IN THE SPOTLIGHT: The Microbiome and Cardiac Transplantation: What We Know and What We Need to Know

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The microbiome is everywhere? Literally, it is: on your skin, in your enteric system, in your blood, and throughout the literature. Our first encounter with the microbiome is in utero and during birth. My first cognizant encounter was as a fourth year medical student doing a GI rotation at HUP. My GI attending physician would one day be my Department Chair when I was on faculty at Temple. My GI fellow is presently my Department Chair at Drexel. These wise men presciently identified the potential importance of the microbiome that we encountered every morning in the endoscopy suite. They pointed out that there were vast numbers of bacteria, which produce important compounds (hello, Vitamin K), and when perturbed could be catastrophic (C. difficile colitis which back then in the early 80’s was an uncommon disease.) The role of microbes living symbiotically within the human body has become a focus of attention within the medical community. As more and more studies have shown, an appreciation of the diversity of microbes within the gastrointestinal tract, skin, lungs, and genitourinary tract has grown, and research has concentrated on the role of these organisms and their functions within various organ systems. Because of the complicated role food plays as one of the largest sources of environmental exposures to the body, more researchers have begun to examine the complex interplay between the intestinal microbiome and cardiovascular health.

The intestinal tract is host to over 100 trillion microbial cells, far exceeding the total number of human host cells [1]. These microbes are then influenced by diet, lifestyle, exposure to antibiotics, and genetic background and are responsible for fermenting non-digestible carbohydrates into short-chain fatty acids, which are then coupled to receptors that modulate energy use. Additionally, the microbiota stimulates innate immune molecules, which then trigger inflammatory pathways. Studies have shown in both animal and human models that gut microbiota are linked in the pathogenesis of obesity and type II diabetes, and increasingly, a relationship between atherosclerosis and microbes is being established [2]. Chronic inflammation and obesity are associated with hypercoaguability and a reduction in fibrinolysis, and enhanced bacterial translocation across the intestinal membrane barriers has been shown to activate inflammatory and coagulation cascades [2, 3]. Repeated exposure to bacterial endotoxins in mice has resulted in dyslipidemia, hyperglycemia, hepatic insulin resistance, obesity, hyperinsulinemia, and macrophage infiltration of adipose tissue [4]. Recent studies have also shown that atherosclerotic plaques host their own microbiota, presumably from bacterial gut translocation [5].

Prebiotics, which are non-digestible food substrates that selectively stimulate growth from one or more limited genera/species, have been demonstrated to lower total cholesterol, triglyceride, and
The prebiotics are thought to form gel-like emulsion complexes with dietary fats, which prevent pancreatic lipase from hydrolyzing them [7]. Supplementation with oligofructose, a prebiotic, is presumed to render bile acids and cholesterol insoluble [8]. Furthermore, probiotics, which are live organisms that are known to confer a health benefit to the host and include such genera as Lactobacillus and Bifidobacterium, promote additional breakdown of bile acids into amino acid conjugates, and when these conjugates are excreted, cholesterol is then broken down to replace the bile acids, eventually leading to lower serum cholesterol levels [9-11].

Probiotics may also have a cardioprotective role too as demonstrated by Lam et al, who showed that administering a solution with Lactobacillus plantarum 299v to rats 24 hours before subjection to ischemia and reperfusion ultimately demonstrated a reduction in infarct size and improvement in post-infarct left ventricular function [12]. Addition of Lactobacillus rhamnosus GR-1 to drinking water for rats subjected to coronary artery occlusion resulted in attenuation of left ventricular hypertrophy and improvement in systolic and diastolic function on echocardiography [13].

Dietary factors, including carnitine and phosphatidylcholine (PC), both of which are found in red meat, are converted to trimethylamine (TMA) by intestinal microbes, and TMA is then transported to the liver, where it is converted into trimethylamine-N-oxide (TMAO), which has been shown to escalate formation of atherosclerosis in mice. Other PC metabolites, including choline and betaine as well as TMAO, have been associated with decreased reverse cholesterol transport, increased forward cholesterol transport, and increased risk of cardiac events, such as myocardial infarction, stroke, and death [14]. TMAO levels have also been found to be elevated in patients with chronic heart failure, and higher levels have been linked with severity of symptoms and survival [15, 16]. In chronic heart failure, reductions in cardiac output and systemic venous congestion within the mesenteric vascular system may result in repeated episodes of microischemia to the intestinal villi, creating an environment in which bacteria may translocate into the bloodstream [17].

Although the association between intestinal microbes and cardiovascular disease is increasing, there is a paucity of data in patients who have undergone cardiac transplantation. However, in the liver transplant patient, immunosuppressive therapy, in conjunction with ischemia-reperfusion injury and altered nutritional status, has been associated with damaged intestinal barriers, changes in the innate immune response, alteration of gut microbiota with proliferation of pathogenic organisms, and intestinal bacterial translocation, all of which affect graft failure, early infection, and mortality [18]. A decrease in the overall diversity of intestinal microbes has been linked to poorer clinical outcome post-transplant in patients receiving liver, kidney, and hematopoietic stem cell transplantation [19]. Increased gut colonization by pathogenic species has been shown in rats with acute cellular rejection after liver transplantation [20]. Tacrolimus and mammalian target of rapamycin inhibitor use after liver transplantation is associated with increased intestinal permeability, bacterial endotoxin levels, inflammation, and mortality [21-23].

Given the direct exposure to the external environment as well as the teeming upper respiratory tract, the transplanted lung is particularly susceptible to alterations in its microbiome. Bronchoalveolar lavage (BAL) samples taken from lung transplant subjects showed a 44-fold increase in DNA from
potentially pathogenic bacteria when compared to samples from control subjects. Additionally, BAL from healthy volunteers showed little fungal DNA, mainly comprised of environmental organisms, while BAL from transplant subjects contained predominantly pathogens, including Candida and Aspergillus [24]. The overall diversity of microbes is decreased in lung transplant recipients when compared to non-transplant controls [25]. The role of diminished microbial diversity, especially with predominance of potential pathogenic organisms, may influence adaptive and innate immune responses to the lung microbiome.

