg and room air-flow of 50 mL/min for varying times: 1, 5, 10, 15, and 30 min (n=10). Control samples (n=10) were open to room-air and unperturbed for the duration of experimentation. In the pH experiment, experimental samples were divided into two groups. In group one (n=4), room-air was used as the bubbling gas. In group two (n=14), 25% CO₂ was used as the bubbling gas in order to mimic physiological pH (7.4 +/- 0.2). In both groups, ovine blood was exposed to a pressure of -600 mmHg, and 50 mL/min of gas flow for ten minutes. The control samples (n=12) were left open to room-air and unperturbed for the duration of experimentation. Blood gases were recorded immediately after each sample was exposed to experimental conditions. All experimental bloodsamples were collected from the test chamber and placed into centrifuge tubes. All samples were spun down in a centrifuge for 10 minutes in order to separate plasma from erythrocytes, leukocytes, and thrombocytes. Plasma was placed into a spectrophotometer to determine plasma free hemoglobin

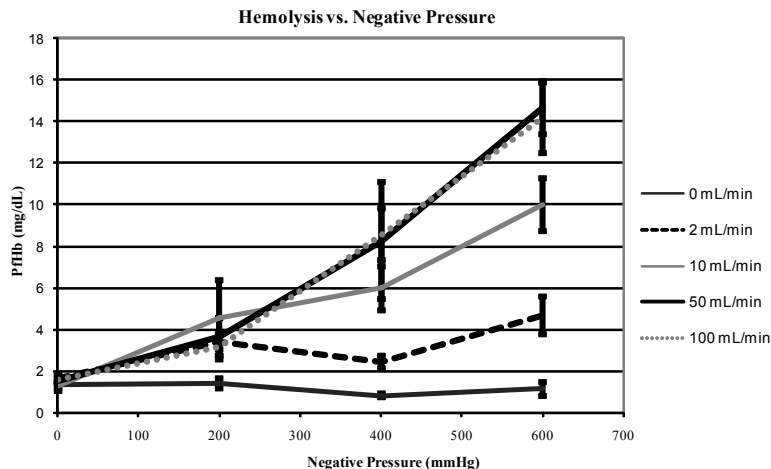


Figure 1: The relationship between hemolysis and negative pressure for 5 different air-flow rates (Pohlmann 2006). There is a synergistic effect of negative pressure and air-flow that causes increasing levels of hemolysis.

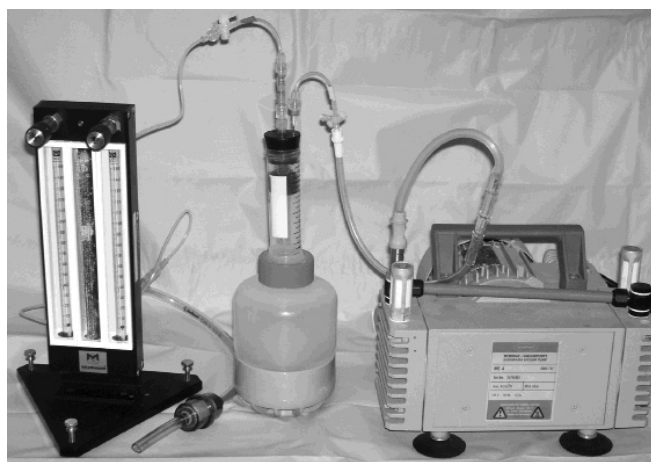


Figure 2: Experimental Design; An air flow meter (left) was used to regulate air flow in to the test chamber (middle). A negative pressure pump (right) was used to create sub-atmospheric pressure conditions within the test chamber.

(pfHb) levels.

Results

Hemolysis levels in ovine blood increased linearly with the amount of time of exposure to an air-negative pressure interface. PfHb ranged from 9.44 mg/dL, after 1 minute, to 27.39 mg/dL, after 30 min. Average pfHb in control samples was 6.00 mg/dL. This is a linear increase of approximately 0.695 mg/dL/min (Fig. 3).

