

# DERECH HATEVA

A Publication of Yeshiva University, Stern College for Women

A Journal of Torah and Science

Volume 20

2015 - 2016





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**A Journal of Torah and Science**  
**A Publication of Yeshiva University,**  
**Stern College for Women**

**Volume 20**  
**2015-2016**

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# Acknowledgements

The editors of this year's volume would like to thank Dr. Harvey Babich for the time and effort that he puts into this journal. As Dr. Babich continues to inspire many of the aspiring scientists at Stern, he reminds us that a Torah lesson can be applied to almost anything, which is the key idea of the journal, Derech Ha'Teva. Dr. Babich, thank you for encouraging all of us to be the best we can be and for helping each of us to exceed our respective goals.

Publication of volume 20 was possible, in part, due to the generosity of the following donors:

Dr. and Mrs. Harvey Babich

Dr. and Mrs. Eliot Ghatan [Ghatan Foundation]

Dr. and Mrs. Richard Grazi

Rabbi Dr. and Mrs. Edward Reichman

Dr. and Mrs. Richard Schwimmer

Mr. and Mrs. Morris Rosenthal

Rabbi and Mrs. Baruch Solnica

Dr. and Mrs. Benjamin Solomowitz

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Allison Tawil

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# Dedication

We dedicate this 20th volume of *Derech HaTeva: A Journal of Torah and Science* in memory of the beloved Henny Machlis a”h, a graduate of Stern College for Women and a true *ishet chayil*. Henny died at the age of 58 on October 16, 2015/Cheshvan 3, 5776. After obtaining a B.S. in education and a Hebrew teaching degree from Yeshiva University, she moved on to studying dietetics at Brooklyn College. The greatest trait that stands out when remembering Rebbetzin Machlis is her open home and even more, her open heart. The Machlis family would prepare Shabbos meals to feed around 100 guests each week. Even when she was sick and stuck in the hospital, Henny continued to give. Her attachment to the *midah* of *chesed* is portrayed by the following incredible story. A relative came to visit Henny at Sloan-Kettering and discovered the Rebbetzin wrapped in a hospital blanket, wandering in the hallway. It turned out that a destitute woman had come to visit Henny, and without hesitation she gave up her hospital bed so this woman could have a comfortable nap.

She lived a life of wisdom and of kindness, as it says in *Mishlei* 31:26 - “She opens her mouth with wisdom, and the teaching of kindness is on her tongue.” May the memory of Rebbetzin Henny Machlis provide us with inspiration to relate to Hashem’s world with wisdom and kindness just as she had done during her life.

“Do you not know - if you have not heard - an everlasting God is the Lord, the Creator of the ends of the earth; He neither tires nor wearies; there is no fathoming His understanding”

*(Yeshayahu 40:28)*

הַלּוֹא יָדַעְתָּ אִם לֹא שָׁמַעְתָּ  
אֱלֹקֵי עוֹלָם הַבּוֹרָא קִצּוֹת הָאָרֶץ  
לֹא יִיָּעַף וְלֹא יִיָּגַע  
אֵין חֶקֶר לַתְּבוּנָתוֹ





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The typical Jewish mother in mid-twentieth century America is thought to have been inordinately proud when she was able to introduce her child as “my son, the doctor.” Of all the white-collar professions, why has medicine become so esteemed by Jews? Did this outlook on medicine change over time, or was the field always respected? When looking back through Jewish history, one finds that as a nation, not only have Jews always valued the medical field, they have also contributed greatly to its development.

When exploring the Jewish outlook on any subject, one must first refer to the Torah, the primary and ultimate source of all legal and ethical views in Judaism. When seeking the Torah’s view of medicine, one must first turn to what is probably the most widely referenced passage relating to this subject, which is found in Exodus (21:19), “virapo yirapey - and he shall cause him to be thoroughly healed.” According to Rashi, Rabbi Shlomo Yitzchaki, this passage means that one who causes bodily harm to another person is required to pay the physician’s fees necessary to heal the victim. This indicates that the Torah must generally require one to who is ill to utilize available medical services. Otherwise, the Torah would not assume that a victim will seek medical help for which the “attacker” would be obligated to pay [1].

As is always the case when following the path of the development of Jewish law and belief, one must next turn to the Talmud for its interpretations and comments on the Torah and general Jewish thought. When exploring the Talmud’s references to medicine, numerous sources regarding the medical field and its practitioners are noted. One significant incident mentioned in the Talmud (Shabbos 82a) occurred when Rav Huna encouraged his son, Rabbah, to study under the tutelage of Rav Chisda, who was known for inserting health tips into his Torah lectures. Though Rabbah was very reluctant at first, eventually he became so enamored by Rav Chisda’s style that he too began commenting on various aspects of medical science (Gittin 69a). [2]

The next stage in the development of Jewish law and belief is the commentaries on the Torah and Talmud by Jewish scholars who lived in approximately the eleventh to sixteenth centuries. Perhaps the most famous Jewish scholar and physician, even among non-Jews, was

Maimonides. In his commentary to the Mishna, Maimonides interprets the commandment written in Deuteronomy 22:1 obligating the return of lost objects to their owners as referring to health as well as physical property [3]. When a physician helps heal a patient, the physician is returning the “lost” health to its “owner,” the ill person.

What is often viewed as the final stop on the journey towards practical applications of the Torah and Talmud is the more recent category of scholars who have codified the laws contained in these works and their details in separate texts. It is safe to say that the Shulchan Aruch is the one such text to which all others turn when researching a particular topic. The Shulchan Aruch (Yoreh Deah 336) declares that not only did the Torah give permission for the physician to heal, but it is his/her religious obligation to do so. The Shulchan Aruch includes the act of healing in the commandment to save an endangered life. Because Judaism values each moment of life, saving a life overrides many other commandments [4]. Therefore, a physician is constantly performing acts which are considered meritorious in Judaism.

In order to properly understand the manner in which Jewish law views medicine, one must trace its attitude towards medicine throughout Jewish history. This is achieved by starting with the original source in Torah, and then tracing it through the Talmud, the earlier commentaries from the first half of the second millennium and to the later compilers of practical Jewish law in the latter half of the second millennium. When doing so, one encounters an overwhelmingly positive outlook on the field and practice of medicine. As healing the ill and saving a life is greatly valued, it is easy to understand the pride of a Jewish parent when a child has devoted his or her life to medicine.

## Acknowledgements

Thank you Dr. Harvey Babich and Rabbi Dr. Richard Weiss for assisting with identifying sources and Rabbi Aaron Cohen for reviewing the article. A special thank you to my parents for their constant ongoing support regarding my education and otherwise.

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In *Tanach*, fifty-five prophets are discussed; fifteen prophets with individual books named after them and another forty mentioned throughout *Tanach* [1]. From a young age, Jewish children learn about prophets and prophecy. They are taught that a prophet is someone G-d has chosen to be a leader and to communicate with. Prophecy, when stated simply, is G-d “talking” to an individual. However, children are not commonly taught what it was like for the prophets to experience prophecy. The Rambam discusses in *Mishneh Torah, Hilchot Yesodei Hatorah*, chapter 7, what prophets experienced when receiving prophecy. The Rambam describes how prophets would lose control of the muscles in their limbs and experience visions (of prophecy). In other locations in *Tanach*, it is seen that prophets would also lose awareness of their surroundings and afterwards would be overcome by exhaustion [1].

These “symptoms” that accompanied prophecy appear to mimic the “symptoms” of a complex partial epileptic seizure: loss of muscle control, visions, lack of awareness, and fatigue. While the prophets were clearly undergoing a completely Divine and spiritual experience when receiving prophecy, to the untrained eye the prophets may have appeared to be mimicking the physical experience of having an epileptic seizure. Therefore, through understanding what happens during an epileptic seizure, and through the Rambam's explanation of prophecy, one can come to a greater understanding of the physical symptoms of prophecy.

Epilepsy is a neurological disorder of the brain in which a patient experiences recurring seizures. These seizures are caused by neurons in the brain suddenly transmitting false signals to each other, as well as by anything else that interrupts neuron communication [2]. There are many types of epileptic seizures, and one of the most common forms is complex partial seizures. Complex partial seizures most often, but not always, originate in the medial temporal lobe and frontal lobes of the brain. However, these seizures can quickly move to other locations in the brain. Like all forms of epileptic seizures, many cases of complex partial seizures are due to a genetic disposition, as well as injury, illness, or abnormal brain development. However, there are also many cases in which the reasons for these seizures are unknown [3].

The brain is the organ that regulates our responses to stimuli, both voluntary and involuntary responses. In particular, the cerebellum is responsible for movement and coordination of muscle movement. Any disturbance in the functioning of the brain or abnormal brain activity would therefore have an effect on voluntary and involuntary responses [2]. The disturbance of normal voluntary responses would thus cause a loss of muscle control

leading to the flailing of arms and legs in a seizure.

In the *Mishneh Torah, Hilchot Yesodei HaTorah*, Chapter 7, the Rambam discusses the experience of prophecy. While experiencing prophecy, the prophet's limbs would shake and the prophet would become weak and lose control of his body. This would enable the prophet to freely communicate with G-d, without the limitations of the body. This can be seen in *Yeshiyah* chapter 21 verse 3, where Yeshiyah states that he had become confused from the prophecy he saw. Rashi interprets this to mean that his body started to convulse from the prophecy [4]. The random motion of the prophet's limbs would thus appear to mimic the movements of one experiencing epilepsy.

A lack of awareness is often experienced as an aura, a warning, before a seizure as well as throughout a complex partial epileptic seizure. The interruption of the nerve signals in the brain and the surge of electrical activity can cause confusion and memory loss [2]. Additionally, in the midst of complex partial epileptic seizures, patients may experience visions or hallucinations. The origins of these visions have been researched as early as the late 1800s by John Hughlings Jackson, who observed how a seizure that originates from the medial temporal lobe can often result in visions during the seizure. As a result of the formed “dream state,” hallucinations sometimes occur, causing familiar people or places to become unfamiliar to the patient [6].

To an untrained eye, a prophet would appear to mimic the lack of awareness, “dream state”, and visions seen in complex epileptic seizures. To be in the right state of mind to communicate with G-d, the prophets had to rise above their surroundings. The Rambam explains that to receive prophecy a prophet had to be in the right mindset; he must separate himself from his physical surroundings and focus on G-d and what G-d is showing him. This can be seen in *Zechariah* Chapter 5, when *Zechariah* received a prophecy in which G-d told him to focus on a flying scroll. During this prophecy, *Zechariah* focused all his attention on the spiritual vision, which led to lack of awareness of his physical surroundings [5]. However, as is clear from the words of the Rambam, the prophet was required to consciously put in effort to remove himself from physicality. This is obviously different from a seizure, which is involuntary and not in one's control.

In *Parshat Bamidbar*, chapter 12, G-d speaks to Aaron and Miriam and says that when communicating to a Jewish prophet, He will make himself known in a vision and in a dream [7]. This is seen with all fifty-five prophets except Moshe who communicated with G-d clearly without visions. This “dream state” enabled the prophets to be able to communicate with G-d through receiving visions from Him. One instance where a vision in prophecy can be seen

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is in Jeremiah, Chapter 1. Jeremiah experiences a prophetic vision of a staff from an almond tree and a bubbling pot. These visions are given to Jeremiah in riddles that alluded to foreign enemies coming to and destroying Jerusalem [8].

At the end of a complex partial epileptic seizure, fatigue and extreme exhaustion are often experienced. After a seizure has passed, the patient can be left confused, exhausted, and lack the ability to function. This state usually remains for a few hours after a complex partial epileptic seizure [4]. Prophecy could again appear to mimic this state of exhaustion to the uninformed eye. After receiving prophecy, some prophets experienced a state of exhaustion and lack of strength. This fatigue was evident with the prophet Daniel in chapter 10 of the book of *Daniel*. After receiving prophecy, Daniel stated that his appearance was horribly changed and that he had no strength left [9]. This loss of strength may appear to mimic the exhaustion that a patient may feel after an epileptic seizure.

Through the above parallel descriptions of brain seizure episodes and prophetic experiences, one can begin to superficially understand how G-d acts through natural means, through *derech hateva*. This can be seen in the idea that prophecy, the way that select individuals

communicated with G-d, can appear to mimic the process of a complex partial epileptic seizure to the untrained eye. However, as is clear from the words of the Rambam, the prophet was required to consciously put in effort to remove himself from physicality, while an epileptic seizure is involuntary and not in one's control. While the prophets were clearly undergoing a completely Divine and spiritual experience when receiving prophecy, to a lay person the prophets may have appeared to be mimicking the physical experience of having an epileptic seizure. Through understanding what happens during an epileptic seizure, and through the Rambam's explanation of prophecy, one can come to a greater understanding of the physical symptoms of prophecy.

#### **Acknowledgments:**

I would like to thank my parents for helping me come up with the idea for this article and for reviewing it, as well as always being there for me, to support and guide me, and for always encouraging me to fulfill my dreams and make myself proud. I would like to thank Dr. Babich for giving me this amazing opportunity and for supporting me throughout the writing of this article. I would also like to thank Rabbi Moshe Rapoport for reviewing the Torah aspects of this article.

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The mystery of the process of aging of the human body is slowly beginning to unravel. We now know that one of the major contributions to the aging process is oxidative damage to cellular material caused by free radicals generated in biochemical reactions in the human body. As a result of these free radicals, DNA molecules and proteins are damaged and altered, creating rigidity of the lungs, heart muscles, ligaments, and tendons, as well as problems with genes and replication. We have also become aware that the telomere, the cap on the end of the chromosome that protects the DNA from deterioration, naturally shortens after each division of the cell. The DNA of some cells reach a limit of divisions, called the Hayflick limit, after which they can no longer divide. This and other factors over time cause cells to degenerate and prevent them from functioning properly [1].