Thus, further investigation into the microbiota of cardiac transplantation patients is necessary. The role of intestinal flora and innate immunity, especially with regard to donor-specific molecules, needs to be elucidated. Given that microbial environments vary between geographic regions, the microbiome of donors may impact the cellular response of the recipient in the settings of acute and chronic rejection. Co-morbidities, such as liver or renal failure, may also alter hormonal and immunological responses from the microbiome. Immunosuppressive agents and their pharmacokinetics may become modified as a result of microbial influences. The viral component of the microbiome has been shown to be influenced by the regimens of antiviral medications and immunosuppressants following transplant. The virome is a sensitive marker related to drug dosage as a similar composition of viral DNA is found in blood samples taken from healthy, non-transplanted subjects and transplant subjects with minimal drug exposure. In contrast, those compositions are markedly distinct from samples taken from transplant subjects with heavy drug exposure. Additionally, the total viral load increases after onset of immunosuppressive therapy, especially with respect to anelloviridae, a ubiquitous family of viruses that cause chronic human infections but have yet to be associated with specific pathology [26]. The link between oral, intestinal, pulmonary, genitourinary, and cutaneous organisms and cardiovascular health is not well understood. The role of the microbiome in cardiac pathology is fertile for new and exciting clinical research.

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The Very Critical, Vastly Chaotic, Vital and Changing VAD Coordinator

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What exactly is a VAD coordinator? What do they actually do? Why do we need VAD Coordinators? ICCAC what?

Those of us who work in VAD programs know that the presence of a VAD coordinator is crucial to the success of a program. The Joint Commission requires that all certified VAD centers have one. So why have we had such a hard time trying to explain what a VAD coordinator is and does? Why has it been so hard to identify the core knowledge necessary to perform the role? Let’s start at the beginning.

The origin of the VAD coordinator role came in the early 1990’s when VAD’s left the lab and became an option as therapy for end stage heart failure. As the field began to develop, it quickly became apparent that there was a growing gap between the medical and technical aspects of caring for this new kind of patient. There needed to be someone to bridge those worlds and integrate them first into the inpatient world and later into the community.

VAD coordinators came from, and today still do come from, many different backgrounds. The role was filled by research coordinators, biomedical engineers, perfusionists, lab techs, physicians and nurses, as well as other backgrounds. As the population and number of implanting centers grew, many centers looked to nursing personnel to fill the gap.

There were no job descriptions, defined responsibilities, or orientation into the position, and very few opportunities for mentoring. Training to manage all aspects of the devices was provided by the manufacturers and often was limited to initial in-person presentations to a core team. Follow up education was very limited, and VAD coordinators assumed responsibility for orienting all personnel involved with VAD patients. Daily tasks included creative interventions as we gained experience using the technology. Coordinators had to be proficient in a technical as well as medical field and be able to blend the two with very little direction. The terms “jack of all trades” and “MacGyver” summed up what was and is still necessary to perform this role.

Some of my favorite memories of creative interventions include taking apart a Thoratec Dual Drive Console (DDC) and reseating computer cards that had come loose during movement of the device; patching a Thoratec PVAD pump that had cracked and was leaking air after the patient fell (Thankfully, I had the pleasure of working with and being able to fall back on some amazing artificial organs engineers and some really cool putty they brought with them to seal the leak); learning how to drive the hospital mini bus so the HeartMate Implantable Pneumatic (IP) device patients could get out of the hospital for a few hours to go to a hockey and baseball game (not to mention making all
of the arrangements to do it safely); identifying and troubleshooting medical issues with patients from the ICU through outpatient clinic and deciding whether the issues were pump related or not.

On a personal level I remember thanking the universe for extensive ICU training as a nurse as well as family practice nurse practitioner training. When caring daily for the 80 year old destination therapy (DT) patient with an elevated PSA and the 14 year old bridge to transplant patient with recurrent VT; calculating dosages of amiodarone, sedation and cardioversion of that 14 yo all while mediating the intense “discussion” between the pediatric cardiologist with no VAD experience and adult cardiologist with lots of VAD experience who disagreed on the correct course of treatment that should be taken (I’ll let you use your imaginations to figure out who won that one). And the stories could go on and on.

The technology has evolved and with it so has the role. The International Consortium of Circulatory Assist Clinicians (ICCAC) was created in 2007 to help establish a community for those caring for VAD supported patients. Its members include adult and pediatric VAD coordinators as well as anyone who cares for MCS patients. Its mission is to be able to provide a network, to ask questions, find a mentor, or discuss issues with others in the field. A wealth of information and experience has been compiled and discussions held on the MCS Collaboration online discussion board. It has helped to connect more experienced coordinators with those who are looking for help or suggestions. More importantly it has helped to connect coordinators so that a more consistent role definition could be developed.

The MCS world has evolved from a limited number of implant centers, all of which were academic cardiac transplant centers. There was a limited population of patients that were all hospital bound. We now have an increasing number of community implant centers with an ever increasing collection of patients in many, and sometimes distant, communities. Daily tasks may have changed but the need for VAD coordinators continues to be essential to successful programs. The overriding theme of the position continues to have at its core bridging the gap between the technical and medical worlds as well as regulatory and administrative worlds within an implant center.

With that in mind I would like to leave you with a job description that was created in the late 1990’s as a parody for the coordinators at that time. It is still relevant today and sums up the role in many ways.

Job description of a VAD Coordinator:

Detail oriented practitioner with the ability to multitask, critically think, prioritize, and is well versed in crisis management. Able to independently manage patients with complex medical conditions as well as perform administrative and investigational tasks simultaneously. Willing to work at least 60 hours per week and remain on call and accessible at all times. Willing to work in high tech, intense field, while frequently making peace amongst members of the team. Possesses the ability to be gracefully overruled despite being made responsible for aforementioned anticipated problems. Able to do large amounts of paperwork while remaining calm in situations that are not familiar and for which training is not provided. Able to deal with other “professionals” from all parts of the medical field while being asked to justify existence to administrators who have no idea as to what it is that
the position entails. Experience in creatively “appropriating” supplies and equipment while magically producing monetary funds as well as patient support systems is desired.

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MCS Registries: Should they be Local, Regional, National, Supra-National, Continental and Global?

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No clinician would doubt the need to register the events and data with respect to the implantation and follow-up of patients with mechanical circulatory support (MCS).

Information about the course of therapy in individual patients, as well as the statistical evaluation of a group of patients over time, can teach us a lot about the effectiveness of the applied therapy. Specifically when, in this relatively new form of therapy, characterized by frequent innovations of the devices, evaluation of detailed information about the successes and failures is of great importance.

As history teaches, local registries, frequently developed by the treating physician(s) or their in-hospital ICT departments, became the source and the pride of professionals to demonstrate their local achievements.