Blood alkalosis (excessive decrease in H⁺ ion) did not appear to contribute to hemolysis levels. The average pH of post-trauma room air trials was 8.279 +/- 0.133, while post-trauma 25% CO₂ samples maintained a pH of 7.269 +/- 0.201 (close to physiological pH). Hemolysis between the 25% CO₂ group and the room air group was not

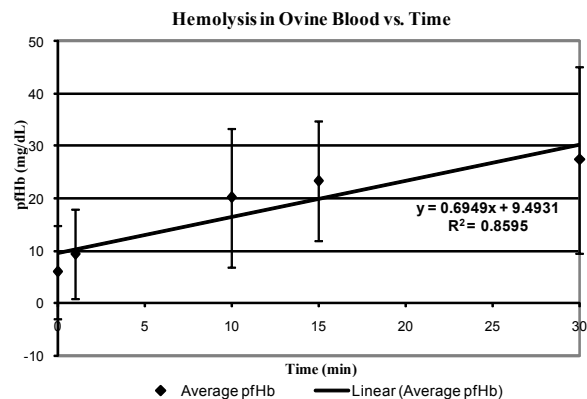


Figure 3: Hemolysis in Ovine Blood vs. Time. Hemolysis levels increase linearly with respect to time. Each point represents the average hemolysis after ten independent trials.

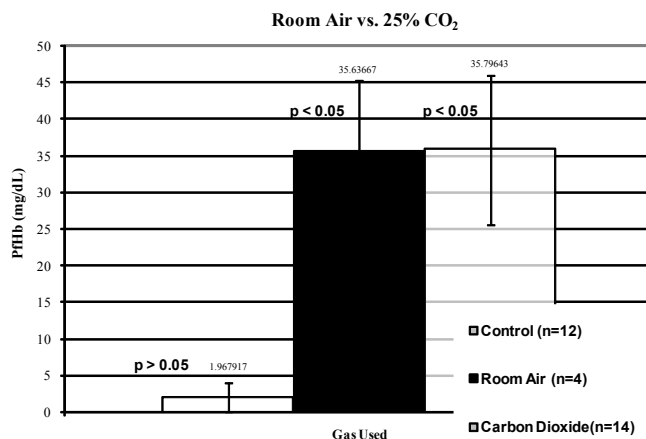


Figure 4: Room Air vs. 25% CO₂; Hemolysis levels between the 25% CO₂ group and the room air group were similar; however, both were significantly higher than control samples.

significantly different ($p > 0.05$). Average pfHb for room air trials (alkalized blood) was 35.69 mg/dL +/- 9.57 mg/dL. Control pfHb (1.96 mg/dL +/- 0.20 mg/dL) was significantly lower than both experimental trials ($p < 0.05$). Average pfHb for 25% CO₂ trials (blood maintained close to physiological pH) was 35.79 mg/dL +/- 10.20 mg/dL (Fig. 4).

Discussion

Hemolysis in ovine blood is a function of negative pressure, air flow, and time. Results demonstrate a linear relationship between the amount of time and the amount of red blood cell lysis; however, there may be limitations to this experimental model. After approximately fifteen

minutes of air-flow, there was a decrease in bubbling due to clot formation. The narrow opening at the base of the flow tube exposed a small portion of the blood to a harsh interface of air-flow that caused the blood to clot within the opening. This occluded the air-flow line and prevented the ovine blood from uniform exposure to air and negative pressure for times above fifteen minutes. A revision of this model to incorporate a wider opening at the base of the air flow tube may help to eliminate clotting and be more representative of cardiectomy suction during CPB.

PfHb was measured as an indicator of blood damage. However, systemic inflammatory response syndrome, common in postoperative CPB patients, is likely caused by leukocyte activation. Further research is required to measure platelet and leukocyte levels under similar conditions. This will provide researchers with a better indication of the mechanisms for blood activation leading to systemic inflammatory response syndrome. Long-term research goals focus on measuring hemolysis, leukocyte activation, and platelet activation on an in-vivo animal model undergoing clinical CPB conditions.

Ovine blood was the model for this study's experiments. Currently, researchers are evaluating changes in human blood with a similar set of experimental conditions.

Conclusion

The combination of air and negative pressure has a synergistic effect on ovine blood that creates significant levels of red cell hemolysis. Hemolysis is linearly proportional to the time that blood is exposed to experimental conditions. In a clinical setting, cardiectomy suction can persist at varying pressures for hours leading to elevated levels of systemic hemolysis and potential leukocyte activation. The time dependence of hemolysis suggests that the clinical use of cardiectomy suction should be avoided or minimized to better prevent damage to red blood cells. The mechanism for hemolysis is likely multi-factorial; however, rapid changes in blood pH do not seem to contribute to this mechanism.