In the past century, we made leaps forward in medical research, gained a greater understanding of how to maintain our health, and saw a dramatic increase in life expectancy. In the United Kingdom, the life expectancy at birth oscillated up and down from 1543 until 1811, with its lowest point in 1561 at 27.77 years and its highest point at 1581 at 41.68 years. With the turn of the 1800's and until the 1900's there was a slow rise in life expectancy, rising from 37.59 in 1811 to 49.95 years in 1905. Thus, about 12 years were added to the human life expectancy. However, the most dramatic increase in life expectancy occurred in the 20<sup>th</sup> and 21<sup>st</sup> century, rising from an expectancy of 49.95 years in 1905 to 80.84 years in 2011 [2].

Throughout this article, we will weave together the thoughts of Nathan Aviezer and Rabbi Aryeh Kaplan, who discuss how recent scientific advances on the aging process help explain longevity in the Bible. As a result of breakthroughs in our knowledge on aging, scientists predict even larger leaps in the human life expectancy. In a piece titled "The Extreme Longevity of Early Generations in Genesis," Dr. Nathan Aviezer quotes an article in the *New Scientist*, titled "Death of Old Age," stating: "We can live healthy lives well into our hundreds." Aviezer also notes Professor Michal Jazwinski, the director of the Center on Aging at Louisiana State University, who states, "The maximum human life span might go as high as 400 years" [1].

The occurrence of a human being living 400 years or longer does not appear to be unprecedented. Genesis records that the first human being, Adam, lived for 930 years (Genesis 5:5). Based on G-d's warning to Adam (Genesis 2:17), "But of the Tree of Knowledge of Good and Bad, you should not eat from it because on the day you eat from it you shall surely die," it appears that Adam was originally created to be immortal. As a punishment for eating from the tree, not only was he punished with loss of

his immortality, but his descendants would also be mortal beings (*Beresheit Rabbah* 16:6).

*Ramban* discusses Adam's punishment of death in his commentary on Genesis 2:17. He explains that "on the day you eat from it" does not mean he would die on the day he ate the fruit, but that he would bear the death penalty from the King (G-d) immediately on that day. The King could choose his execution date for any time period, and the perpetrator would eventually die due to his sin. Therefore, Adam would not necessarily die immediately, but from that point on he was sensitive to death.

*Ramban* continues and describes the opinion of the natural scientists of his time who believed that a group of elements must decompose back into individual elements. Therefore, they claimed that man must eventually decompose into his simpler elements and die. The question that remains from this analysis is that if this was the case, what change did Adam's eating of the fruit create? If man was destined to die based on his physical makeup, how would eating the fruit alter this reality? *Ramban* counters their argument by stating that those who think man must die because of a physical law have little faith in G-d, because G-d has the ability to will anything to happen. *Ramban* contrasts their opinion with the words of the Sages who write that had Adam not sinned, he would have been immortal, for the soul given to him by G-d bequeathed to him eternal life. *Ramban* writes that G-d's Divine favor for Adam would have caused Adam to be sustained forever.

However, Adam ultimately sinned and was punished. His punishment was spoken by G-d, ending with the words, "By the sweat of your brow you will eat bread until you return to the land because from it you were taken because you are dust and to dust you will return" (Genesis 3:19). From this, it is clear that Adam and his subsequent generations were punished with death as the ultimate end. However, we are told that Adam lived for 930 years (Genesis 5:5) so it is apparent that his death was not an immediate, but rather an eventual, punishment for his sin.

The generations after Adam continued to live for extremely long periods of time (at least those men representing their generation as recorded in Genesis). Rabbi Aryeh Kaplan writes that the average age of death for the ten generations between Adam and Noah was 857.5 years (ranging from 365 years to 969 years) and ignoring two low numbered outliers, the average age was 929 years (ranging from 905 years to 969 years) [3]. Rabbi Kaplan presents the possibility that those years were shorter than current years and that is why the age expectancy seems so high compared to modern standards. Kaplan negates this possibility because the years during the description of the flood consisted of 12 normal months. Therefore, it is

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probable to assume that the years describing Noah's life also consisted of 12 normal months [3].

Josephus, a Jewish historian of the 1<sup>st</sup> century, cited reasons for the longevity of those generations, as described by Kaplan. Josephus writes in *Antiquities* (1:3:9), "...those ancients were beloved of G-d, and [lately] made by G-d Himself: and because their food was then fitter for the prolongation of life, might well live so great a number of years. And besides, G-d afforded them a longer time of life on account of their virtue, and the good use they made of it in astronomical and geometrical discoveries." Josephus also writes of other historians who agreed that the ancients lived a thousand years. According to Josephus, it appears that the reason for their long life related to spiritual matters, such as virtue and closeness to G-d, as well as physical matters, such as the food which promoted long life [3].

Kaplan also notes Maimonides (*Moreh Nevuchim* 2:47) who attributes the longevity of those generations to their diet. Maimonides believes that only those explicitly recorded in Genesis lived to extremely old ages, as he writes, "I say that only the persons named lived so long, whilst other people enjoyed the ordinary length of life." The reason they had such long lives was "in consequence of different causes, as *e.g.*, their food or mode of living, or by way of miracle, which admits of no analogy." If their longevity was due to a diet or lifestyle choice, then the long life spans of those generations were humanly possible. Kaplan writes that linking long life with diet, as seen in Josephus's writing, indicates that "even unusually long lifespans are within the realm of physical possibility" [3].

With recent scientific discoveries in the field of aging, there is increasing evidence that genetics play a role in the aging process. Dr. Aviezer states that a "scientific consensus is emerging that the root cause of all aging processes is genetic." He quotes Professor Mark Azbel who claims that there is "a genetically programmed probability to die at a given age." Aviezer also discusses Professor Tom Johnson of the University of Colorado, who performed research to alter a single gene and successfully doubled the life span of a small nematode worm. Similarly, Professor Michael Rose of the University of California designed a new genetic strain of fruit flies that were healthier and stronger at every age and lived twice as long as the standard fruit fly [1].

In addition, Professor Michal Jazwinski, quoted by Aviezer, was able to introduce genes into *Saccharomyces cerevisiae* (yeast) which lengthened life span as well as maintained its "youth" for a longer period of time. Aviezer explains how some animals, such as some species of turtles and marine birds, maintain a low mortality rate throughout their lives. Turtles remain fertile their entire lives and a colony of marine birds maintain their female fertility with no decline until the age of 40. Professor Leonard Hayflick of the University of California explains, "Non-aging animals experience a peak in their physiological functions at some point, but these functions do not seem to decline...non-

aging animals do not live forever because of accidents, disease, and predation" [1].

If we apply the phenomena of non-aging to human beings of ancient times, this would mean that people could still die, due to accidents or violence or sickness, but that the mortality rate would remain constant throughout one's life, independent of age. Thus, age would not increase one's chances of dying. Aviezer writes, "This is how human society would appear if one could eliminate all the genetic defects that cause aging." Aviezer proposes that the immortality of Adam and Eve was due to their lack of genetic defects (termed genetic purity). Since there was no violence, sickness, or other non-genetic causes of death in the Garden of Eden, they would essentially be immortal. However, once they sinned and were expelled from the Garden of Eden, they entered the outside world where they were exposed to non-genetic causes of mortality. Therefore, they became susceptible to dying [1].

Aviezer writes, "In the absence of aging, the average human life span would be about 1300 years. Thus, we really have to explain why the early Biblical life spans were so short!" Aviezer attributes the shorter life spans of the generations between Adam and Noah to diseases for which we now have antibiotics to cure. The phenomena of non-aging also explains the old ages of childbearing fathers in the generations between Adam and Noah. For example, Methuselah and Lemach were about 200 years when they fathered children and Noah was about 500 years old. Also, Noah was expected to be strong enough, mentally and physically, to build the ark at the age of 600 years [1].

Rabbi Kaplan discusses how longevity declined in the generations after Adam. He explains an opinion in the Talmud, which states that there were 974 generations before Adam (*Hagigah* 13b-14a). He cites a *midrash in Beresheit Rabbah* 3:7, stating, "G-d created worlds and destroyed them." Based on this, Kaplan writes, "[I]t would seem man already had the physical and mental capacities that we possess as early as 974 generations before Adam." He continues, "Thus, even though pre-Adamic man had a 'normal' lifespan, Adam was created without his biological clock being set for eventual death." Even after Adam sinned, the "biological clock was set through which the body would ultimately terminate its own life processes." Thus even after he sinned, Adam maintained exceptional longevity [3].

Rabbi Kaplan writes how Adam's descendants inbred to maintain this trait for longevity (*e.g.*, Cain married his twin sister according to *Pirkei de-Rabbi Eliezer* 21(48a-b)). He explains that this seclusion is why Cain was afraid of the outside world, stating, "All who find me will kill me" (Genesis 4:14). According to Rabbi Kaplan, his longevity was subsequently reduced due to interbreeding. Genesis (6:2) reads, "The sons of G-d saw the daughters of

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man that they were fair, and they took for themselves wives of all whom they chose.” According to *Beresheit Rabbah* (26:5) the “sons of G-d” were the descendants of Adam. Kaplan writes, “The decedents of Adam began to intermarry with the surrounding primitive human stock, and this interbreeding resulted in the reduction in the group’s average lifespan” [3].

After the Flood, there was inbreeding between Noah’s descendants, which maintained their longevity, stabilizing the average lifespan to about half of Adam’s. Rabbi Kaplan explains that Noah’s descendants interbred once they journeyed east to Babylon, decreasing the longevity of their descendants. This continued until the point where the highest expected lifespan was reduced to 120 years, as it is written in Genesis (6:3), “My spirit shall not abide in man, for he is mere flesh, but his days shall be 120 years.” However, the life span did not decrease right away, for after this statement, Abraham lived to 175 years. *Ibn Ezra* explains that this verse means that the human longevity would decrease over time until the human lifespan reached 120 years [3].

Aviezer understands this third verse in the sixth chapter of Genesis as “meaning that the genes for aging were introduced into the human gene pool at the time of Noah.”

He explains that it took time for these aging genes to spread and take effect, and therefore 16 generations passed from the time that statement was pronounced by G-d until it was fulfilled in the time of Moshe. During that time, the average human lifespan gradually declined [1].

As human beings increasingly gain knowledge of the aging process, we are confronted with the possibility of extreme longevity. It is important to recognize that this extreme longevity is not unprecedented. In ancient Biblical times, people lived close to a thousand years. The decrease of the average lifespan since that time period can be explained using the principles of genetics. If, as Kaplan and Aviezer write, humans originally experienced extreme longevity due to purity in their genetic makeup, then perhaps this longevity could be attained once again with genetic purity in the times of Messiach. In this search for long life, only time will tell.

#### **Acknowledgements:**

I am continually filled with a tremendous *bakarat hatov* to *Hashem*. Thank you Dr. Babich for your continued support in the making of this article and beyond.

---

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# Infertility in the Torah: The *Halachic* Discussion of Treatment

By Tehila  
Feinberg

A recurring theme throughout *Tanach* is the infertility of our matriarchs. Sarah (Genesis 16:5), Rivka (Genesis 25:22), and Rachel (Genesis 30:2), as well as Manoah's wife, the mother of Shimshon (Judges 13:24-25); Chana, the mother of Shmuel (Samuel 1 1:5); and Michal, the wife of King David (2 Samuel 6:23) were all afflicted with varying degrees of infertility. Most female infertility is associated with problems in the ovulation cycle, stemming from polycystic ovary syndrome (PCOS), primary ovary insufficiency (POI), and/or endometriosis [1]. PCOS results in irregular menstrual cycles and excess androgens, male hormones [2]. POI is categorized by abnormal ovarian cycles and a lack of female hormones [3]. Endometriosis is caused by displaced endometrial tissue (the lining of the uterus) that builds and leads to infertility [4]. The article focuses on the various explanations regarding the cause of Sarah's infertility, which can serve as a template to better understand the *halachik* implications of fertility treatments.

It is apparent that Sarah was unable to conceive from the verse in Genesis, "And Sarai was barren; she had no child" (11:30), where it is noted that she had no children after already mentioning that she was barren. Rashi, a Rabbinic scholar and commentator from France living in the 11<sup>th</sup> century, comments on this redundancy and presents a plausible answer. Some women are childless, but eventually are able to conceive, but here the verse is stressing that Sarah was completely incapable of bearing children. Rashi quotes the Talmud in *Yevamos* (64b), which interprets this repetitiveness to indicate Sarah lacked a uterus. This is a puzzling concept, since it is known that Sarah eventually bore Yitzchak. However, it later becomes clear, through Rashi's comment on the *pasuk* where God blesses Sarah with youthfulness (Genesis 17:16) that God provided Sarah with a uterus and allowed her to conceive.

The analysis of the dynamic relationship between Sarah, Avraham, and Hagar leads to a possible understanding of the cause of Sarah's infertility. Genesis (11:30) notes that Sarah, being unable to conceive, instructed Avraham to take her maid, Hagar, as a wife, thereby giving herself the opportunity to have a child through her maidservant. However, some time later, Sarah conceived and gave birth to Yitzchak and sent Hagar and her son, Yishmael, away. Oddly enough, after decades of marriage, Sarah was able to conceive only after Avraham had a child with someone else. Rav Levi ben Gershon (Ralbag), a mathematician and physician as well as a known Rabbinic commentator living in France in the 11<sup>th</sup> century, draws a parallel between Sarah and Rachel's paradoxical behaviors towards their husbands when confronting their infertility. Rachel suffered a great deal from her infertility, especially since her

sister Leah, who was also wedded to Jacob conceived with ease. The prophecy told as follows, that there would be 12 sons born to Jacob, and from them the whole Jewish nation would be born. Therefore, Rachel's inability to conceive, especially while her sister was fulfilling the prophecy of the tribes, brought a great deal of pain and jealousy to her. Rav Levi develops the thought that jealousy arising from polygamy was the common cure to both Sarah and Rachel's infertility. As a result of their husbands taking their maids as wives, both Sarah and Rachel became jealous, causing them to stop eating, which resulted in weight loss. It is the weight loss that allowed them to conceive. This theory would prove correct if Sarah and Rachel were severely overweight, *i.e.*, obese, which Rav Levi strongly suggests. PCOS is the leading cause of female infertility, and it is associated primarily with hormone imbalances and secondarily with obesity [5]. Thus, Rav Levi relates Sarah's infertility to her condition of PCOS.