Then, those who think big, and rightly so, develop initiatives to gather data on a larger scale. While in the USA hospitals were obliged to provide data to Intermacs, the Europeans created a voluntary registry, called EUROMACS, which connects with local and national databases. Thirty-seven hospitals have now joined, and another 34 are taking steps to follow. The difference between EUROMACS and other registries is that data are provided to professionals who wish to carry out clinical and/or scientific analyses. Further, data completeness checks by statisticians and on site audits add to the quality of the data. The development of a near real-time dashboard will enable the participating sites to benchmark their outcomes by comparison with the anonymous data of the other hospitals.

For reasons of different regulatory environments and spans of control, an agreement with the IMACS Registry sees to the provision of data on a global level. Thus we have connected the world of MCS from the ground up, from local to global, expecting that the clinical and scientific data will enable us to learn how to improve the care of patients with end-stage heart failure.

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Joint Forces Combined in EUMS – The Number 1 MCS Meeting in Europe

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In December 2015, EUMS (the European Mechanical Circulatory Support Summit) celebrated its tenth anniversary with a meeting in Paris. EUMS was created in 2006 from a common effort of the CT surgery departments of Bad Oeynhausen (Germany) and Paris (France). The aims of the meeting are to promote experience and share multidisciplinary knowledge in the field of mechanical circulatory support (MCS). During the past 10 years, EUMS has been held alternately in Bad Oeynhausen and Paris and has regrouped between 300 and 400 participants from all over the world for two and a half days; this year participants came from 28 different countries. The format is based on expert conferences and long panel discussions to give opportunities for the attendees to explore and share on topics related to MCS and advanced heart failure. Twenty-eight abstracts were accepted as posters. VAD coordinators from the ICCAC (International Consortium for Circulatory Assist Clinicians) also actively participated in the sessions.

For the first time, EUMS organized a one-day pre-meeting. Attendees were able to participate in the wet lab and sim lab on HVAD implantation (HeartWare), ECMO cannulation and ECMO management (Maquet/La Pitié-Salpêtrière). Simultaneously, formal training for HeartMate III took place, organized by Thoratec/St. Jude. Parallel to these workshops there was an expert opinion conference on cardiogenic shock. This session was organized and chaired by Pascal Leprince, Head of the CT surgery department in La Pitié-Salpêtrière hospital, Paris, France and Dr. A. El Banayosy, from Integris Baptist Medical Center, Oklahoma City, US. This conference brought together 13 international experts to work on stratification of severity of cardiogenic shock, short-term device-based treatment and network organization. A position paper will be coming soon.

In 2015 EUMS revisited the history of mechanical circulatory support (MCS) in the US and Europe and Prof. Cabrol gave a lecture on his pioneering experience of MCS. We also addressed the role of cardiologists in the network of advanced heart failure care. One recurrent message from several sessions, and particularly from the panel discussion moderated by Dr. Long on “Where are we going next?”, was the imperative necessity of reducing the adverse event rate associated with MCS. Improving biocompatibility could help us to reach this goal and several speakers addressed this topic, from basic to clinical applications.

Patient management was the subject of a very interactive morning clinical case session and also of a moderated panel discussion entitled “ECMO best practice”. Care of MCS outpatients and special populations was discussed and the total artificial heart was revisited, with SynCardia experience in congenital patients and long-term implantations, and an update on Carmat and continuous flow pumps. Moreover, attendees were able to listen to recent industry data through 2 VAD update sessions.
Finally the guest lecture session took us on an incredible journey from the big bang and through the beauty of the universe. Moreover, some of us took the opportunity for some early jogging in the beauty of awakening Paris.

Recently EUMS decided to join forces with the group from the Deutsches Herzzentrum Berlin and thus the 2016 meeting will be held in Berlin.

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Studying the Studies or Surfing PubMed

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“Long-term mechanical circulatory support is an established treatment of end stage heart failure.” This is how many, if not the majority of papers start. And the words are correct. In the past, there have been many papers reporting that implanting MCS saves lives. This has now become an established scientific fact, but it is based on only one prospective randomized study for destination therapy. It is also clear that no surgeon would randomize dying patients on the waiting list for heart transplantation (HTx).

The focus of prospective “survival” studies has moved from dying to stable NYHA III patients. One example is a Germany based multicenter “Early LVAD” study, which should help us to understand the value of the LVAD during waiting times for HTx. This study is supported by the DZHK - German Center for Cardiovascular Research. Another, although observational and nonrandomized, is the recently published “ROADMAP” prospective multicenter study – the new edition of the REMATCH study, supported by Thoratec. Then there is the randomized study ENDURANCE, which has led to improvements in patient management and pump settings.

Following the implantation of thousands of devices another point of interest has arisen: the complications associated with LVADs. Work on this seems to come in wave sets – to name just some, right heart failure and the tricuspid valve, then von Willebrand factor (vWF), the role of pulsatility regarding the aortic valve, and GI bleeding. Most recently, pump thrombosis is en vogue. All these studies are of a retrospective nature, the analysis of single or multicenter registries or of international registries such as Intermacs or Euromacs.

Few of these studies have actually changed our practice of VAD use in reality. If a surgeon repairs the tricuspid valve for moderate tricuspid valve regurgitation during LVAD implantation, that person believes in this approach and will continue to follow it. On the other hand, I do not know of a single center that still routinely measures vWF in VAD patients. The debate about LVAD settings in terms of opening of the aortic valve is still controversial and the pulsatile mode of HeartMate III or HeartWare MVAD does not add clarity. Even the optimal anticoagulation is not defined, and all recommendations are based on retrospective analysis or are more or less arbitrary, relying on institutional experience. And the most important question of all, LVAD vs. HTx, is also still open.

Recommendations for all aspects of perioperative management could ultimately be provided on the basis of prospective randomized trials (such as the DZHK supported study mentioned above) and I am sure that all surgeons and heart failure cardiologists would be happy to participate in such trials. However, due to the large number of patients required for the sake of adequate statistical power, such studies are only possible with multicenter efforts. We, as a Society in which most end-stage heart failure specialists are involved, should initiate such studies and urge industry and national
research organizations to support them. And major VAD companies should continue to support prospective randomized studies like those cited above to find the optimal pump for the individual patient and the optimal settings for each pump operation.