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Exploring how Culture Influences Religious and Spiritual Beliefs in the Indian Health Care Setting

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Figure 1: The Non-Resident India (N.R.I) Academy of the Sciences. This is a view of the N.R.I. General Hospital with the temple Hindu temple connected to it.

Abstract

Using ethnographic techniques, I studied the religious and spiritual aspects of health care at the N.R.I. Academy of the Sciences in Chinakakani, Andhra Pradesh, India, to gain perspectives on how culture influences people's beliefs about health. It became apparent that "cultural customs" accounted for people's similar beliefs concerning recovery from disease and injury, irrespective of their diverse religious orientations. With this understanding of culturally-influenced beliefs, perhaps culturally competent health care can be provided both in South India and the U.S.

Introduction

When beginning to examine holistic health care that is, caring for the mind, body and spirit—in the Indian health care setting, one must not look for the obvious signs of holistic care that might be recognized in a westernized health care setting, but rather observe with a forcedly forgotten palate of ideas. One should discard expectations of seeing a chaplain searching each hospital room for those in need of spiritual support or a social worker determining mental well-being and the strength of family support systems, as these are western-based images of holistic care. Understanding the western origin of these images

allows one to be open to all forms of holistic care that may be present in a foreign environment.

In search of new holistic care ideas, I carried out 6 weeks of participant observation and interviewing in the hospital wards at the N.R.I. Academy of the Sciences, Chinakakani, Andhra Pradesh, India. At N.R.I., I began to see the different ways in which holistic care was and was not expressed through different social interactions. Most of these interactions stem from what one of my main interlocutors termed the “cultural customs” that make up life in India (at least southern India) today. Thinking about these beliefs and customs, which may subtly emerge during the health care process, one can observe a hospital with an awareness to expressions of holistic health care, while not being fully bound to the constructs of Westernized medicine.

With my background in both anthropology and nursing, I originally proposed to study a subset of holistic health care, specifically the religious and spiritual aspects. I wanted to see if health care providers treated patients under the influence of a spiritually or religiously based worldview. My intentions were to compare Indian methods of treatment to those of the West, with an eye toward finding new ways of caring to apply in our American health care setting. Over time, however, my plans changed.

My original proposition gradually became an exploration of how culture influences people’s religious and spiritual beliefs in the health care setting. Some of the questions I explored were: what influences a person’s health from a holistic perspective, in terms of mind and spirit? Does religion play a large part in each person’s beliefs about recovery? And, do people of different religions share the same beliefs about recovery from disease and injury?

These were the grounding questions of my research. Beginning with literature to support my main ideas, this was primarily an ethnographical study that began with incorporating one person’s ideas and ended with data to substantiate them. Before reading this, please note that I am not an anthropologist or a nursing researcher. The reason I call this study an “exploration” is that I went at it like a surgeon operating with a kitchen knife—this was an unrefined first attempt at research. I began with limited experience in and knowledge of actual fieldwork.

“Cultural Customs”

To establish (to the reader) the “cultural customs” as I witnessed and learned them from Indian friends and contacts, I would like to talk about the idea that Hinduism is both a culture and a religion. This may seem obvious to many people, especially if they have lived in or visited India. However, the concept needs emphasis since Hinduism forms a basis of a person’s way of life, irrespective of his or her religion. Dr. A, a Brahmin, stated that, “Hindu cultural issues are imbedded in each individual. It doesn’t have to do with religion; it has to do with cultural

custom. Hinduism is synonymous with secularism here in India.” The final portion of his statement initially felt rather extreme. I saw his view of Hinduism being synonymous with secularism merely as an exaggeration to help me understand the concept marking Hinduism as a religion and a way of life. As my research progressed, however, I came to see that there is truth in it—Hinduism is a cultural way of living. Part of the reason Indians of all religions share this Hindu-based worldview comes from the mode of teaching.

After conversations with this doctor I began to think about his belief that most Indian traditions are passed on orally through the generations. This idea stems from the assumption that most people do not read the Indian epic tales or, as some people consider them, the Hindu scriptures. Dr. A continued, “Muslims and Christians have written rules like the Koran and the Bible. In India, there is no such dictation; everything gets transferred from generation to generation informally.” In this light, he infers that the religious-based ideas are passed on informally to form a backbone of Indians’ cultural worldviews in a secular sense. He later added, “Ninety percent of the people don’t know religious [Hindu] issues. Instead, it is custom that continues to travel through the generations based on previously established values.” The important idea to grasp is that these values, in theory, are transmitted to every person irrespective of his or her religion.