Today there are several known treatments for infertile women, which include *in vitro* fertilization, and if needed, surrogacy. When contemplating these treatments, questions arise of who would be the Jewish (genetic) mother and who would be the *halachik* mother. This is crucial in defining the child's religious status. According to Jewish law religion is dependent on the mother. Rabbi Lord Jonathan Saks, previous Chief Rabbi of England, notes several possibilities of who would be considered the *halachik* mother: the genetic mother (the source of the egg) or the surrogate, birth mother (the "fetal incubator"), both or neither. Surrogacy includes an egg donor, a sperm donor, and the surrogate- who carries the child to term. Rabbi Shlomo Goren, who served as the chief Rabbi of Israel in 1972, maintained in cases of surrogacy that the *halachik* mother is the egg donor, not the birth mother. He derived this interpretation from the *pasuk* (Exodus 12:2) that notes "when a woman conceives," using the word "conceives" as the most significant event in a pregnancy. Therefore, if conception is the moment of life, which requires penetration of the egg by the sperm, then apparently it is the egg donor, not the fertilized egg carrier (*i.e.*, the surrogate) who is the *halachik* mother [6].

After investigating Sarah's infertility, and recognizing that it is an ongoing theme through *Tanach*, and still a current issue, Rabbis and commentators have come up with plausible treatments within the boundaries of religious observance. In light of these rabbinic commentaries, women who do have PCOS and cannot conceive, and could potentially have a child through surrogacy, or IVF, must be aware of the questions and possible answers to the definitions of a *halachik* mother in this case.

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## Acknowledgment:

I would like to thank my parents for supporting my education. I would also like to thank Dr. Babich for

taking the time and effort to guide me in writing this composition.

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# Watch Your Step: Our Rabbi's Warning Against a Change in Lifestyle

By **Tamar Fishweicher**

The Talmud in Kesubos 110b presents a discussion regarding changing one's location of residence. According to Rabbi Shimon Ben Gamliel, a man may not require his wife to move from a bad dwelling to a good one because a good dwelling tries a person's constitution. At first glance this seems quite odd considering that a good dwelling denotes exceptional living conditions. However, Shmuel explains that when an individual's routine is changed, he or she will inevitably experience health ailments. Rashi, a medieval Talmudic commentator, elaborates that any change in lifestyle, even for the better, can harm the body [1]. Rambam, who was famous for being a doctor and philosopher, outlines strict guidelines in the Mishnah Torah on how to lead a healthful lifestyle, and he warns against the harmful nature of change: "He must avoid that which harms the body and accustom himself to that which is healthful and helps the body become stronger [2]." Specifically, relocating from a bad dwelling to a good one may negatively alter one's eating habits, thereby compromising one's health. This enthralling Gemara presents itself on many occasions throughout Jewish history.

During the times of the Beit Hamikdash, the kohanim encountered physiological stresses due to requirements of their priestly jobs. They were required to abide by unusual work, which included consuming large portions of meat within strict time restraints [3]. Since there was no refrigeration in their era, consumption of beef by the general populace was uncommon. During their work in the Beit Hamikdash, the kohanim transitioned from a diet low in beef to one rich in beef, causing tremendous detriment to their health and intestinal ailments [4, 5]. Additionally, the kohanim were strictly prohibited from wearing shoes or footwear in the Beit Hamikdash while giving sacrificial offerings. They would stand barefooted on the cold stone floor, weakening their immune systems [6]. Furthermore, the kohanim were inadequately dressed for their activities and were barely protected against the cold weather [7]. These rapid transitions in lifestyle caused the kohanim's physical constitution to weaken and the well-functioning of their internal organs to suffer when they reached the age when they officially began their priestly role [5]. Fortunately Ben Achiya, a gastroenterologist during the times of the second Beit Hamikdash (Mishnah Shekalim 5:1), used his illustrious skills in herbal medicine and provided medical care to the kohanim on a daily basis [6].

Similarly, a sudden change in diet and lifestyle had adverse effects on the health status of immigrant populations who emigrated from third-world countries to the State of Israel. Acculturating post-immigration consistently involves major

cultural changes in the diets of various Jewish ethnic groups. The immigration and urbanization of Yemenite and Ethiopian Jewry to Israel had an adverse effect on their health as they transitioned from a low calorie, low fat, and low sugar diet to a high caloric diet rich in fat and sugar [8].

Yemenite Jewry dates back 2,600 years with a history of geographic isolation from other Jewish groups. Before immigrating to the State of Israel, Yemenite Jews were typically shorter and thinner than other Jewish ethnic groups. This changed in the 1950's after immigrating to Israel. Upon emigrating from the isolated rural areas in Yemen and encountering a new Western diet in the State of Israel, Yemenite Jews developed an immense increase in the incidence of diabetes which was accompanied by severe and perilous weight gains [9]. Ten years after immigration, initial rates of diabetes at a low of 0.06% rose to a high of 13%, accompanied by high rates of hyperlipoproteinemia, an over abundance of lipids in the blood, in 27.7% of the population [8,10]. Obesity was the main factor leading to the many other detrimental health conditions that the Yemenite Jews experienced. Many suffered from coronary heart disease due to blockage of major nutrients to the heart by accumulation of cholesterol in blood vessels. The rise of hypertension led to high mortality rates amongst the Yemenite Jewish community post-immigration to Israel [13]. Even though the Yemenite Jews migrated from a "bad dwelling" to a "good dwelling" their rapid change in nutritional diet brought forth precarious health conditions.

Origins of Ethiopian Jewry are unclear, but one school of thought traces its origin to the time of the destruction of the first Temple in 586 B.C.E. which led to a major wave of dispersion to locations outside of Israel. One community ultimately settled in Ethiopia, living in villages established on a tribal system and isolated geographically and culturally from other Jewish ethnic groups for centuries. Only relatively recently, from the early to late 1980's, have many Ethiopians immigrated to Israel; they resided initially in absorption centers and later in various communities throughout the country. Through the inevitable process of urbanization in a newer developed location, they began to change their dietary habits from consuming unrefined flour, legumes, fruits, and vegetables to consuming meats, milk, and other foods rich in carbohydrates and fats. Following urbanization in their newly developed homes, the Ethiopians adapted to a high fat and carbohydrate diet, which was accompanied by a decrease in physical activity. This new lifestyle caused rapid weight gain, abdominal fat accumulation, and insulin

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resistance leading to type II diabetes. Upon their arrival, clinical tests were performed on 158 Ethiopians under the age of thirty who immigrated to Israel from various villages in Ethiopia and were performed again a few years after immigration. Of the 158 participants, fourteen developed diabetes, fourteen exhibited impaired glucose tolerance, and thirteen displayed dramatic increases in capillary blood glucose levels [12]. This high prevalence of diabetes in the Ethiopians was undoubtedly due to their change to a Western diet. These numbers were higher than the prevalence estimated from most previous epidemiologic surveys of specific ethnic groups in Israel [13].

When considering the findings presented above, it is fascinating how the laws of the Talmud, as well as the insights of the Rishonim, align extremely well with the real

life happenings of people. The halacha prohibits a man from moving his dwelling place for fear that it will effect physical health. When analyzing the health of the kohanim, the Yeminites, and the Ethiopians, all who underwent a drastic change in lifestyle, it emerges that the wisdom of the Torah and its scholars is unrivaled.

### Acknowledgments

I would like to thank my parents for their constant support and encouragement in pursuing my goals. Furthermore, I would like to express gratitude to Dr. Babich for providing me with sources for this article, and for assisting me with this article. I would also like to thank Rabbi Benjamin Yudin for approving the Torah content of this article.

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# Cleopatra's Children's Chromosomes: A Halachic Biological Debate

By Merav  
Gold

In narrating the birth of the tribes, the Torah mentions as an afterthought to the birth of Leah's sons, "And afterwards [Leah] gave birth to a daughter, and she named her Dina" (Genesis 30:21). The Talmud Bavli (*Brachot* 60a) picks up on this strange language and relates the following *midrash*. Rachel and Leah were each destined to have a baby of the other gender - Leah a boy and Rachel a girl. After analyzing and estimating the number of children each wife of Yaakov would have, Leah prayed that she should give birth to a girl, so that her sister should not have fewer sons than a maidservant. Based on this occurrence, the *midrash* reflects the fact that it is *halachically* permissible for parents to pray for a desired sex of their child for 40 days after conception [1]. However, this begs the question- where does this timeframe come from?

Fetal development has been a topic of interest that has been studied by various cultures. The Talmud Bavli (*Nida* 30b) relates the story of Cleopatra VII and her quest to establish when the sexual development of a fetus begins. The Talmud recounts that she condemned rebellious maidservants to death, but only followed through with the punishment 41 days after they had cohabitated with a man. After the maidservants' death, Cleopatra performed autopsies and discovered one maidservant who was pregnant with a boy, and another who was pregnant with a girl. From this experiment, she proved that males and females develop along the same timespan *in utero*.

Rabbi Yishmael, a third generation *tana*, rejects the conclusion of Cleopatra, stating "I bring proof from the Torah, and you disprove me from imbeciles?" (*Nida* 30b). Rabbi Yishmael himself is of the opinion that a male baby is fully developed by 40 days, and a female by 80 days. As Shlomo *HaMelech* aptly said, "There is nothing new under the sun" (Kohelet 1:9), which in this case proves to be true, since science gives proof to Rabbi Yishmael's opinion. Biologically, the key difference between males and females is due to the 23<sup>rd</sup> pair of chromosomes. In females, each of the two sex chromosomes looks like the letter X, and therefore is called an X chromosome. In males however, there is only one X chromosome; the other chromosome has the appearance of a Y. Fittingly, it is called a Y chromosome. Each child gets one chromosome from each parent. The mother passes one X chromosome to her offspring through her egg, and the father will transmit either an X or a Y chromosome in his sperm. The joining of the two cells creates the zygote, which will either have its 23<sup>rd</sup> pair of chromosomes as XX or XY. Remarkably, aberrations on this will still follow the same distinct pattern. If a zygote carries XXY, it will develop into a male, and if it carries XO, it will develop into a female [2]. The

lack of variability in allosomes leads us to wonder how it is possible that male and female fetuses develop at different rates. Furthermore, if the allosomes are determined at conception, how can parents pray for the sex of his baby at any time after conception?

The development of gonads in a fetus, like most events that occur in humans, is predicated on the translation of the genetic code into proteins. In this case, the gene of interest is the SRY gene, the sex-determining region of the Y chromosome which is located on the Y chromosome. When SRY is activated, it encodes for testis-determining factor (TDF), the transcription factor that initiates the development of male gonads. Interestingly, SRY expression is first detected in a fetus at 41 days, and is detectable until day 52 of the pregnancy [3]. This phenomenon would explain Rabbi Yishmael's statement. While he could not have known about SRY expression, his calculations that a male is developed after 40 days are not completely off target. But, he is inaccurate in regard to his statement that male development is *finished* after 40 days; modern science reveals that it *starts* after day 40. The *halacha* allowing a parent to pray for the sex of the child until day 40 is logical regardless of whether sexual development of the fetus starts or ends by day 40. By that time, even though the sex was already determined based on which allosome was present in the sperm, the actual physical development of the child's sex is fully underway. It is after that point that *halacha* deems it impermissible to ask God for a miracle and "switch" the sex of the child, similar to the miracle performed for Leah and Rachel.

Yet, the debate between Cleopatra and Rabbi Yishmael is not yet resolved. The real dispute between Cleopatra and Rabbi Yishmael is not about male development, which they both agree is completed after 40 days, but rather, it concerns female development. Cleopatra claims that females develop on the same timeline as males and are also sexually developed by 40 days. Rabbi Yishmael, however, uses the amount of time the Torah commands a woman to keep the laws of *tumah* and *tabara* after the birth of the baby to calculate that female development is completed after 80 days of fetal development.

As far as we know, maleness is determined by the expression of SRY, but what about femaleness? Is it just the lack of maleness, or are other genes transcribed and other events occurring in the forming female? Rabbi Yishmael does not seem to equate female development with the lack of male development, rather it is its own occurrence that happens to occur later in the pregnancy [1]. Rabbi Yishmael is, in fact, correct in this assessment. Biologically speaking, the basic developmental pathway of

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gonads from stem cells would end in the development of ovaries [3]. It is only the transcription of SRY that changes the developmental pathway to develop the male urogenital system.

Physically, the absence of maleness would mean that if SRY is not expressed by day 41 the zygote will immediately begin developing a female urogenital system. If Cleopatra were to emerge from the debate victorious, femaleness would be the absence of maleness. However, femaleness is not just the absence of maleness. The ability to identify the development of the female urogenital system is not immediate. It occurs during the 12<sup>th</sup> week, or about 80 days of fetal development [3]. This occurs 30-days after SRY stops expressing, proving that, in fact, females and males do not develop at the same time, and Rabbi Yishmael is the victor.

An additional proof against Cleopatra causes Rabbi Yishmael to say "...and you bring me proof from the imbiciles?!" The harshness of his answer comes not from the fact that his contemporaries rejected his math, but it comes from the proof of Cleopatra herself. She claimed to have autopsied two women who conceived a child at the

same time and they each carried one of each gender. There is a glaring error in this scientific experiment: At day 40 the gonads are not developed to look different from each other. SRY is only beginning to be expressed at day 40. Prior to this, only undifferentiated gonads are found, along with sets of both female and male internal duct systems. Regardless of the angle the fetus is looked at, it is impossible to identify its sex at such a young age of development [4]. Truly, Rabbi Yishmael emerges from the debate, victorious in his knowledge of human fetal development.