However, I am a realist and I know that such dreams will never come true until the number of implants reaches a critical mass – in my opinion, 5-10 times more implantations would force physicians to ask fundamental questions and to perform prospective studies. In the meantime, the analysis of VAD registries for basic questions, and of large institutional databases for more sophisticated issues, remains the only tool available to us today and in the near future. This opinion is shared with us in the October issue of the Journal of Heart and Lung Transplantation by Dr. J. Stehlik et al. The quality of registry analysis is dependent on us – how precisely and completely we feed the registries – and on the registries themselves – quality control of the submitted data is indispensable and should be evident for researchers and users of the registry based studies. However, a larger problem arises from the limitations in conception of the data collection and amenability to analysis. There is a lack of uniformity of diagnostic and therapeutic approaches between the reporting centers – this is the view taken by Dr. S. Urschel et al. in the same journal one month earlier. It made me smile to read this paper immediately after that by Stehlik et al. It is, of course, not a completely controversial opinion, but it urges us against meaningless use of registry based studies for developing clinically relevant decisions. I strongly recommend that Urschel’s paper is read before registers or register based studies are designed and before decisions based on such studies are made.

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Genetic and Genomics in Transplantation: It’s complicated...but are we prepared?

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It’s been a long time since the human genome was explicated in 2003. No one questions the importance of genetic and genomic influences on the development of cardiovascular or thoracic diseases. In fact, among transplant patients, individual patient responses to treatments, most notably medications, vary from expected outcomes, to no effect or deleterious effects. While great strides in genetics and genomics have been seen in transplantation particularly as it relates to the use of Allomap [1]; new findings on the horizons related to the use of genome-wide association studies [2], next generations sequencing exploration and cell free DNA methodologies continue to provide promise to improve patient outcomes. Translations of this knowledge into practice will require system wide changes to support the translation of genetic and genomics into practice [3]. Clinically, this work still requires efficacy trials to insure patient safety. However, the steps to successful translation of this knowledge into clinical practice are complex and multifaceted [4]. Many discoveries are slow to fulfill their promise. A major impediment to widespread translation of genetic and genomic science is lack of basic literacy in genetic and genomic concepts. In practice there remains a difference between care providers who are knowledgeable in the application of genetic and genomic in transplantation and those who may not be as familiar [5].

In 2006, a Consensus Panel established the first competencies and curricular guideline for nursing in genetics and genomics [6]. Competencies were then expanded to include outcome indicators in 2009 [7]. The competencies apply to all registered nurses regardless of academic preparation, clinical role or practice specialty, including nurses practicing in transplantation. Then in 2011, another consensus panel was convened to establish the competencies specifically for nurses with graduate degrees [8]. All the competencies have been published by the American Nurses Association (ANA) and specify the minimum genetic and genomic knowledge, skills, and attitudes required of nurses who are not practicing in a genetic sub-specialty.

The difficulties encountered in translating competencies into practice have prompted the development of educational strategies necessary to prepare nurses to care for patients in this genomic age [9]. Interventions are most successful when targeted towards specific genetic/genomic educational needs of a specific practice group. To date, no studies have been conducted to assess transplant nurses knowledge of genetics and genomics. As discoveries in genetics and genomics of transplantation continue to emerge, such as pharmacogenomics, genetic variation and transplant outcomes, the clinical translation aimed at improving transplant outcomes is primary limited by the
capacity of the transplant team to understand and implement those findings. Since an impressive amount of time is spent in patient and family teaching, all transplant nurses must assess their own genomic competency and consider strategies to understand the concepts of genetics and genomics as they will surely be confronted by patients and families with questions in this area.

The NHSAH is committed to assisting in this endeavor. Recognizing that this knowledge area is critical for the NHSAH council and that no literature could be found to inform our council’s educational strategic planning, we plan to conduct a survey of our council members’ basic knowledge of genetics and genomics. This IRB approved survey will be distributed in January 2016 via survey monkey. Results will be presented at the Pre-conference Co-sponsored by NHSAH and the Junior Faculty Councils entitled: “Genomics: What Do I Have to Know and How Will It Affect My Practice”. We welcome your participation.

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References:
The Road to Recovery – Rehabilitation after Lung Transplantation

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The definition of rehabilitation is the act of restoring something to its original state and comes from the latin re meaning “again” and habitare meaning “make fit”.

Exercise rehabilitation is an established element of care after lung transplantation (LTX). There is evidence about improving functional exercise capacity & muscle strength, but what about the patients’ experience of post transplantation rehabilitation? What elements of the rehabilitation program are more useful to them? It can be challenging commencing an exercise program for many patients given the reduction in physical activity pre transplantation.

Acute post LTX rehabilitation programs vary in duration and composition worldwide. These can range from in patient to outpatient or home based programs. There is little supporting evidence to establish the exact composition of exercise rehabilitation programs.

Our current program of 36 supervised sessions has an average attendance rate of 85%. It is undertaken for all post lung transplantation recipients once they have achieved outpatient status (average time from transplant is 20 days) Goal of rehabilitation should be to return patients to peer matched normal life activities including return to school, work, sport or community work. A combination of aerobic training and strength training is performed in the gym, supervised by physical therapists and allied health assistants. Exercise prescription is patient tailored and progressive. Strict infection control procedures are followed.

Recent qualitative research has highlighted that the rehabilitation program in this format is highly valued by patients. There is an overwhelming desire to return to normal activities and rehabilitation is considered as the vehicle to enable this to happen. Whilst the musculoskeletal improvements are more obvious, it is the psychological improvements that are more surprising. There is a sense of having exceeded expectations and achieving a physical level that empowered patients to continue to exercise.

Exercising in a group environment provides peer support, motivation and camaraderie in a friendly, informal atmosphere whilst still allowing access to professional guidance. There is also a strong sense of community within the group and a heighten sense of achievement on completion of the program.

Interruption to rehabilitation either from pre-existing musculoskeletal co-morbidities or medical setbacks post-transplant is particularly concerning to the patients. Frustration at missing gym sessions increased anxiety about delays in goal attainment and particular attention needs to be paid to the musculoskeletal assessment pre transplant to eliminate these co-morbidities.
These patient experiences and expectations have impact on our rehabilitation program design. Educating patients about realistic physical goals setting and constant re-assessment of their goals is important particularly considering the physiological changes or drug side effects on skeletal muscle and its subsequent ability to exercise.

From the patients’ perspective, the rehabilitation program design needs to include peer support and an opportunity to interact with other transplant patients, either in a group exercise setting or an informal debriefing session.

Tailoring our rehabilitation programs to the patients expectations will certainly again make them fit!

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Pediatric Cardiac “Prehab”

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Cardiac rehabilitation (rehab) programs are therapeutically guided efforts usually aimed at recovery after heart surgery or other functional restorations. A tolerance-limited version of this sort of therapy, a cardiac “prehabilitation” (“prehab”), may be instituted for waitlisted cardiac failure patients in order to prevent further deconditioning before heart transplantation. Unlike adult heart failure patients, infants and younger children may not be able to recognize or verbally express activity intolerance during physical therapy sessions. Trained-eyes monitoring the child and supervising individually measured/planned activity prevent syncopal events or sudden death.