While searching journal articles for writings that would support Dr. A’s idea, I came across Singer’s work from the mid-1950s. He wrote:

It is seldom that I came across an Indian who read these stories [the Ramayana, the Mahabharata and the Bhagavata Purana] as I did, simply in a book. This is not how they learn them and it is not how they think of them. There is a sense of intimate familiarity with the characters and incidents in the references made to Hariscandra, Rama and Sita, Krsna, Arjuna, Prahlada, as if the world of the stories were also the every day world. Many children are told these stories from an early age by parents and grandparents, but this is by no means the only way in which they learn them. The very tissue of the culture is made from puranic themes....¹

The way in which Singer writes about these stories, stating that people frame them in an applicable context to the everyday world, supports the idea that the stories have a secular side and use. He shows that the stories set the example of how to live properly in Indian society. Singer states that this way of passing on values is found among people at all levels of socio-economic-status, and in the village and urban areas alike.¹ Again, these values and ideas are passed on to Indians of all religions since these “puranic themes” form the “tissue of the culture.” I do not know the degree to which this idea still holds true, but Dr. A talked about it on several occasions.

Yet, reading Singer and other writers, I still found no trace of Hinduism-based “cultural customs” being

expressed by Indians of different religions. For instance, never did I read about a Christian seeing God in everything and everyone around him, as is discussed in the Bhagavad-Gita. But in my entry point into this culture, the N.R.I. Academy of the Sciences, I did find some beliefs that may be relevant for understanding Indian culture and, more specifically, beliefs about disease and injury.

Before explaining how the beliefs that interest me fit into the health care setting, it is important to note how Indians understand these ideas in everyday life. Let us take one basic Hindu belief that Dr. A described, the idea that God is in everything and everyone. As we talked about it, Dr. A explained the concept with a story. Smiling and making deep eye contact, he spoke like a teacher. I could not help but feel like a student as I rigorously scribbled down his words and ideas; they sounded like the secrets of life at the time. He began enthusiastically:

A man was taught by his guru that God is in everyone and to listen to God. As he walked through the street, a mob of people came running by him yelling that an elephant was coming and trampling people. The man didn't listen to the people as they warned him remembering that God is in everyone, even the elephant. He stood there, but he was trampled by the elephant and ended up in the hospital. When his guru talked to him, the man said, "I don't believe in God. If God was in the elephant, it wouldn't have trampled me." The guru replied, "Were there any other people running away?" The man said, "Yes they were screaming to run from the elephant." "Well," the guru said, "Did you listen to them?" The man replied, "No." "Well you should have listened to them because God was in them too. His grace was speaking through them and you didn't listen.

As I considered the story, I began to understand that in Indian culture stemming from Hinduism, God acts through the material world. In this quote, the man did not listen to the people's warning which was really God speaking through them.



Figure 2: Casualty Ward (Emergency Department). The nurses work with the doctors and the incoming patients in the casualty ward of the hospital.

This belief can also be detected in the health care setting. Dr. A continued by telling me another story that recounts how God acted through a doctor:

My dad was on his deathbed and he was in a horrible condition. I was far away, and the doctor, my friend, called me to let me know. Right away, I left to reach him. I was about six hours away. I prayed to God that he would be alive at least enough for me to see him. As the doctors worked on him, one doctor decided to give him an emergency drug that is rarely used. It worked and my father is still alive. This is an example of how God worked through the material world and the doctor. Through God's grace, the doctor chose to try the emergency drug and it worked. The God was also in the medicine helping it to heal my father.

Dr. A's personal anecdote presents the belief that God acts through the physical world, the doctor, in the health care setting. God heals patients working, in a way, with the doctor's knowledge of physical medicine.

When interviewing patients and nursing students, I explored whether this idea is held by the general population—if it is in fact a “cultural custom.” I found that many people did believe that God works through health care providers and medicine to heal. I first asked the patients if God plays a part in their recovery from disease and injury. All eighteen patients that I asked stated that they believed God would play a part in their current recovery.