### Acknowledgements

I would like to thank my parents for supporting me in my pursuit of learning both Torah and *Madda*. I would like to thank Dr. Babich for providing me with most of the articles sourced in this paper, and for being a constant source of inspiration to find the true junction of Torah *U'Madda*. I would also like to thank Rabbi Dr. Richard Weiss for taking the time to read over this article, and his guidance in both Torah and *Madda* content of the article.

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Many religions throughout the world observe fast days as part of their spiritual requirements and fulfillment. In Judaism, two climactic fast days are Yom Kippur and Tisha B'Av. When it comes to fasting, most have their own tried and true method designed to keep hunger and thirst at bay for as long as possible. However, scientific research backs certain practices that have been proven to be effective at both reducing hunger and preventing fasting headaches.

Hunger, as with any metabolic process, depends largely on the endocrine system. Among the many hormones that work in tandem to regulate energy balance, ghrelin is a rapid acting hormone that initiates a cascade of biochemical reactions, ultimately producing the feeling of what we perceive of as hunger. Also known to have a major influence on our energy levels, ghrelin plays a key role in meal initiation by sending signals to the hypothalamus when an increase in metabolic efficiency is necessary [1]. It was demonstrated that increases in ghrelin levels correlate with increased hunger in healthy individuals. Intravenous injection of ghrelin has been shown to induce hunger and food intake among both healthy and obese humans, indicating ghrelin's function as a meal-initiation signal for the body's short-term regulation of energy. Therefore, to suppress one's appetite before a fast, it is imperative to eat foods that lower ghrelin levels in one's body. Research has shown that foods high in fiber, particularly apples, avocados, chickpeas, lentils, nuts, oatmeal, and whole grains, keep ghrelin levels at bay. Rye in particular suppresses the release of ghrelin and lowers the insulin response, thereby boosting post-meal fullness [2]. In addition to their ghrelin-lowering abilities, foods high in fiber generally contain fewer calories than high-fat or high-protein foods per unit of volume, and therefore cause the stomach to stretch and empty slowly. This prolongs the feeling of fullness, which can delay hunger pains during a fast [3]. Dr. Barbara Rolls, a researcher at Pennsylvania State University, conducted extensive research on the volumetric theory of eating and found that

when people eat foods high in volume yet low in density (calories), they eat less during the remainder of the day because these foods keep them fuller, longer [4].

Another common side effect of fasting is the notorious fasting headache, which has been shown to result from low blood sugar, and can be exacerbated by the withdrawal of caffeine [5]. The likelihood of developing a fasting headache increases proportionately with the duration of the fast. Studies have been trying to develop medication that can reduce fasting headaches. One such drug is etoricoxib (arcoxia), a medication that is taken just before the fast to prevent headaches or, at least, to lessen their severity. However, this drug is not yet approved by the Food and Drug Administration (FDA) for consumption in the U.S.A. Another drug for fasting headaches is being tested by Dr. Michael Drescher, director of emergency medicine at Hartford Hospital in Connecticut. This drug is an anti-inflammatory pain-relief compound and works as a COX inhibitor. COX inhibitors are a form of non-steroidal anti-inflammatory drugs (NSAIDs) that target cyclooxygenase (COX), an enzyme responsible for inflammation and pain [6].

In an effort to maximize our observance of religious fast days in the healthiest and most comfortable way possible, research suggests eating a relatively high volume of complex carbohydrates before a fast and abstaining from caffeinated drinks a few days before the fast. Although the development of medications is in progress, the suggestions above are simple measures we can take in order to make fasting as meaningful as it can be.

## Acknowledgments

I would like to thank my parents and family for their continued love and support. In addition, I would like to thank Dr. Babich for his guidance and mentorship throughout my academic career.

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# Of Public Baths and Military Latrines: Public Health and Halakha

By **Yardena  
Katz**

As defined by the World Health Organization, “Public health refers to all organized measures to prevent disease, promote health, and prolong life among the population as a whole” [1]. Though the term “public health” was only coined in modernity, the concept is present in Biblical and Talmudic literature, proving that it has been around for quite a while. *Halakhot* that prevent and combat communal health risks are outlined in the written Torah itself, and were further developed and legislated in Mishnaic and Talmudic times. The halakhic principles on which most of these public health measures are based are clearly illustrated in the specific cases of military latrines and public baths. These examples illuminate the rabbinic perspective on the duty of a governing body to promote communal and national health.

The unifying principle in these cases – and in fact, in much of modern halakhic medical discourse – is the duty to preserve life. In the context of self-preservation, this duty is rooted in the verse, “And you shall guard yourselves very well,” “*Venishmartem meod lenafshoteichem*” (Deuteronomy 4:15). In the context of public health, the more pertinent duty is that of preservation or rescue of another, which is rooted in the verse, “You shall not stand by your fellow's blood,” “*Lo taamod al dam reecha*” (Leviticus 19:6). This principle is further emphasized by the Talmudic teaching, “Those who have the capacity to eliminate a wrong and do not do so bear the responsibility for its consequences” (*Shabbat* 54b) [2]. The Talmudic literature on public health issues is founded upon the assumption of the duty to preserve the lives of others.

This is very apparent in the case of public baths, which are well-documented in Talmudic literature. There are also several instances of bathing recorded in Tanakh. For instance, David watches Batsheva bathing from his roof, though it is unclear if this is a private or public bath (II Samuel 11:2), and the woman in Song of Songs washes her feet before laying down to sleep (Song of Songs 5:3).

With the proliferation of sophisticated Greek hot baths in the Tannaitic era, the practice of bathing was held in high esteem by Talmudists. The Midrash describes a dialogue between Hillel and his disciples in which they inquired why Hillel was leaving them on one particular occasion. “He replied: ‘To do a pious deed.’ They asked: ‘What may that be?’ He replied: ‘To take a bath.’ They asked: ‘Is that a pious deed?’ He replied: ‘Yes. If in the theaters and circuses, the images of the king must be kept clean by man... how much more is it a duty of man to care for the body, since man has been created in the divine image and likeness” (*Vayikra Rabbah* 34:3). The Gemara also

emphasizes the importance of bathing by forbidding scholars from living in a city that is without a public bath (*Sanhedrin* 17b). Despite rabbinic skepticism towards Roman practices, Rabbi Yehuda overtly praises them for their public baths: “How fine are the works of this people! They have made streets, they have built bridges, they have erected baths” (*Shabbat* 3b).

Though no specific injunction to bathe is recorded in the written Torah, the rabbis adopted a strongly encouraging attitude towards bathing and facilitating the public's accessibility to baths. Despite the absence of a direct Biblically written source regarding bathing for health purposes, the practice may have been promoted due to concern for the personal and communal duties of preservation. Today, bathing is known to prevent disease and infection, which in turn prevents communal sickness. Countries without access to proper sanitation and bathing facilities are most prone to nationwide epidemics and health crises [3]. Though the Talmudists may have been unaware of the exact health benefits of bathing, the Talmud cites a demon called *Shibbeta* that embodies the harm caused by filth. This indicates the Talmudists' awareness of bathing's general health purposes (*Yoma* 77b) [4].

The rabbinic authorities throughout the ages mandated public health infrastructure related to bathing and deliberated related halakhic issues that arose. The Midrash states that in Biblical times, the territory of each tribe had one public bath run by the local governing authority. In Talmudic times, privately owned baths designated for public use (for a fee) were more common than baths run by the state or town, and some public baths were segregated for the wealthy and poor. Water for baths, which were called *batei merkhatz*, was collected from cisterns managed by the local authorities. On the fifteenth of every Adar, the authorities would send workers to repair and dig cisterns. As defined by the World Health Organization, “Public health refers to all organized measures to prevent disease, promote health, and prolong life among the population as a whole” [1]. Though the term “public health” was only coined in modernity, the concept is present in Biblical and Talmudic literature, proving that it has been around for quite a while. *Halakhot* that prevent and combat communal health risks are outlined in the written Torah itself, and were further developed and legislated in Mishnaic and Talmudic times. The halakhic principles on which most of these public health measures are based are clearly illustrated in the specific cases of military latrines and public baths. These



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examples illuminate the rabbinic perspective on the duty of a governing body to promote communal and national health.

The unifying principle in these cases – and in fact, in much of modern halakhic medical discourse – is the duty to preserve life. In the context of self-preservation, this duty is rooted in the verse, “And you shall guard yourselves very well,” “Venishmartem meod lenafshoteichem” (Deuteronomy 4:15). In the context of public health, the more pertinent duty is that of preservation or rescue of another, which is rooted in the verse, “You shall not stand by your fellow’s blood,” “Lo taamod al dam reecha” (Leviticus 19:6). This principle is further emphasized by the Talmudic teaching, “Those who have the capacity to eliminate a wrong and do not do so bear the responsibility for its consequences” (Shabbat 54b) [2]. The Talmudic literature on public health issues is founded upon the assumption of the duty to preserve the lives of others.

This is very apparent in the case of public baths, which are well-documented in Talmudic literature. There are also several instances of bathing recorded in Tanakh. For instance, David watches Batsheva bathing from his roof, though it is unclear if this is a private or public bath (II Samuel 11:2), and the woman in Song of Songs washes her feet before laying down to sleep (Song of Songs 5:3).

With the proliferation of sophisticated Greek hot baths in the Tannaitic era, the practice of bathing was held in high esteem by Talmudists. The Midrash describes a dialogue between Hillel and his disciples in which they inquired why Hillel was leaving them on one particular occasion. “He replied: ‘To do a pious deed.’ They asked: ‘What may that be?’ He replied: ‘To take a bath.’ They asked: ‘Is that a pious deed?’ He replied: ‘Yes. If in the theaters and circuses, the images of the king must be kept clean by man... how much more is it a duty of man to care for the body, since man has been created in the divine image and likeness” (Vayikra Rabbah 34:3). The Gemara also emphasizes the importance of bathing by forbidding scholars from living in a city that is without a public bath (Sanhedrin 17b). Despite rabbinic skepticism towards Roman practices, Rabbi Yehuda overtly praises them for their public baths: “How fine are the works of this people! They have made streets, they have built bridges, they have erected baths” (Shabbat 3b).

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The Talmudists also allow bathing with gentiles (Makhshirin 2:5), which enabled Jews to bathe in the hot water of gentile-maintained baths immediately after the Sabbath. These baths were very hot and thus somewhat dangerous; bathers could be burned by the water or the fire warming it from beneath, faint from the extreme temperature (Shabbat 9b), or suffer from “oblivion and amnesia” [6]. Hot bathing was practiced universally and frequently enough that special blessings were written for recital on entering the bath: “Let the Almighty protect me from being burned by the fire, from being injured by hot water and from falling down...” On exiting, one would recite, “I thank you – O Lord – for having saved me from the fire” (Jerusalem Talmud, Berakhot 9:4) [6]. The Sages’ clear facilitation and regulation of bathing would have contributed to the health of their communities, and sets a precedent for the meticulousness with which we must care for our bodies and communal health today.

In the case of military latrines, health standards for military camps are explicitly outlined in the Torah. The Torah states that latrines must be demarcated beyond the camp’s bounds: “And you shall have a designated place outside the camp, so that you can go out there [to use it as a privy]” (Deuteronomy 23:13). Presumably, this would contribute to keeping the camp environment sanitary. Exposure to, and contact with, excrement can lead to various infections, such as Hepatitis A, salmonella, gastroenteritis, and various parasitic infections [7]. These infections can further spread through human contact or through consumption of contaminated water or provisions. According to UN Water, “Cross-country studies show that the method of disposing of excreta is one of the strongest determinants of child survival: the transition from unimproved to improved sanitation reduces overall child mortality by about a third” [8]. This demonstrates its critical function in determining the level of public health.

Establishing latrines outside the camp bounds mitigates the risk of communal infection. Beyond this measure, the Torah states that each soldier must be supplied with a stake with which to dig holes and conceal their excrement: "And you shall keep a stake in addition to your weapons; and it shall be, when you sit down outside [to relieve yourself], you shall dig with it, and you shall return and cover your excrement" (Deuteronomy 23:14). During war, the governing body is not only responsible for initiating communal hygiene, but it also must equip each of its people with personal tools to facilitate it.

The Mishnaic era's closest conceptual equivalent to the military latrine is the *beit ha'kisay*, a permanent or temporary latrine area or vessel used in domestic or public spaces. These latrines are considered to be beyond the bounds of the "holy camp," the clean space in which recitation of prayers is permitted. The Mishna regards the *beit ha'kisay* with respect, referring to the one in the *Beit Hamikdash* with the word "honor," "*beit ha'kisay shel kavod*" (Tamid 1:1). In the times of the *Beit Hamikdash*, the idea of facilitating communal health in a public space by establishing latrines persisted. The importance of the *beit ha'kisay* is reinforced in the Talmud, which suggests that when Psalms 32:6 notes a "time of finding" God, it might mean finding a Torah, finding a wife, or according to the Talmudist Mar Zutra, finding a *beit ha'kisay*. The Talmud states that "This interpretation of Mar Zutra is the best of all" (Berakhot 8a).

The justification for military latrines is that "Your camp shall be holy (*kadosh*), so that He (Hashem) should not see anything unseemly among you and would turn away from you" (Deuteronomy 23:15). This closing statement raises the interesting question of whether commandments that seem to be mandated for a public health purpose may actually be mandated for a spiritual health purpose. After all, recitation of prayer is forbidden in the presence of *tzo'ah* (excrement) and foul odors, and latrines must be outside the "holy camp" in order to enable prayer within it [9]. Is spiritual health actually the matter of concern

behind the *halakhot* of military latrines, public baths, or other public health measures?