Pediatric heart transplant referral diagnoses include severe heart failure from cardiomyopathies (dilated, hypertrophic, restrictive, left ventricular non-compaction, arrhythmogenic right ventricular dysplasia) and congenital cardiac malformations. These children may be maintained on intravenous inotropes or ventricular assist devices as inpatients if necessary.

The degree of heart failure and physiologic responses associated with these conditions may impair our ability to entirely treat the resultant debilitation. However, consistent carefully directed physical therapy sessions may effectively allow achievement of timely developmental milestones and promote maintenance of reasonable strength for faster recovery after transplant.

Infant
An infant’s primary role should be growth and exploration. How can this be safely promoted in an infant that may have the desire to explore and interact, but whose cardiac reserve severely limits activity? Physical therapists (PTs) aim to facilitate an environment and positions from which they can explore.

Infants with limited experiences may not spontaneously reach out for tactile exploration of a toy. They may not lift up their lower extremities to discover their feet. This important precursor to rolling requires strength, but also causes an increase in intra-abdominal pressures, and therefore may require close monitoring when facilitating these movements. In fact, simply positioning an infant in upright can be taxing and poorly tolerated. However, given that a majority of life is intended to be spent upright, the benefits (opportunity to practice head control, reinforcing the visual and vestibular systems’ orientation to the horizontal plane) make this goal a priority.

Another challenge presented to our young patients is bone growth and development. Wolff’s law teaches us that bone development occurs in response to the forces exerted on them by gravity and the pull of muscles, for better or for worse. Infants’ long bones, ribcage, and skull are particularly
vulnerable. PTs can help minimize positional plagiocephaly and promote the proper recruitment of the core postural muscles that influence ribcage development and efficient breathing mechanics. We can provide modified opportunities for lower extremity weight bearing to enhance the gross motor development skill set and prime them for ongoing skill acquisition.

PTs educate caregivers on providing appropriate opportunities for safe movement experiences, which fosters the infant’s ongoing desire to explore, in turn motivating our young patients to move themselves. Because when movement is limited, cognitive development is limited to only what is immediately available within reach or line of sight.

**Toddler**
A toddler or older infant may be on the cusp of acquiring the exciting new skill of walking. Ambulation is an incredible accomplishment for a typically developing child at home. In the hospital, multiple barriers stand in the way of new walkers: safety (typical toddlers fall 17 times per hour when learning to walk [1]), logistics and line management, insecurity in his environment, and energy expenditure. For brand-new walkers, limited energy from diminishing cardiac reserves may cause them to regress to a more energy efficient strategy such as crawling. Research shows that infants learning to walk will practice the equivalent distance of 7.7 football fields per day [1] before mastering this skill.

Add a heavy VAD, multiple lines, stranger anxiety, cardiac insufficiency, and limited opportunities for practice, and it seems incredible that these little ones are ever able to overcome these obstacles during their hospitalization! A PT must help the early walker safely strengthen, practice static and dynamic balance, weight shifting, and protective responses over and over.

Acquisition of a new skill such as ambulation is not energy efficient at all, and a failing heart can only give so much. PTs can help pace activity and carefully monitor for subtle physical and behavioral signs of intolerance, including worsening movement quality and compensations. Even once a child is mechanically compensated with a VAD, the logistical difficulties require a coordinated team of therapists, therapy aide, nurses, and child life specialists.

**School-Age**
Our school-age patients often present with an acute onset of cardiac insufficiency. Learning to balance their newfound restrictions with a safe activity level can be a tricky transition. Designed for adults, the Borg rating of perceived exertion (RPE) scale translates poorly for children, which despite our best efforts, gets misused as an inverted rating of perceived *fun* instead of exertion.

PTs teach patients to monitor their body’s response to activity, a crucial skill post-transplant, particularly given the transition from a neural to a hormonal mechanism for changes in heart rate. We prioritize the pending effects of surgery to focus activities on core control and stability, preventing substantial losses in strength (particularly throughout the trunk and lower extremities), and line management and safety.

We practice transfers, warm-up and cool-down periods, and sternal precautions in preparation for the acute and sub-acute post-operative period. This is a critical age group for promoting healthful
behaviors and activity. Modeling this approach for families can help them transition what they’ve learned in the hospital to their home after discharge and set them up for success.

**Teens/Betweens**
Survivors of single ventricle physiology or other impairments early in life may eventually reach adolescence, perhaps after years of cardiac dysfunction. They may come to us with poor health habits or outlooks on exercise. Their deconditioning may have long preceded their hospitalization. They present with decreased lean muscle mass and poor posture, which inhibits full recruitment of their lungs for appropriate ventilation and contributes to early onset kyphosis or lower back pain.

A directed physical therapy program can target individualized issues, teach activity pacing, strengthen target muscle groups, and promote healthy attitudes towards activity. We aim to help adolescents discover a physical activity that they enjoy and can participate in post-transplant to build healthful, life-long habits.

**Summary**
Children somehow must just know they are supposed to seek opportunities to learn new skills and grow. They instinctively find new experiences and learn quickly...just watch a two year old figure out how to navigate a computer screen or master the television remote to watch a video.

Helping them learn and grow while supporting their severe heart failure can be a challenging task for all involved, particularly the child. Poor cardiac output may result in irritability, developmental delay and feeding intolerance. Tangled intravenous inotrope lines, nasogastric feeding tubes and anticoagulation safety precautions pose barriers to their freedom to walk, run, and investigate all those really interesting things in their environments.

Depending on the resultant physiology of the child’s particular cardiac disease process, exercise may provoke arrhythmias, increase already elevated venous pressure and intensify ischemia (cardiac or other organs) if not monitored and performed appropriately. Staff working with children must be alert to early, sometimes subtle, signs of exercise limitations such as shortness of breath, heart rhythm changes, dizziness and fatigue.

It is important to maintain some level of physical strength, even in the setting of heart failure, in order to advantage post-operative recovery. After all, those of us who work in pediatrics must confess: the truly inspiring reward after transplant is seeing that child who required many months of support finally be able to just take off and **RUN** like a kid! All that said, in many ways, this “Prehab” really pays off!

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Big Decisions

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If you are like most people who work in medicine, you probably think that you make rational and purely data-driven medical decisions. Well, I’m going to kick off this article with some bad news for you. You don’t. There is a substantial body of research describing cognitive errors and biases that come to play in decision making that often lead us to make irrational decisions. Medical decision making is not at all immune to these errors and biases, and may even be the perfect breeding ground for them [1-3].