Narrowing my question, I asked, with the help of a nursing student, “Do you believe that God is in the doctors and medicines?” Of the thirteen people that answered this question, six were Christian, six were Hindu and one was Muslim. Only one, a Hindu, said “no, God is not in doctors or Medicines.” The other twelve answered in the affirmative.

Not only did the Hindus believe God to be in material and corporeal items like people and medicines, but the Christians and the Muslim did, too. The similar belief between people of different religions shows that Hinduism-based “cultural customs” must be playing into their beliefs. This shared belief most likely emerged from the founding Hindu idea that God is in everything living and non-living.

Even though each patient answered somewhat differently, I grouped the similar responses together into the belief that God is in health care providers and medicines. To give readers a better understanding of what people believed, I will present some of the statements that patients made in response to this question. One answered, “I see God in the form of medicines and sisters [nurses].” Another patient was more specific, saying, “God won’t directly help me, but in the form of doctors, nurses and medicines, God will help me.” A few others responded similarly, with responses like these: “Yes. The doctor is equal to God. You can see visible Gods in doctors unlike the invisible God, Jesus Christ”; or “doctors are like Gods for healing my son.”

Within this idea that God works through physical medicine and doctors, I wanted to see which of the factors people believed would play a larger part in their recovery. I asked both nursing students and patients a variation of this question. When I surveyed the nursing students, I asked them to rate their disagreement or agreement on a scale of 1 to 5, with the following statement (1 being complete disagreement and 5 being complete agreement): “I believe that praying and believing in God(s) or a higher power when combined with physical medicine will help me recover from a diseased state—but God(s) or a higher power will have a greater healing effect than physical medicine.” A majority of the students, fourteen, rated their agreement at a “5,” one at a “4,” and three students at a “3.” Some eighty-three percent believed that God would play a larger part in their recovery than physical medicine. Among the fifteen students that either fully agreed or rated their level of agreement at a “4,” eight were Christians and seven were Hindu (there were ten Christians and eight Hindus in the survey sample). Among the Christians, eight were from the Southern state of Kerala and two were from Guntur, Andhra Pradesh, the hospital’s neighboring city. Among the Hindus, one was from the state of Kerala, one was from the state of Tamil Nadu, and the rest were from the Guntur area. This suggests that not only do similar beliefs span the line of individuals’ religious orientations, but similar beliefs are found across the larger geographical area.

In a similar vein, I asked all of the patients that I in

terviewed, “What do you think will have a greater effect on your healing process, God or physical medicine?” Out of seventeen that answered the question, nine said God would have a greater healing effect; five said God would have an equal healing effect; and three said God would have less of a healing effect when compared to physical medicine. Fourteen out of seventeen, or 82 percent, believed God would account for at least 50 percent of their recovery. Of the fourteen patients, nine were Christian and five were Hindu.

Comparing the nursing students and the patients, we can see a similar belief pattern—a majority in both groups believed God plays a larger part in recovery from disease or injury than physical medicine. Both groups included similar numbers of Hindus and Christians in the majority group. This leads me to believe that shared “cultural customs,” not diverse religious beliefs, are most important in these people’s beliefs about recovery. However, it remains unclear if this belief—that God plays a larger part in a person’s recovery from a diseased or injured state—stems from a traditional Hindu-based “cultural custom,” as did the first belief I discussed above.

What is clear to me, however, is that “cultural customs” influence an individual’s recovery from disease and injury in this part of India. I think that the shared spiritual and religious beliefs among people of different religions originated from uniform Hinduism-based “cultural customs” of the past and present, but I cannot fully conclude this without a more detailed case study. Most of my detailed data on the view, that cultural practices in India are mostly passed down through stories and cultural events, comes from just one elder’s beliefs. But what I did learn can serve as a primer for longer-term, in-depth research into cultural beliefs about disease and illness in southern India.

Reflection

Back in America, considering my original purpose was to learn from the different cultural ways in the Indian health care setting, how can ideas from this study help fuel future discussions and projects in America’s health care setting? One way to utilize the concepts I talked about is to look at the roles “cultural customs” play in influencing people’s beliefs. For instance, have Americans’ beliefs throughout history been influenced by the popular religion of the time? More specifically, do traditional Christian beliefs of the past influence Americans’ beliefs about medicine and death and dying today? When asking and attempting to answer questions like these, the value of cross-cultural studies in the Indian and other health care settings should be evident; further research is warranted.

Acknowledgements

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