As contemporary scholar Rabbi Avraham Greenbaum articulates, "We keep the Torah not only because it is the means to protect our health but more essentially because this is what God has commanded us. Yet the true Torah life is the proven golden path to health of soul and body as God promises." After crossing the Red Sea, the Jewish nation is told that if they keep the commandments they will be guaranteed public health. "There He laid down for him a statute and a judgment. And He said: If you will surely listen to the voice of Hashem your God and do what is right in His eyes and attend to His commandments and guard all His statutes, all the diseases that I have put upon the Egyptians, I will not put upon you, for I Hashem am your Healer" (Exodus 15:26) [10].

Throughout the evolution of the halakhic system, it has always been a religious medical priority to maintain public health. The duty to preserve the physical health of both the individual and community drove the development of infrastructure, customs, and *halakhot* related to public health. It is also apparent that our corporeal health and fulfillment of the statutes related to maintaining it may be related to our spiritual health as well. Today's rabbinic scholars can draw from the Talmudists' commitment to public health, as demonstrated in the specific cases of public baths and military latrines. When confronted with modern public health concerns and potential solutions (e.g. the risk of infectious disease and the halakhic permissibility of immunizations; the risk of genetic disease and the halakhic permissibility of genetic screening), we can learn from the pragmatic and sensitive approach of our predecessors.

### Acknowledgments:

Thank you to Dr. Babich for his assistance in writing this article and to my parents for their support in every way.

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# 'I'm Orthodox Jewish & Single, Can I Freeze my Eggs?' An Analysis of *Halachic* Issues Related to Oocyte Preservation

By Chava Kaufman

We live in a society where gender equality is championed and women's health issues are gaining increasing attention. With women achieving similar career success alongside their male counterparts, it is common in many societies for women to postpone motherhood. With the advent of modern technological advancements in medicine, oocyte cryopreservation or "egg-freezing" may be a viable option for women who feel their "ticking biological clock" and want to have children, but later in life. However, with this trend comes many questions about the efficacy and viability of these procedures. For the Orthodox Jewish community, this is compounded by the philosophical, cultural, and other complex issues of Jewish law (*halacha*) inherent in such cases.

Older single women in the Orthodox Jewish community often feel the pressure to marry grow stronger as they hit their later 20's and early 30's. Dr. Sherman Silber, director of the Infertility Clinic of St. Louis, notes that "most orthodox women marry early, often at age 20." Dr. Silber's practice is supervised by top halachic authorities from Jerusalem. He is a proponent of egg freezing for single women who want to become more "marriageable in the eyes of their communities" by keeping childbirth possible and recommends that they do so no later than "age 38." This is because women experience a decline in ovarian function and ability to conceive spontaneously after that age. Out of her 200,000 to 400,000 oocytes, a woman will usually ovulate only 200 - 400 eggs during her entire reproductive life span. Most of these eggs are rendered practically inert and unfit for reproduction for one of two reasons: apoptosis of the oocyte or the occurrence of chromosomal abnormalities of the egg. As a woman grows closer to her late 30's and early 40's, both of these biological events increase and lower the chances of the woman conceiving via natural methods. The historical data demonstrate that a woman first marrying in her early 20's only has a 6% statistical chance of being infertile, while a woman marrying in her early 40's has a 64% chance [1]. Based on multiple case studies, the preferred age for successful oocyte preservation is before the age of 35 [2]. Orthodox Jewish women are taught from a young age that one of the tenets of Judaism is to fulfill the Biblical injunction "to be fruitful and multiply" and that procreation is one of the major purposes of marriage [3]. It is no wonder that more and more older Orthodox Jewish single women are prepared to spend up to \$10,000 per monthly cycle to freeze their eggs with fertility specialists who comply with the halachic framework.

Before discussing the potential hashkafic or potential halachic issues involved in oocyte cryopreservation, a brief history of "egg-freezing" is in order. The process of harvesting viable eggs from a candidate involves aspirating multiple follicles via a transvaginal ultrasound-guided needle through the back of the vagina (the posterior fornix) into the ovary itself. Although general anesthesia is usually used for this procedure, most patients can return home within 1-2 hours after the procedure. The eggs are then kept "frozen" in liquid nitrogen until needed for in vitro fertilization. Since 1953, scientists have been able to freeze sperm and even an embryo in order to later produce a live birth, but freezing eggs proved difficult as the classic freezing process created ice particles that damaged the egg's mitotic spindle. Hence, from 1986 through 1996 there were only 5 live births from frozen-thawed eggs [4]. To solve this, scientists developed the idea of using sucrose as an anti-freeze to prevent ice damage and dubbed it the "slow-freeze" technique. Additionally, a technique called intracytoplasmic sperm injection (ICSI) was devised whereby a sperm is injected directly through the hardened zona pellucida after freezing. Using these techniques, 100 live births were reported from 1997 through 2005. A more recently developed technique - the vitrification method - involves rapidly cooling the oocyte in a minimal volume of solution, causing high viscosity and allowing solidification at a more optimal temperature [5].

Although the American Society for Reproductive Medicine published a position paper in 2007 that labeled egg-freezing as an "experimental procedure" and "not an established medical treatment" [6], the Israel National Bioethics Council is of the opinion that egg-freezing is an accepted practice today and permits registered fertility centers to freeze eggs using the newer vitrification method [7]. The controversy is not related to the safety of the woman undergoing the procedure, as everyone agrees that the evidence indicates there is only a 0.08%-0.75% chance of serious complications, such as intra-abdominal bleeding, abscess, ovarian torsion, etc. [8]. Rather, the question is regarding the safety of the fetus created from thawed eggs. It is reassuring to know that thawing sperm and embryos have produced no demonstrable safety risks to children and, thus far, studies have not shown any negative outcomes in children born from thawed eggs [9].

The Orthodox Jewish community practices halachic Judaism. Halacha is Hebrew for "the path" and refers to adherence to the many Biblical and Talmudic mandates and laws regarding how to live a Jewish life. Hashkafa is

colloquially translated as “the outlook” and refers to the legal culture that creates the frame for how to evaluate certain halachic questions. In reference to oocyte cryopreservation, a number of potential issues must be considered: are elective procedures halachically permitted? Even if they are, is a woman’s motive to procreate enough of a reason to permit this procedure and what other motives could play a role in this decision? Furthermore, would in vitro fertilization be a violation of “wasteful emission of sperm”, a halachic prohibition?

In regards to elective surgical procedures, let us begin with the Bible which states “but the judge must not impose more than forty lashes” (Deuteronomy 25:3). From here, the Talmud (Bava Kama 91b) infers that imposing a forty-first lash is forbidden because it would cause bodily harm. However, the verse being analyzed is discussing the scenario whereby person A hits person B. What about where person A injures himself? This is a subject of debate amongst the Talmudic scholars. Maimonides (Hilchot Chovel Umazik 5:1) rules that self-injury is strictly forbidden. The legal source that a Jew is allowed to undergo a surgical procedure which may be considered “self-injury” is derived from the verse in Exodus 21:19, “and he shall surely be healed.” The Talmud (Bava Kama 85a) understands this to be a license for a physician to take whatever action is necessary to heal the body. Additionally, this verse provides the license for a physician to heal a person without any theological argument that human actions are interfering with some kind of divinely ordained destiny for the patient to be ill [10].

Of course, the argument may be that this entire legal development only applies to a mandatory surgical procedure and not to an elective one. The classic response to this in rabbinic literature is that Jewish law relies on the theological premise of “shomer peta’im Hashem,” that God will protect people undergoing an accepted medical procedure even if elective [11]. Nonetheless, the Talmud (Pesachim 8b; Kiddushin 39b) limits this clause to a situation when danger is not prevalent. The definition of “danger” is debated by later rabbinic authorities, and Rabbi Yekusiel Yehuda Halberstam, the Klausenburger Rebbe, ruled that “the absence of danger” can only be defined by the exact same examples listed in the Talmud, and extrapolations to other situations are not permitted. Rabbi Yaakov Breisch, better well known as the Chelkat Yaakov after his halachic sefer, offers a rationale permitting elective surgeries even though there can be small health risks involved. He writes, “If a birthing mother is considered as a person in danger, can we really prohibit her from childbearing?...therefore, since many people freely subject themselves to elective surgery despite the attendant risks...and our own eyes see that the vast majority are cured/avoid complication...we can trust God” (Chelkat Ya’akov, Choshen Mishpat 31). Hence, according to Rabbi Breisch, a woman undergoing the elective surgical procedure to freeze her eggs can rely on this

halachic basis even though it was not an example listed in the Talmud.

Interestingly, the famous halachic authoritarian, Rabbi Moshe Feinstein, permits rhinoplasty (a “nose-job”) as an elective procedure and does not consider it to be “self-injury.” Although it’s not a mandatory procedure, Rabbi Feinstein understands that a procedure desired by the patient is not considered “inflicting self-injury” because “chavala - self-injury” is defined only as an injury committed in an “aggressive or demeaning” manner (Iggerot Moshe, Choshen Mishpat 2:66). Rabbi Breisch also permits it but understands the permission is not because of the definition of “self-injury,” but rather because the license for physicians to heal includes psychological pain as well (Chelkat Ya’akov, Choshen Mishpat 31). Interestingly, Rabbi Eliezer Yehuda Waldenberg, 20th century Rabbi of Shaarei Zedek Medical Center and commonly known as the Tzitz Eliezer, disagrees with this logic. He forbids cosmetic surgery because it’s a rejection of the Divine design of the person. In other words, he understands the physician’s Biblical license to heal as an allowance to contravene in a Godly destiny only when the patient is in danger but not for cosmetic purposes (Tzitz Eliezer 11:41).

One may be able to apply reasoning from the debated case of rhinoplasty to our scenario of egg-freezing. Bolstering our case is the fact that egg-freezing is not a cosmetic procedure but one that greatly improves an older single woman’s odds of bearing genetically-related children in the future. Another factor to consider is the applicability of the premise that a woman has a halachic obligation to procreate. The source for the Biblical injunction to procreate is derived from the verse “be fruitful and multiply” (Genesis 1:28). The Talmud debates whether this applies to men, women, or both. The conclusion in Talmud (Yevamot 65b) is that women do not have this Biblical responsibility. Nevertheless, rabbinic authorities included women in this commandment because women are also obligated to “populate the world” (Kiddushin 41a, Commentary on the Rif, 16b; Orach Chaim 153, Responsa of the Chatam Sofer, Even HaEzer 1:20). Furthermore, later rabbinic authorities have stopped requiring men to fulfill this Biblical injunction in a number of ways. Firstly, they do not force a man to divorce his wife after 10 years of infertility nor do they prevent a man from marrying a woman who cannot procreate (Ramo, Even Haezer 1:3). Therefore, one can argue that egg-freezing would help a woman with her rabbinic injunction and her husband with his Biblical injunction to procreate.

Based on the above discussions, there are many reasons to permit freezing the egg via an elective surgical procedure according to Orthodox Jewish halachic standards. Yet there remains another aspect of the process that is under halachic question. This is in relevance to the in vitro fertilization (IVF) procedure which requires the male to ejaculate. Based on Genesis (chapter 38), the Talmud

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forbids male ejaculation outside of coitus (Talmud Niddah 31a). Rabbi Waldenberg therefore forbids IVF under all circumstances since, even if one of the sperm used via IVF results in a child, the excess unused spermatozoa are “wasted male emission” (Tzitz Eliezer 15:45). Conversely, Rabbi Avigdor Nebenzahl argues with this reasoning by emphasizing that IVF may be an infertile couple’s last resort and forbidding it may result in endangering the permanence of the marriage [12]. Some modern rabbinic authorities such as Rabbi Ovadiah Yosef and Rabbi Yosef Shalom Elyashiv both permit IVF as long as there is strict supervision of the gametes being used [13].

The Puah Institute, directed by Rabbi Gideon Weitzman, has been the preeminent authority in the Orthodox Jewish world on fertility issues and solutions. Founded on the idea that the development of new scientific procedures provides opportunities for the Orthodox Jewish, halacha-sensitive community, the Puah Institute encourages the

practice of egg-freezing for older, single women. Additionally, Rabbi Weitzman notes that often the women who freeze their eggs end up marrying and conceiving naturally without the need to utilize their frozen eggs. Nonetheless, the option to freeze one’s eggs offers hope and psychological solace to Orthodox Jewish women in an ever complicated and nuanced society. As Rabbi Weitzman says “We get calls on this topic every week, if not every single day” [14].

### Acknowledgements

I would like to thank my parents for supporting my education and providing me with a deep appreciation and love for Torah. I would also like to thank my amazing husband for always encouraging me to follow my dreams and inspiring me every day.

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Many grow up singing, “Dip the apple in the honey...” at their Rosh Hashanah sederim. Why specifically is an apple, rather than another fruit, dipped into honey on Rosh Hashanah? Is dipping challah into honey insufficient? Interestingly enough, this holiday is not the only time apples make an appearance in Jewish life. There is no question that the apple tree and its fruit have a much deeper meaning than is apparent.

## Symbolism of Apples

An apple has four distinguishable components: a sweet taste, an attractive appearance, a beautiful fragrance, and a remarkable power to heal. The Shulchan Aruch notes in Orach Chayim (Hilchot Rosh Hashanah, 3) that the four properties of apples symbolize the blessings of “children, life, and sustenance throughout the new year.” Hence, apples are most appropriate to consume at the Rosh Hashanah meals. A hint of the blessings of apples is mentioned in the Talmud (Pesachim 116a; Sotah 11b), in which a note is made that in Egypt, the Jewish women delivered their babies under apple trees.

Not only does the apple allude to blessings, but it also symbolizes the Jewish people. Most fruit-bearing trees have their leaves grown before the fruit blossoms. However, apple trees blossom before their leaves are fully developed. As such, the apple is a representation of *na-aseh v'nishma*, when B'nei Israel agreed to follow the Torah's commandments even prior to hearing them (Shabbat 88a). The natural sequence is to hear what must be done and then to accept the command. In this case, however, B'nei Israel simply accepted the Torah prior to being told what laws it contained. In this way, apples embody the essence of the Jewish people.