As professionals working in the area of transplantation, we make difficult decisions all the time, with life-and-death consequences. The scarcity of suitable organs makes listing decisions in transplant more difficult than decision making in many other medical settings. And now I have more bad news for you. Because transplant listing decisions are often made collaboratively by groups of people, this kind of decision making is prey to a further host of problems that arise specifically in group contexts. This article will focus on three ways in which group dynamics can negatively affect the quality of decisions made by well-intentioned professionals working in groups [2].

The first is power dynamics. If you’ve ever been part of a group decision making discussion, I’m sure you’ve noticed that some people exert more influence than others over the final group decision. There is substantial empirical evidence that higher status group members have more influence than lower status members [4]. Sometimes this may be totally appropriate (due to knowledge, expertise, or role on the team). A surgeon’s opinion should weigh more when the issue at hand is surgical in nature. At other times, however, this extra influence may simply be product of popularity or charm. For example, if some surgeon throws really amazing Christmas parties, or happens to be clever and amusing at rounds, the warm and fuzzy feelings this engenders may lead you to weigh her opinion more even when what is being considered is not a surgical issue.

A second problem goes by the name of “groupthink.” Groupthink refers to the tendency of a group to strive for unanimity to such an extent that it interferes with critical thinking, and interferes with good decision making. In some cases group members will systematically avoid asking important questions or broaching topics about which there might be disagreement. Agreement is good, but so is a full-throated discussion of the many tricky issues that attend transplant decisions; and it is rarely good to prematurely agree to a bad decision. While it may be true that many people who work in medicine are quite willing to disagree with each other, humans in general do want to agree and it can be useful to realize that this tendency can affect group decision making outcomes.

A third group decision making dynamic to be aware of is the group polarization phenomenon [5]. This refers to the tendency for groups to make decisions that are more extreme than the initial inclination of its members. Group decisions may be extra risky if individuals’ initial tendencies are
to be risky, and these group decisions may be extra cautious if individuals' initial tendencies are to be cautious [6-7]. This shift happens for a variety of reasons. For example, in the process of participating in a transplant listing meeting, you may be exposed to other team members expressing opinions that support your own, and this may lead you to be even more certain that your opinion is correct [8]. There is empirical evidence that this group polarization does indeed affect decisions about the allocation of scarce medical resources. For example, one experiment involving the allocation of dialysis found that groups of three made final decisions that were more extreme than the decision made by three people individually [9].

So far I have shared nothing but bad news: A few of the many ways that group decision making can go sideways, and may lead to suboptimal medical decisions. Happily, I do have some good news too. There are some simple and straightforward ways of limiting these problems. In fact, there is evidence that just knowing about problematic group dynamics can mitigate their negative impact. So, congratulations! Just by reading this article you are already better off. Additional evidence shows that by putting some simple procedures in place, you can avoid a lot of the predictable problems that sometimes arise in group decision making [2]. Here are some things to do that help: Promote full and open discussions in your team meetings. Identify strategies to guard against premature agreement. Develop a planful approach to decision-making—and actually follow the plan!

At our center we have worked hard to do so. About 10 years ago we developed the Heart Transplant Decision Making Grid. We complete this document as a group whenever we make a transplant listing decision. You will see it is divided into 4 quadrants: Medical/Surgical Contraindications; Psychosocial Contraindications; Lifestyle Management Contraindications; and a Decision Making Process checklist. We have found it to be very useful in focusing our discussions, helping us to evaluate multiple relative contraindications, and ultimately helping us to make fully-considered listing decisions. Especially relevant here is the quadrant on “Decision Making Process.” It’s just a short checklist, but it helps to ensure that we make an explicit effort to mitigate the negative impact of group decision making. I would encourage you to do something similar with your team. (Please feel free to use our Decision Making Grid, or to adapt it as needed.) By doing so, you may be able to better guard against problematic group dynamics, so that you can more fully avail yourselves of the many benefits of collaborative decision-making.

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ISHLT International Traveling Scholarships Awarded for December 2015

Daniel R. Goldstein, MD
Stephan Ensminger, MD, DPhil
Daniel Kreisel, MD, PhD
ISHLT Grants & Awards Committee Co-Chairs
www.ishlt.org/boardsAndCommittees/grantsAndAwards.asp

The ISHLT community extends to every corner of the globe and our members offer world leading expertise in every aspect of heart and lung transplantation, mechanical circulatory support, pulmonary hypertension and management of the failing heart or lungs. We encourage you to take advantage of being part of this amazing community by applying for an ISHLT International Traveling Scholarship.

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Applicant's Institution: University of California, Los Angeles, CA, USA
Host Institution: Hospital University Puerta de Hierro Majadahonda, Madrid, SPAIN

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Applicant's Institution: Post-Graduate Institute of Medical Education & Research, Chandigarh, INDIA
Host Institution: Harvard Medical School, Boston, MA, USA

Allison Carroll, MD
Applicant's Institution: University of Alberta, Edmonton, AB, CANADA
Host Institution: Texas Children's Hospital, Houston, TX, USA

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Host Institution: Royal Brompton & Harefield Hospitals NHS Trust, Harefield, UNITED KINGDOM

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A Healthy Laugh

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On April 20, 2010 the phone next to bed rang at 1:30 in the morning. My husband and I both woke up and knew it was “the” call. My transplant coordinator calmly told me that a new set of lungs were being prepared for me. The next few hours were a blur of activity. The drive to the hospital, being prepped, calling family and friends and then the wait in the pre-op area with my husband. I’m not sure if it came too slowly or too quickly, but it was time to head to the OR. Show time.

I remember there was this bright light shining above me. At first I wasn’t sure if I was supposed to go into the light or if it was just a light. When I tried to move a bit I realized I had made it through. The breathing tube caused me to panic a moment, thinking something had gone wrong. That’s when a very calm nurse reassured me things went right.

By the time I was taken to my room upstairs I was thrilled. I had made it – soon I would be able to take on the world. No more leaning over shopping carts, steps would not be the enemy and my fuzzy dog was going walking with me. That was what my mind said – my body pointed out a few minor things I had to deal with first – 6 drain tubes, a bronchoscopy or two, 10 day hospital stay, blood draws and a few months of rehab and learning the names and dosages of all my new meds. Prograf – Tacrolimus – tomato – tom-ma-toe.