Ultimately, the apple symbolizes the Jewish nation's connection to Hashem, as taught by a parable found in the Talmud (Ta'anit 5b). A hungry, worn-out, and thirsty traveler passed through a desert and happened upon an apple tree with sweet fruit that provided satisfying shade, with a stream of water at its base. The traveler stated how this apple tree had everything he desired, and blessed the tree that its offspring should be just as satisfying. In this parable, the stream symbolizes the Torah, allowing all those who yearn for Hashem's words to satisfy their thirst. The fruit symbolizes the Jewish people who grow in holiness, paralleling the blessing the traveler made to follow in the ways of the parent tree. In the month of Nissan, the apple tree blossoms, and its fruit ripens fifty days later. This can be equated to Hashem giving the Torah. He redeemed B'nei Israel from Egypt in Nissan, and gave them the Torah fifty days later, in the month of Sivan. Therefore, the Jewish people sit in the shade of

Hashem and are protected by Him and the Torah, as the apple tree tended to the traveler.

## Health Benefits of Apples

Ibn Ezra, one of the most distinguished Jewish scholars of his time, interprets King Solomon's words, “Sustain me with flagons of wine, spread my bed with apples, for I am lovesick” (Shir HaShirim 2:5) to mean “invigorate me with apples.” Rashi comments that our Sages recommended apples to heal the sick. Today, a constant reminder of this suggestion is found in the hackneyed saying, “an apple a day keeps the doctor away.” The Zohar (Acharei Mot; Ziv ha-Zohar, Va'etchanan) also connects the various and vibrant colors of apples to one's physical health. The plentiful colors of apples - white, red, and green - represent the varied attributes of Hashem, corresponding to *chesed* (kindness), *gevurah* (strength), and *tiferet* (glory). In kabbalah, the Zohar explains that the color green is associated with healing. Additionally, *tiferet* derives from the root *pe'er*, which is reflected in the word for healing, *refuah*. Ya'akov Avinu is associated with the attribute of *tiferet*, and represents the balance between kindness and strength, as stated in the Talmud (Ta'anit 5b). When Ya'akov came to receive a blessing from his father Yitzchak, Yitzchak smelled the fragrance of apples (Ta'anit 29b). Most riveting is the Ben Ish Chai, a leading Sephardic scholar and kabbalist, who writes that the apple tree is the only fruit tree that has an association with *tiferet*, or healing, further implicating the connection between apples and health (Halachot Nitzavim).

Current research corroborates the idea that apples have healing power. Apples contain various phytochemical nutraceuticals, i.e. plant chemicals that have protective or disease preventative properties. Apple phytochemicals include phenolics and flavonoids, which have antioxidant properties. Apples also contain indigestible fiber, which has anti-constipation and anti-cancer potential, as well as soluble fibers including pectin, which lowers serum levels of fats, including cholesterol and triglycerides. [1].

The antioxidants within apples have the ability to fight and delay aging, while their flavonoids lower blood cholesterol levels, prevent blood clotting, and decrease heart disease mortality rate. Today, many people are terrified of aging; in 2014 alone, Americans underwent a total of 6.7 million injections for botulinum toxin type A, a type of botox, which is a 6% increase from 2013 [2]. Anti-aging creams, botox, filler injections, and cosmetic surgery have gone from a luxury to a modern day necessity. A study utilizing the yeast *Saccharomyces cerevisiae* demonstrated that exposure to solutions of whole apple extracts prolonged

the cellular life span of yeast cells by 100 percent [1]. A study done on Pink Lady apples found that when exposure included the peel, cellular life span increased by 40%, which was associated with the antioxidant polyphenol content of the peel [3].

Scientists have discovered the beneficial value of apples towards intestinal health. Pectin, a soluble fiber present in apples, modifies the human gut microbiota, which is the collection of microorganisms in the human colon. These bacteria play an important role in human health because they increase the efficiency of “energy harvest” from the diet, maintain homeostasis, and synthesize vitamins. Apple ingestion correlated with an enhancement of growth of gut microbiota, which in turn correlated with a direct positive effect on intestinal health. Fiber, the main source of energy for the gut microbiota, plays a significant role in the immune system and in lipid metabolism [4]. In another study, apples were shown to prevent oxidative damage from oxidizing agents to human cells lining the gastrointestinal tract. The study demonstrated that apple extract decreased impairment of human gastric epithelial cells in vivo by 50% and injury to the rat gastric mucosa in vitro by 40%. It is also important to note that the use of catechin, or chlorogenic acid, the main phenol component of apple extract, was shown to be equally as effective as apple extract in preventing damage to the gastric cells. The study concluded that apple extract protected the gastrointestinal cells by permeating cell membranes and increasing intracellular anti-oxidant activity [5].

Colon cancer is the third leading cause of cancer-related deaths in the United States. Fortunately, apples may function as both a cancer preventative and a cancer-fighting agent. In one study, rats were treated with azoxymethane, a chemical carcinogen that causes morphologic changes typical of cancer cells. Rats that were fed with apple phytochemicals had azoxymethane-induced lesions reduced by as much as fifty percent, as compared to the untreated group. Gossé and colleagues [6] suggested that, by extension, a similar effect could potentially be induced in humans, as the amount (per kg body weight) of polyphenols ingested by the rats was comparable to the daily consumption of two apples by an average-weight human. Kern et al. [7] demonstrated that polyphenol-rich apple extract played an important role in suppressing human colon cancer cell growth. The level of protein kinase C (PKC), which plays an important role in colon carcinogenesis, was shown to decrease when colon cells were treated with the apple juice extract. There was also an increase in activated caspase-3 and DNA fragmentation, both signs of apoptosis, or programmed cell death.

Breast cancer is the most commonly diagnosed cancer in women in the United States. Increased fruit intake,

particularly of apples, has been consistently linked with a reduced risk of breast cancer. Cancer cells become resistant to NF-kappa B activation, a transcription factor that plays an important role in cell proliferation, apoptosis, and immunity. The phytochemicals in apple extract inhibited the NF-kappa B activation and significantly inhibited proliferation of human breast cancer MCF-7 cells [8]. Additionally, a study conducted in 2015 found that the pectin in apples induces apoptosis in human breast cancer cells [9]. Pink Lady Apples, with or without their peels, are cytotoxic to human breast and colon cancer cells tested in vitro. Cytotoxicity to cancer cells was greater for apple extract with peels than those without their peels, which were attributed to the flavonoids in the peels [3].

Studies conducted in the in vitro toxicology laboratory at Stern College for Women have thus far corroborated the positive health benefits, and particularly the anti-carcinogenic effects, of apples. Oral carcinoma is one of the most common head and neck cancers, with over 30,000 new cases each year. The cytotoxicity, or quality of being toxic to cells, of an apple extract derived from the species *Malus pumila* Mill was significantly greater towards human squamous oral carcinoma (HSC-2) cells than to normal fibroblast (HF-1) cells from the tissues of the mouth; comparative cytotoxicity was evaluated with the neutral red assay (Figure 1). Microscopic analysis and flow cytometry demonstrated that upon treatment with apple extract, apoptotic death was induced in the HSC-2 cells. Further studies are still necessary to determine the mechanism by which the apple extract induces apoptotic cell death [10].

Apples have great significance in the Torah for maintaining health. Spiritual health goes hand-in-hand with physical health. Through building a stable spiritual connection with Hashem and providing proper nutrients to the body, apples not only shape a “healthy” person, but also someone who is stronger both mentally and physically.

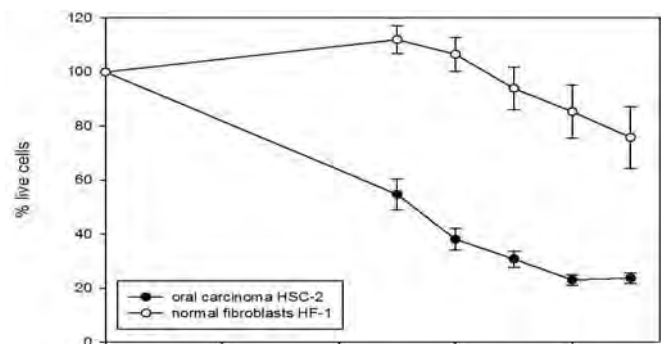


Figure 1: Cytotoxicity of apple extract to HSC-2 oral carcinoma and HF-1 normal gingival fibroblasts after a 24-hr exposure.

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## Acknowledgements

I would like to thank my parents for their continuous support, valuable guidance, and boundless love. Thank you to Dr. Schuck for not only having me in her research laboratory and teaching me, but also for being a mentor to

me in many ways. Finally, I would like to thank Dr. Babich for giving me this wonderful opportunity and always encouraging students to go above and beyond.

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# An Analysis of Eating Disorders in the Jewish World

By **Tamar  
Landsman**

With social media portraying unrealistic, idealized body images, there is no question why a growing number of adolescents today are becoming more and more self-conscious of their appearances, thus causing various types of eating disorders. Within the ten million females who struggle with eating disorders every year in the United States, there is a rampant number of Jewish girls suffering from different types of eating disorders, including anorexia nervosa and bulimia. Anorexia nervosa is a serious, potentially fatal, eating disorder characterized by self-starvation and excess weight loss, whereas bulimia involves excess eating followed by induced vomiting. Both can be categorized as psychological disorders since they distort one's body image with an obsessive desire to lose weight.

Although charedim, or ultra-Orthodox Jews, tend to stay away from social media, studies done in Israel show that the statistics of eating disorders among charedi and secular Jews are equal. It can thus be deduced that there are factors aside from the media that cause eating disorders, such as low self-esteem, feelings of inadequacy, lack of control in life, and depression. An Israeli study by Marjorie Feinson and Adi Meir involving questionnaires and phone conferences with over 800 Jewish women demonstrated no significant difference between the number of eating disorders in the Ultra-Orthodox community and in the secular community [1]. Apparently, strict religious adherence and an insular lifestyle of protection against social media do not prevent eating disorders. In fact, Feinson and Meir found that among those charedi women who were self-critical, almost one-third had serious eating disorders. Cases in the charedi community tend to go unreported, as families are reluctant to acknowledge the illness until there is a need for hospitalization. Hesitance to report illnesses may have much to do with the importance of being thin for marriage-arrangements in the Ultra-Orthodox community. Being physically thin is just as important in the more religious community, even without the mediating influence of social media, as in the secular community. While the secular communities and ultra-Orthodox communities have different sociocultural causes of eating disorders, the percentages of cases between these two communities are statistically similar.

Aside from the sociocultural causes, there may also be a genetic cause for eating disorders. A case of two sisters who both suffer anorexia can be attributed to one sister copying the behaviors of her older sister, or it can possibly have a genetic backing. Studies are currently being performed by Japanese researchers evaluating certain genes that code for proteins in the human body that control appetite and are possibly linked to eating disorders [2].

Both environmental and genetic components are taken into account when studying the growing number of eating disorders, especially in the Jewish world.

Some of the most significant symptoms of any eating disorder, including a lack of appetite, disturbed satiated response, withdrawal from the community, and decreased spirituality, correlate inversely with the halachik requirements of eating a meal. As Orthodox Jews, we follow Halacha, a strict set of rules which guide proper behavior in just about every aspect of our daily lives, from the shoes we tie in the morning to the bread we eat. Eating is an essential part of Judaism, with halachot controlling what can and cannot be eaten, with whom we can eat, where we can eat, and more. The brachot we make before and after eating, which are preferably said with a group of people, show how integral the mere act of eating is in Halacha, and how we transform every seemingly mundane act into a spiritual experience. Not only does the Torah specify how we should eat, but it demands of us to be satiated to the point when we can make a bracha, as it says in Devarim 8:9, “V’achalta v’savata uveirachta,” You should eat, become satisfied, and bless. Awareness of satiety is demanded to be able to make a bracha. Eating past the point of satiety is gluttonous and is considered improper.

Additionally, appetite and satiety are integral components of the Pesach seder, the prototype of the seuda, or Jewish meal, as explained by Rav Soloveitchik. Even though the Korban Pesach, the Passover sacrifice, was supposed to be eaten quickly to commemorate the hurried process of yitzias mitzrayim, the exodus from Egypt, it was only to be eaten up until the point of satiety and not further. Eating past the point of satiety would be gluttonous and not expressive of the personal freedom we celebrate on Pesach. For this reason, it is forbidden to break the bones of the Korban Pesach, for only a ravenous person would treat food in such a way. The fact that it is forbidden to eat after the afikomen, the second half of the matza that we eat at the end of the meal, further serves to prove the significance of the sense of satiety that is to be felt on Pesach [3].

Though cases of anorexia nervosa and bulimia were officially documented in literature towards the end of the nineteenth century, proofs from the Torah and the Talmud ascertain that there may have been cases centuries earlier. A possible biblical source for anorexia can be found in the story of Chana in Shmuel Aleph (1:1-28). Although Chana is the more beloved wife of Elkana, only Penina is able to provide him with children, as Chana is barren. Penina

torments Chana to the extent that she weeps and does not eat. Elkana then asks Chana, "Why do you weep? Why don't you eat? Why are you so unhappy? Am I not dearer to you than ten sons?" When Chana goes to Shiloh to pour out her heart in prayer for a son, Eli, the kohen, or priest at the time, mistakes Chana for a drunkard as he sees her whispering to herself. After explaining her predicament, Chana is told by Eli to go in peace and that HaShem, the Lord of Israel, would grant her request. After Chana leaves and eats, she becomes pregnant with Shmuel. It can be claimed that when Shmuel wrote this story, he provided a clinical cause for Chana's infertility, as she stopped eating after being tormented by Penina. This is one of the few examples in the Torah that explicitly states that someone has either started or stopped eating. It can thus be deduced that, perhaps, Chana's condition was the first historically documented case of anorexia nervosa, likely incited by depression, with a common symptom of infertility. After Eli reassures Chana, she starts to eat again and is healthy enough to conceive. It is interesting to note that Eli's reassurance can serve as proof of the effectiveness of therapy in couples suffering from infertility. Overall, the fact that Chana triumphs over her barrenness can be attributed to a success story of a battle with anorexia [4]. Obviously, nothing can solely be defined by science. Chana clearly understood HaShem's involvement in her predicament and resorted to prayer in Shiloh. When she was assured that HaShem accepted her prayers and that she would conceive, Chana sang a shira, a song of gratitude to HaShem.