There were good days and bad days, but not one day when I couldn’t breathe. Learning to care for my new lungs and rebuild my body took some time and a lot of effort, but it was worth every ache, pain, scar and frustration that happened. My inner voice kept reminding me that someone had given me a gift and I needed to appreciate it. Mentally it took a little longer to wrap my mind around everything that happened. Weeks after the transplant for some reason the thought that I had someone else lungs in my body hit me like a wall. It took a bit for me to wrap my mind around the fact that not all my body parts were original factory issue. Had these lungs ever smelled lavender in France? Run a marathon? Off and on for a month my mind would mull these and other questions, but as the months passed I realized it was more fun to actually go out and run, sniff and breathe for myself.

I wasn’t 100% optimistic 100% of the time. I was always a tall, thin girl. Remember Twiggy? I found out that with the help of loading and then a daily maintenance dose of prednisone I suddenly had curves. Ok I gained weight and rounded in places I never did before. A female and weight gain – this was going to take a bit to come to terms with. Funny when I was really thin I wanted curves, now not so much. I’ve dealt with people asking me what it was like to be dead, do I have feelings from my donor and why I would do this only to live an extra year or so – if I could handle that I could handle these blasted curves. After intensive shopping therapy, basically a whole new wardrobe, I realized I can breathe deep, look good and shake my curves on the dance floor. The Twiggy look was over rated. Time for Andrea 2.0.
It might seem that I have a more humorous approach to my experience than others. The truth is any transplant is not easy, not for the recipient or the donor/recipients families. There is that moment when you’re told your only options is a transplant and your mind just shuts off, all those seemingly endless test, jumping every time the phone rings and well-meaning friends and family who saw, read or knew somebody who went through something. Humor was my coping mechanism. I found that if I could find humor in some of the small things, the big ones didn’t seem too bad.

It’s been over five years since I started my transplant journey. I have no idea where the future will take me, but then again nobody does. I’ve been able to live life, instead of being just a by-stander − which is what organ transplant is all about. The first Halloween after my transplant I carved a pumpkin for my front yard − Frankenstein. Given my experience I wanted to tip my hat to the first organ recipient. (I told you, humor works.)

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EDITOR’S CORNER: From the Great Depression and World War II to the Cold War and Nuclear Arms Race: FDR, Harry and Ike

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Franklin Delano Roosevelt was born in Hyde Park, New York on January 30, 1882. An admirer of his fifth cousin, Theodore Roosevelt (Teddy), he graduated from Harvard, attended Columbia Law School, married his distant cousin Eleanor Roosevelt (niece of Teddy) practiced law in New York City, was elected New York state Senator and became widely known by his initials, “FDR.” He was appointed Assistant Secretary of the U.S. Navy in 1913 (the same position Teddy served in the 1890s) by President Wilson and kept this position through World War I.

FDR developed a reputation as a progressive politician and not unlike Teddy, had a knack for self-promotion. With his political and social prominence, FDR was selected by the Democratic Party as a Vice Presidential running mate with James M. Cox in the 1920 election against Republican Warren Harding. Cox and FDR lost by a landslide. Along with this political defeat, FDR met two personal tragedies: 1) the discovery of his affair with Lucy Mercer by his wife Eleanor and 2) the contraction of polio (possibly Guillain-Barre) in 1921 which paralyzed him from the waist down. His marriage to Eleanor became purely professional. She focused on becoming accomplished in the world outside her home. Eleanor called Roosevelt’s crippling disease his “trial by fire” which gave him patience, determination and resiliency.

Following these challenges, he convalesced, underwent intensive therapy enabling him to walk using crutches and braces, was urged to re-enter politics in 1928 and was elected governor of New York. Roosevelt became the Democratic nominee for President in 1932 in the darkest hours of the Great Depression. He promised a “New Deal” and defeated incumbent Herbert Hoover. When inaugurated the 32nd President on March 4, 1933, he inspired America with the words “The only thing we have to fear is fear itself.” With nearly 25% of America unemployed and banks facing a severe crisis, FDR immediately put his recovery plan into action. To inspire America out of its despair, he reached millions through the medium of radio in his “fireside chats” from 1933 to 1944 to explain directly to the people how the government was working on their behalf. Congress enacted programs for business and agriculture. The Social Security Act of 1935 brought relief to the sick and elderly and the Works Progress Administration provided work for millions.

FDR was re-elected in 1936 by an even greater margin than in 1932 and won an unprecedented 3rd term in 1940. While America continued to recover and strengthen at home, WW II escalated in Europe. FDR responded to Hitler’s aggression in Europe by sending the British 50 destroyers in exchange for military bases, followed by massive “Lend-Lease” aid and proclaiming America as the “Arsenal of Democracy.” The U.S. remained neutral, but the Japanese attack on Pearl Harbor, Hawaii on December 7, 1941 forced America to enter World War II. With Stalin and Churchill, Roosevelt planted the seeds of a post-war world and the emerging United Nations. Despite his failing health
Roosevelt won a fourth election. On April 12, 1945 – just weeks into his fourth term – he died of a cerebral hemorrhage at the “Little White House” in Warm Springs, Georgia and was buried in the Roosevelt family plot at Hyde Park.

As Abraham Lincoln for the Civil War and Woodrow Wilson for World War I, Roosevelt led America through World War II without any combat experience.

Despite his affliction with paralysis throughout his Presidency, FDR was able to pull America through its greatest crises, The Great Depression and World War II. His tools were his vigor, charm, undimmed charisma and contagious optimism. In just over 12 years as President, FDR realigned the American political system, reshaped the Democratic Party, refined domestic and foreign policy and reinvigorated the presidency and executive branch of government.

The influence of the Roosevelt family on America remains profound beginning at the onset of the 20th Century with Theodore Roosevelt. At the wedding of Eleanor and Franklin Roosevelt in 1907, the bride was given in marriage by her uncle, President Teddy. Other influential families have emerged including the Kennedy’s, the Bush’s and the Clinton’s but we are getting ahead of ourselves. The Roosevelt wave continued with FDR which rippled outward. Such ripples were amplified by Teddy’s daughter, Alice, and most notably FDR’s wife, Eleanor. As a reminder, Alice Roosevelt Longworth was probably 20th Century’s first global celebrity who later hissed: “When I think of Frank and Eleanor in the White House I could grind my teeth to powder and blow them out my nose.”