A striking description of bulimia is found in the Talmud Bavli in Masechet Yuma (83a,b) and in Tosefta Shabbos (8:30). The term bulmos is used in both sources, translating as excessive or ravenous hunger. Interestingly, this term, known as bulimy in Greek, was then later referred to as bulimia in English by Gerald Russel, a twentieth century British psychiatrist [5]. Masechet Yuma discusses what should be fed to a person who is "seized by hunger." The conclusion reached is to feed this person sweet foods such as honey, so that his "eyes may become clear." The same term is used in Tosefta Shabbos and is explained as a life-

threatening condition. One suffering from this condition may even eat forbidden foods. Bulmos, as described in the Talmud, seems to have a sudden onset, without any prior symptoms, and is taken very seriously, as the victim is overcome by impaired judgment [6]. This description of bulmos in the Talmud is strikingly similar to bulimia as we know it today, although the purging aspect was not recorded in the Talmud. However, ancient Egyptian physicians recommended purging after binging as a health practice. After eating a large meal, wealthy Roman Caesars had a similar practice that involved visits to a room known as the "vomitorium." They would tickle their throats with a peacock feather to induce vomiting, in order to consume subsequent courses of the meal. Rabbi Nechemia probably had these practices in mind when he prohibited the induction of vomiting because food would be wasted (Masechet Shabbos 147b). He prohibited this act, and further noted that doing so on the street would be improper [7]. Science today explains that aside from the fact that induction of vomiting is improper, it is hazardous to one's health. Frequent induced vomiting of stomach acid burns out the esophagus and rots one's teeth [8]. The practice of induced vomiting, which seems to have been an ancient practice, is actually hazardous to one's health and categorized today as a fatal eating disorder.

The number of eating disorders among both charedi and secular Jews is growing as different sociocultural factors in the communities are in effect. Sources from the Torah and Talmud show the centrality of appetite and satiety in Judaism, and even include possible cases of eating disorders.

## Acknowledgments

I owe a great deal of *bakarat batov* to my parents who support my college education. Thank you to my shul rabbi, Rabbi Krohn, and to his rebbetzin, Chani Krohn, for reviewing my article, and a special thank you to Dr. Babich for his constant encouragement and assistance in writing this article.

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The earliest mention of anesthesia, the use of medication to relieve pain, is found in the Bible in the story of Creation. During the creation of man and woman in Genesis, the procedure for creating woman was described as follows. “And the Lord God caused a deep sleep (tardaymah) to fall upon man, and he slept, and He took one of his sides, and He closed the flesh in its place. And the Lord God built the side that He had taken from man into a woman, and He brought her to man” (Genesis 2:21-22). Many Jewish scholars and commentators interpret this Biblical word, “deep sleep” (tardaymah) as anesthesia. Both Rabbi Samson Raphael Hirsch, a nineteenth century German Rabbi and scholar, and Rabbi Meir Leibush, a nineteenth century Russian Rabbi and scholar commonly known as the Malbim, commented that the word tardaymah refers to a form of anesthesia. Tardaymah and the concept of a “deep sleep in order not to feel pain” is found in various writings throughout Jewish literature.

Throughout the Bible and Talmud there are many recorded injuries and incidents that require some form of anesthetic to conduct surgery or to relieve pain. The Babylonian Talmud noted the usage of alcohol as an anesthetic before execution. “When one is led out to the execution, he is given a goblet of wine containing a grain of frankincense in order to benumb his senses, for it is written: ‘Give strong drink unto him that is ready to perish and wine unto the bitter in soul’ [Proverbs 31:61]” (Sanhedrin 43a). Another instance of the usage of an anesthetic was recorded for an abdominal operation performed on Rabbi Eleazar son of Rabbi Simeon (Baba Metzia 83b). The name of the anesthetic fluid was not specified, although it was described as a sleeping draught (samma deshinta) [1].

A case of cranial surgery is described in the Talmud (Kesubos 77b), with much detail presented about the preoperative anesthetic. Abaye stated that the surgeon should create an elixir containing pennyroyal, wormwood, the bark of a nut tree, the shavings of a hide, a lily, and the calyxes that cover red dates, which are boiled together. Thereafter, three hundred cups of the mixture are poured onto the head of the patient until the skull softens. From these instructions one may presume that the mixture is a surgical antiseptic, not a pain reliever. However, Rav Solomon Bar Isaac, an eleventh century French Rabbi and scholar, commonly known as Rashi, interpreted these instructions as two separate steps: the brew is first poured onto the head of the patient until the surface of the skull softens and then the soft spot of the skull is located for surgery. The distinction between these two steps implies that the medical elixir was specifically used as an anesthetic. The Talmud further specified the amount of the mixture needed for the surgery, three-hundred cups, to explain its pain relieving ability. Because the elixir was an antiquated

form of anesthetic, the surgeons rushed and needed to use an abundant amount of the anesthetic mixture to reduce as much pain as possible. Today, we have surpassed what was once unimaginable in the field of anesthesia and have medications that are stronger and more effective even in smaller dosages [2].

Profound advancements in the area of anesthetics have brought medical Jewish customs into the twenty first century. Prior to the 1980’s, circumcisions on neonates were performed without the usage of anesthetics, as it was believed that a baby was unable to feel pain. However, research has shown that in a ritual circumcision, infants indeed feel pain during the surgical removal of the foreskin [3]. To alleviate a newborn’s pain, safe topical anesthetics and anesthetic injections have been developed specifically for babies. An effective way to prevent pain during the surgical removal of the foreskin is to inject 1 mL of lidocaine (1%) in a ring pattern around the middle of the penis or at the base of the foreskin. Although this procedure has the advantages of a local anesthetic, the injection itself can cause pain to the infant. The other suggested route is to spread a lidocaine or EMLA (eutechtic mixture of local anesthetics) cream on the area of the foreskin an hour prior to circumcision. The cream is a viable choice because the anesthetic is effective and does not enter the blood stream of the infant. However, there is a lag time between the application of the topical ointment and the ability to conduct the procedure.

There are multiple Poskim (Rabbinic authority figures) who question whether using anesthesia for a circumcision is halachically allowed (if it’s in accordance with Jewish codified law). The objections are derived from an understanding of the halachic requirements to fulfill the commandment of circumcision and the need to maintain classical Jewish tradition above all else. It is believed by some that the commandment of circumcision for males must be solidified by the pain felt by the infant during the surgical procedure. It is G-d’s will for the baby to experience pain during the circumcision, and if not, the commandment is not fulfilled. In addition, many Poskim assert that anesthesia should not be utilized during the circumcision procedure in an effort to maintain the traditional Jewish ritual without any modern day innovations impeding on this Jewish custom. Many believe that because circumcisions were done for centuries without the usage of a pain reliever, it is not necessary to use anesthetics just because they are readily available today. Rabbis S. Wosner, M. Halberstam, and M. Elyahu, are of the opinion that “the Torah prohibits innovation” to be added to Jewish customs.

Other Rabbinic authorities disagree with this viewpoint regarding anesthetics and instead encourage mohelim

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(those who conduct the surgical ritual procedure) to use some form of anesthetic while performing the Jewish circumcision. Despite the notion of needing to experience pain during the removal of the foreskin to fulfill the commandment of circumcision, there is no direct source in the Torah, halacha, or kabbala that requires the infant to feel pain. Those who believe in the need for a child to suffer during the circumcision derive this concept from a Midrash (a compilation of Jewish commentaries) which stated that Abraham, during his own circumcision, increased his pain to increase his reward for fulfilling G-d's commandment, although it was not a requirement. While there is no direct commandment to feel pain during circumcision, there is a belief that some pain must be felt during the procedure. The anesthetic options listed above help to reduce the pain of the procedure, but do not totally eliminate the suffering sensation. Because the baby still feels some pain, there is no concern of not fulfilling G-d's will if one chooses to use anesthetics. Regarding innovations, many Poskim believe that in certain circumstances, innovations that do not impede upon the main halacha are permitted. Some have agreed that minor alterations to traditions can be changed as long as the main aspects of the halacha are maintained. In the case of circumcision, the use of anesthesia does not seem to directly transgress the commandment of circumcision and

only changes a subsidiary aspect of the halacha. This school of thought allows for anesthetics to be used for a traditional Jewish circumcision [4].

While we have seen many instances in Jewish texts relating to the use of anesthesia, the modern day usage of anesthesia in Jewish practices is still contested by some. Despite its practical use in relieving pain in infants, many in Rabbinic authorities strive to maintain the traditional route of circumcision to protect Judaism from being tainted by the modern world. Regardless of this view point, many Rabbis have acknowledged the usefulness anesthetics brought to the Jewish custom of circumcision and have recommended mohelim to use anesthetic injections or a topical cream on the baby. The application of current anesthetic medication to traditional Jewish customs is just one example of the many ways in which modern advancements have integrated into long-established Jewish practices.

#### Acknowledgements:

I would like to thank my parents for their support and encouragement in my ongoing studies. I would also like to thank Dr. Babich for all of his assistance and guidance in writing this article.

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# “Kosher” Salt: A Study of Jewish Cultural Risk Factors for Cancer

By **Daniella Marcus**

Thyroid Cancer is one of the most common endocrine cancers. Most thyroid tumors are benign, but there is potential for malignancies. Thyroid tumors are three times more likely to form in women than in men. About 32,000 cases a year of thyroid cancer are diagnosed in the United States. Fortunately, it is one of the most curable cancers and can be remedied through surgery, iodine radiation therapy, or thyroid hormone therapy [1].

Several studies indicate that Jewish Americans have a higher risk for developing thyroid cancer compared to other Americans. Researchers from the University of Southern California Cancer Surveillance Program examined the relationship between religion and cancer during the years 1972-1981. The study was performed by comparing death records and information in the Los Angeles cancer registry, which noted each person's religion. The results indicated a higher risk of thyroid cancer in Jews than in other religious groups. The Proportional Incidence Ratio (PIR), a statistical measure used to compare rates of a disease within a population, was calculated. The PIR of Jewish males with thyroid cancer was 2.3, and the PIR for Jewish females was 1.8. These were significantly higher scores than the scores for those who developed thyroid cancer from other religious groups.

In 2007, a study conducted in New York explored a possible association between living in ultra-Orthodox Jewish neighborhoods and a recent increase in thyroid cancer. These communities, mostly in Brooklyn, NY, were characterized based on the percentage of children who spoke Yiddish and the proximity to an Orthodox synagogue. The study showed that there was about a 40% higher risk of thyroid cancer development for Jews living in these ultra-Orthodox Jewish communities [3].

It is interesting to note that the higher risk for thyroid cancer appears to affect specifically Orthodox Jews. In both of these studies, the risk factors appear to be environmental and cultural, rather than genetic. The goal of this paper is to explore possible environmental risk factors of thyroid cancer that may pertain to Orthodox Jews.

One plausible risk factor for developing thyroid cancer is an iodine deficient diet. Iodine is a mineral found in some foods, such as fish and dairy products, as well in iodized salt. Iodine is important in the functioning of the thyroid because the follicular cells in the thyroid use iodine to produce hormones that are involved in some of the body's main functions, such as metabolism, heart rate, and blood pressure [1]. A lack of iodine in humans causes an increase in the production of the thyroid stimulating hormone

(TSH), which leads to the formation of nodules in the thyroid, known as goiters. Studies have shown that goiters are more prevalent in iodine poor populations. In a population where goiters are widespread, people are less aware of changes in their thyroid gland, which may delay diagnosis of thyroid cancer. More aggressive tumors form when there is a lack of iodine because the increased cell proliferation will be more susceptible to mutagens and carcinogens [4].

Aside from the direct carcinogenic effects of thyroid cancer, studies have shown that there is a correlation between high intakes of saltwater fish and cruciferous vegetables, and thyroid disorders. This correlation was magnified specifically in iodine deficient regions [5].

It is important for people, especially pregnant and lactating women, to have an adequate amount of iodine. The World Health Organization and UNICEF recommend that preschoolers (birth - 6 years) should have 90 µg of iodine daily, schoolchildren (6 -12 years) should have 120 µg iodine/day, adolescents (age 12 years and up) require a daily dose of 150 µg iodine, and pregnant and lactating women should have 250 µg/day of iodine [6]. A majority of the dietary iodine that is normally consumed is from iodized salt, which is salt that is fortified with iodine. Most of the table salt that is used in the United States is iodized.

It is possible that in the ultra-Orthodox Jewish communities, there is less of an awareness of the importance of iodine in the diet. Most of the salts used in these communities are coarse kosher salt and sea salt. Both kosher salt and sea salt lack iodine fortification. Kosher salt is a coarser kind of salt that is also not processed and does not contain additives. Sea salt is evaporated from oceans and saltwater lakes and is processed very minimally. Table salt, on the other hand, is mined from underground salt deposits and usually includes anti-caking additives and iodine [7, 8].

Thyroid cancer is not the only cancer which has environmental and cultural risk factors that relate to Orthodox Jews. In contrast to the heightened risk of Orthodox Jews developing thyroid cancer, cervical cancer and uterus-related diseases have a much lower rate in the Jewish, mainly Orthodox, population. There have been several studies suggesting possible explanations for this lower risk of cervical cancer, with one possible explanation being the circumcision of males. This is based on the theory that cervical cancer is related to the transfer of smegma during cohabitation, which is produced more in uncircumcised males [9]. Additionally the observance of

taharas hamishpacha, laws of family purity, lowers the risk for cervical cancer. Cohabitation with multiple partners and early age of intercourse are other lifestyle risk factors that are forbidden by Jewish law and may contribute to the lower rates of cervical and uterus-related diseases in the Orthodox Jewish community [10].