Adlai Stevenson said of Eleanor Roosevelt, “She would rather light a candle than curse the darkness and her glow has warmed the world.” Eleanor was able to overcome shyness after FDR was paralyzed in 1921. She became active in politics when FDR ran for governor. When he was elected President, she emerged among the most active and influential First Ladies in American history. She was a crusader for human rights and world peace. She traveled everywhere and met everyone. She reported to her husband and worked tirelessly on behalf of African-Americans, women, the poor, and all those who hoped the federal government would help improve their lives. After the death of FDR, President Truman appointed her as a delegate to the United Nations. She helped draft the Universal Declaration of Human Rights and spent the rest of her life promoting peace, teaching and speaking out for those treated poorly by those in power. She was recognized the most influential woman of the twentieth century.

Harry S. Truman was born in Lamar, Missouri on May 8, 1884, and not unlike Lincoln, he rose from humble beginnings and his own limitations to become an American hero who led America through a most difficult time in history. Controversy about Truman abounds from whether he initiated the nuclear arms race or contained communism to whether a period should be used or not after his middle initial – he had no middle name. His initial “S” was a compromise honoring his grandfathers, Anderson Shipp Truman and Solomon Young, it was not an abbreviation for any name. Truman grew up on his family’s farm with an aggressive father, but Harry S Truman preferred to get his way through persuasion and conciliation. Similar to Teddy Roosevelt, Harry was a weak and sickly child, but unlike Teddy, he did not build himself into a strong and athletic man. After briefly attending business college, he worked on the railroad, in banks and helped his father run the family farm until
the age of 30. During World War I, Truman was sent to the French front in 1917 as first lieutenant and was discharged a major in 1919. That year he married his “only one sweetheart from the time I was six,” Elizabeth “Bess” Virginia Wallace. Later that year, he opened an unsuccessful haberdashery store in Kansas City. With this failure in 1921, other than his marriage, Truman had achieved no notable accomplishments in his life – he was a farmer, a bank clerk and a haberdasher – until 1922 when he was elected a county court judge in 1922 which launched his political career. He retained this position until 1934 when he was elected to the US Senate. As a senator from Missouri, Truman was chairman of the prestigious committee overseeing the national defense program, known as the “Truman Committee.” Because of his national prominence, President FDR selected Truman as his Vice Presidential running mate in 1944. Although Truman did not campaign for the Vice Presidency, he and Roosevelt handily won the election.

Truman was rather suddenly thrust onto the political stage when sworn in as the 33rd President on April 12, 1945 merely six weeks after FDR’s 4th inauguration and at a time when World War II was almost over. Germany surrendered on May 7. His first year of his Presidency was called “a year of decisions,” and Truman faced his biggest decision of his life. American troops were closing in on Japan as World War II was coming to an end. Should America drop the first atomic bomb on a Japanese city, or should thousands of Americans invade Japan? Truman chose the bomb and on August 14, Japan surrendered. Noted for his candor and wit, Truman originated the line, “The buck stops her.” Indeed, President Truman continued to face up to difficult decisions. In the Cold War that followed, he stood firm against the Soviets. In Greece, Turkey, West Berlin and South Korea, Truman carried out a policy of “containment.” While seeking the Presidency in his own right in 1948, a campaign rally supporter shouted, “Give‘em hell, Harry.” Truman adopted the slogan which became his nickname. He was expected to lose to Republican Thomas E. Dewey, but he surprisingly won the election by a narrow margin. The gutsy and straight-talking politician who suffered from having to fill the shoes of a giant, FDR, was willing to decide and take responsibility when others might be reluctant to make tough decisions which earned him respect. He continued making tough choices, such as the decision to go to war in Korea in 1950 after Communist North Korea invaded South Korea. Truman was eligible to run in 1952, but instead he retired to Independence, Missouri. He died on December 26, 1972 in Kansas City of either the proverbial internal medicine residency training diagnostic dilemma of heart failure versus pneumonia complicated by multisystem organ failure. My opinion, he died of pneumonia. He was buried in Independence, Missouri in the courtyard of the Harry S. Truman Library and Museum leaving us this quote, “It is amazing what you can accomplish if you do not care who gets the credit.”

Dwight D Eisenhower was born in Denison, Texas on October 14, 1890, but was raised in Abilene, Kansas, where he became renowned for his athletic abilities. Originally named David Dwight Eisenhower, he went by his middle name and changed it to Dwight David when he attended West Point in 1911. He was a star halfback for the West Point team until he injured his knee. Following graduation from West Point in 1915, he worked with the Tank Corps, trained recruits for World War I and served in Panama from 1922 to 1924. Eisenhower was encouraged to attend Command and General Staff School at Fort Leavenworth, Kansas, from where he graduated first in 1926. Later, he graduated from the Army War College in 1928 and accompanied General Douglas MacArthur to the Philippines as a military advisor until 1939.
When World War II began, few people outside the army had ever heard of this 50-year-old career officer. But soon everyone knew “Ike,” as he became one of the great generals of the century and a much-loved two-term President. As he rapidly rose through the ranks, he was put in command of US Troops in Europe in 1942. Then he directed the successful Allied invasions of North Africa and Italy. And in 1944, he planned the largest invasion in history. On June 6, more than 150,000 Allied troops under his command landed on the beaches of Normandy, France. Eisenhower’s ability to win the cooperation of soldiers of many nationalities was a key factor in the Allied victory over Germany.

World War II made him a national hero. He was named General of the Army on December 20, 1944, and is one of only five 5-star generals in United States History. After the war, he retired from active duty and was appointed president of Columbia University in 1948 and commander of NATO forces in Europe in 1950. In 1952, he won the Republican Presidential nomination and was elected the 34th President of the United States. Although he suffered a heart attack in 1955, he was re-elected in 1956. In these Presidential elections, Eisenhower used the memorable slogan “I Like Ike” in his successful campaigns. During his presidency, he oversaw eight years of peace and prosperity. He ended the Korean War, supported civil rights and desegregation, authorized the interstate highway system and supported the development of NASA. Also during his Presidency, the polio vaccine was first made available, Alaska and Hawaii brought the number of states to 50 and America’s diplomatic relations with Cuba were severed. The pursuit of peace in the Cold War era was one of Eisenhower’s priorities. Domestically, he continued the New Deal policies and declaring “There must be no second class citizens in this country,” he fought for equal rights for minorities. He was criticized by some for being aloof on controversial issues, however Eisenhower’s down-to-earth manner and kindness won him the nation’s affection. When he left office the former soldier warned against the acquisition of unwarranted influence by the “military-industrial complex.” He retired to his farm at Gettysburg, Pennsylvania. He died on March 28, 1969 of congestive heart failure, and was buried in Abilene, Kansas. Ike was a wartime leader and peacetime visionary, best remembered as the architect of victory in Europe who built peace, prosperity and equality at home.

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