Endometriosis is a disorder which occurs when the endometrium grows outside the uterus. In a study conducted by Shaare Zedek Medical Center in Jerusalem, only 1.12% of the 1,434 hysterectomies studied indicated endometriosis. One of the possible reasons for this low incidence of endometriosis is the adherence of the laws of taharas hamishpacha by the Orthodox population. By abstaining from cohabitation during menses and for an additional 7 days afterwards, there is a lower risk of endometrial cells passing into the fallopian tubes during intercourse, causing endometriosis [11].

It is interesting to note how Jewish cultural and environmental factors have an effect on both of these types of cancers in different ways. In regard to cervical cancer, keeping the mitzvos of bris millah and taharas hamishpacha, in addition to living a non-promiscuous lifestyle, lower the risk for cervical cancer. In contrast, thyroid cancer has a high occurrence in populations who

choose to use not processed salts, in order to be more careful with the laws of kashrus.

While the Torah asks of us to be very careful with the laws of keeping kosher, Judaism also stresses the importance of watching one's health. The Torah commands "Venishmartem meod lenafshoseichem," be very careful about your lives" [Devarim 4:15]. The Rambam writes in Hilchos De'os [4:1], "Keeping the body healthy and whole is part of the ways of Hashem, as it is impossible to understand the will of Hashem if one is sick. Therefore, one has to be careful to distance himself from things which ruin the body." It is important to realize that adherence to halacha is beneficial to us in every aspect of our lives, including our health. However, we must also have an active role in taking care of our bodies and providing them with the proper nutrition.

### Acknowledgements

I would like to thank my parents for their love and support in all areas of my life, and providing me with a rich Torah and secular education. I also want to express tremendous gratitude to Dr. Babich for his encouragement and guidance in writing this article.

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The commitment to Torah U'Mada invites us to investigate all areas of life through the lens of Torah and science. Of the many areas in life that require investigation, the consumption of red meat is one that is worth studying.

The Torah relates that the first time consumption of red meat was permitted was during the time of Noach. It was not until later that, this permission turned into a commandment when G-d formally gave the mitzvah to the Jewish people to slaughter and eat animals as part of the korbanot. In Mishlei, Shlomo Hamelach advises us to consume meat in moderation and not in excess.

Throughout the Gemara, there are numerous discussions about the consumption of red meat. In Pesachim (109a), it is written that red meat is consumed on joyous occasions such as the holidays. Masechet Pesachim (42b) also discusses the benefits that the consumption of fatty meat has on the body as a whole. In Nedarim (49b), it is noted that meat is more nourishing than vegetables or grains. The Gemara in Ketubot (60b) notes that pregnant women who eat meat will have robust children. [1] From glancing at these primary sources, it seems as if the Torah views the consumption of meat as something generally positive and beneficial.

In Sanhedrin (59b), the Tannaim discuss the reason why the consumption of meat permitted to man only at the end of Noach's life. One of the opinions in the Gemara is that at first, Adam had no desire to eat meat, and man acquired a carnivorous nature only after the sin and at the end of Noach's life. Because of this transformation in character, G-d allowed man to eat meat. This opinion questions the immorality of consuming meat by explaining that the change reflects the high moral standard of abstaining from meat consumption because it was only allowed after Adam sinned. The implication is that man should aspire to the highest level of moral conduct and abstain from consuming meat. The other explanation is that before the sin of Adam, humans were able to get all their nutrients from plants, but by the end of Noach's life, the supply of consumable plants was limited and man had to substitute meat into his diet in order to get all the necessary nutrients. From this explanation it is clear to Rabbi Bleich, an expert on ethics, that red meat contains nutrients that are necessary for man.

Rabbi Bleich not only shows through the Gemara the nutritional benefits of red meat but also discusses the practical obligation in present times of consuming red meat. Rabbi Bleich references the Gemara in Pesachim (109a) which notes, Ein Simcha Elah be'Basar... referring to the time of the Beit Hamikdash. The Jewish people were obligated to bring korbanot, consisting of red meat, on the holidays in order to experience the joy of the day. It is debated if the obligation to consume meat on the

holidays still applies, even after the destruction of the Beit Hamikdash. Many poskim, such as the Ritva and the Rashbash, are of the opinion that in present times, there is no absolute obligation to consume meat on the holidays. However, the Rambam in his Hilchot Yom Tov and in the Tur disagree and explain that rejoicing on Yom Tov is done by meat consumption, especially red meat. Regardless if there is a formal obligation, it is clear to many Poskim that consumption of meat was encouraged and praised because of the enhancement it brings to the joyfulness and festivity of the holidays. Therefore, abstaining from meat would not have been praised by Chazal. [2]

Throughout Jewish history, consumption of red meat existed, either as part of the korbanot or for a different reason. Now that the nutritional benefits and the value the Rabbis have placed on red meat consumption have been introduced, we will discuss cases that possibly indicate otherwise.

The life and kingship of King Yehoram is described in Divrei Hayamim. At the end of his life it is written, "The Lord smote him in his bowels with an incurable disease. And it came to pass, that in the process of time, after the end of two years, his bowels fell out by reason of his sickness: so he died of sore diseases..." (Divrei Hayamim II: 21: 5) Modern day physicians try to understand the disease that afflicted King Yehoram's bowels. Based on the symptoms that are described in the text, many physicians and scientists conclude that his disease was colorectal carcinoma (CRC). The text describes it as a sickness of his bowel that was incurable- both common symptoms of CRC. Most likely, King Yehoram was around 38 years of age when he started to show symptoms, ultimately leading to his death, which is around the age when individuals with CRC are diagnosed. If it was CRC, it is probable that his disease reached the 4th stage of cancer which is when it began to metastasize to other organs and became untreatable as it followed a very malignant and incurable course. In this case, it most likely spread to his circulatory system, his lymphatic vessels, his perineurium, or other distal organs. [3] The disease that afflicted King Yehoram was CRC. As later discussed, science has shown that consumption of red meat can possibly be associated with CRC.

In the time of the Beit Hamikdash, the Kohanim were predisposed to gastrointestinal diseases. Ben Achiya, an official who served during the time of the second Beit Hamikdash who's role was to treat the Kohanim's gastrointestinal maladies that they experienced during their two weeks of service in the Beit Hamikdash. The Kohanim's diet is often implicated as one of the factors that most likely caused their digestive difficulties. Ben Achiya used his herbal knowledge and the addition of

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fruits with antioxidants to treat the ill Kohanim and maintain their health. In their role, the Kohanim supervised the korbanot of the animals and often consumed a large portion of the sacrificed animals. The meat from the sacrificed animals that they ate was often roasted and/or broiled, cooking methods that tend to char the meat. Sometimes it was left undercooked, which according to medical literature, can cause diarrhea, since eating charred and undercooked meat is difficult and sometimes dangerous for the body to digest. Often wine is used as an antioxidant to aid in digestion, however, the Kohanim were not allowed to drink wine while in the Beit Hamikdash. By including herbs and special fruits in their diet, Ben Achiya introduced antioxidants to aid in the digestion of meat. [4]

In ancient and Talmudic times, there was no refrigeration to store raw or cooked meat, and the sh'chita of a cow generates more meat than can be physically and morally consumed in one sitting. Due to these conditions, consumption of red meat was limited during those times. However, in present times with the development of refrigeration, fresh raw meat can be stored for an extended period of time. As a result, there is now an opportunity for an over-dose of meat consumption cooked via various methods. This potentially presents many health risks such as colorectal, gastric, breast, and lung cancer.

The correlation between elevated cancer risk and consumption of red meat is possibly due to certain compounds found in red meat that have been proven as mutagenic. The mutagens are: N-Nitroso compounds (NOCs), Heterocyclic Amines (HCAs), and Polycyclic Aromatic Hydrocarbons (PAHs). In addition, red meat is a large source of heme iron, which has been associated with increased endogenous NOC formation. [5]

HCAs, PAHs, and NOCs are formed through the process of cooking red meat at high temperatures. HCAs result from amino acids, sugars, and creatine reacting at high temperatures. PAHs form when meat is smoked, charred, or cooked above an open flame leading to fats and juices dripping onto the fire. The fatty drips yield flames that contain PAHs, which then adhere to the surface of the meat. In addition, red meat is rich in fatty acids which when over consumed are possible cancer risk factors and a source of heme iron which can promote oxidative damage that has a positive correlation with cancer risk. [6]

Researchers have further studied the association between red meat and cancer. One study showed that when participants ate red meat that was charred outside and well done inside, they consumed greater amounts of dietary mutagens which led to an increase in colorectal cancer risk. A suggested method to possibly lower cancer risk is to reduce meat doneness. [7] A different study showed a statistically significant positive association between intake of pan-fried meats and oven broiled meats with cancer.

Pan-frying uses a small amount of oil, allowing the meat to reach very high surface temperatures. Based on this, researchers suggest to flip meat often, reducing cooking temperatures, or preheating the meats in a microwave prior to cooking, thus reducing HCA formation and possibly decreasing cancer risk.

Not only is the cooking method of red meat a factor in the association between red meat and cancer, but the diet that comes along with consumption of red meat affects the association. Data has shown that often diets that are high in red meat consumption leave out plant based foods such as fruits, vegetables, and dietary fibers which have cancer protective compounds. [6] Therefore, when consuming red meat, one should also consume vegetables or other antioxidants. This modern scientific knowledge validates a part of Ben Achiya's treatment plans for the Kohanim. The Gemara writes that he was an expert in herbal medicine. Although the kohanim were not allowed to drink wine while in the Beit Hamikdash, after their service he would give them various types of wine. Throughout their service, he added different herbs and fruits to their diet. These items that Ben Achiya included in the Kohanim's diet, contained antioxidants that aid in the digestion of the meat. Through these methods, he maintained their health and treated their intestinal disorders. [4]

A breast cancer study found a relationship between consumption of red meat during adolescence and premenopausal breast cancer. From puberty until a woman's first birth, women's breasts have regular division of undifferentiated cells causing the cells to have an increased susceptibility to cancer. The study found that women who consumed well done and fried meats on a regular basis had a 30-40% increase in breast cancer risk as compared with women who consumed the lowest amount of red meat that was cooked medium. Another study also found that growth hormones that were used in cattle farms caused a greater risk for breast cancer resulting in, regulation of growth hormone use in cattle farms. [8]

There is a concept in Judaism referred to as "shomer pesaim Hashem," G-d guards the fool. The understanding of this phrase is debated by many poskim. One opinion understands that it is limited to situations where it is difficult to avoid the risk and in such conditions, it is permitted to rely on G-d's help. A different understanding is that it only applies when the risk is minimal and in those cases, one can rely on G-d for help. From the research that has been done, it is clear that red meat has carcinogenic risks in addition to the many nutrients it contains. There is a question if one can rely on the verse "shomer pesaim Hashem" while consuming red meat in moderation. Because the risk is small, the halacha cannot prohibit red meat consumption and one can rely on "shomer pesaim Hashem." However, if scientific data would one day show



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that one is at complete risk for cancer as a result of consuming red meat, then this would not apply and one would be permitted to abstain from consuming red meat provided that the mitzvah to consume meat at certain times is not in jeopardy. [9]

By studying the Torah and scientific literature, a balance in consumption of red meat can be found. The Jewish primary sources discuss the praise of red meat as something that brings us joy and as a pathway to connect to G-d. However, later sources discuss the digestion difficulties that the Kohanim suffered most likely as a result of the meat from the korbanot. Scientific literature offers an explanation for why meat from the korbanot

caused the digestion difficulties. Yet, science has also shown ways to consume meat in a way that will decrease some of its health risks thus allowing for its consumption on those occasions deemed appropriate by the Rabbanim.

### Acknowledgments

I would like to take this time to thank my parents for their support in my education and allowing me the privilege to study at Stern College for Women. I would also like to thank Rabbi Eliezar Lerner and Dr. Babich for reviewing this paper.

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For centuries, beauty has played a major role in society. Cosmetology, the practice of enhancing beauty through the application of makeup, has even become a full time profession. The word “cosmetic” originates from the Greek word “kosmētikos,” which was first used to describe Greek slaves who adorned their mistresses in perfume. We know that as early as 4000 B.C.E., the men and women of ancient Egypt wore eye makeup regularly, which is no different from today’s society. The first recorded cosmetologists were tribal hunters who smeared ash under their eyes to reduce the glare of the sun and animal urine to alter their scent. Warriors also used cosmetology in the manner that we now call camouflage [1]. Although primitive in its origin, this practice eventually led to cosmetic products such as eyeliner and perfume. Over the course of time, eye makeup has become more a part of women’s tradition than men’s, although some makeup, i.e., camouflage, is still used by the armed forces. Today, the extensive range of cosmetic products has necessitated changes in halacha, and has resulted in a potential increased health risk to the human genome. We can see that the long history of cosmetics has made an impact on Jewish society, as well as the world at large.

Despite its secular beginnings, the use of cosmetics is found both in halachic, midrashic and Talmudic literature. The Talmud (Yoma 75a) states that cosmetics came down daily from heaven with the manna. In Kings 2 (9:30) it is written that women placed puch on their eyes. Puch corresponds to the Greek phykos and it represents antimony sulfide [2]. The midrash (Psikta de Rav Khana p.135a) notes that puch and kochol are the same color; Rashi interprets kochol as blue in color. Jeremiah (4:30) states that applying puch to the eyes makes them seem larger. In fact, Jeremiah’s description is supported by modern day science. As Psychology studies have proven that eyeliner and mascara cause the eye to appear 6% larger and that eye shadow enhances the eye’s apparent size by 5% [3]. Not only did they have makeup in midrashic and Talmudic times, but they even had special instruments for makeup. The Mishnah (Kelim 13:2) provides a name, makchol, for the cosmetic stick used for makeup application.

In Biblical and Talmudic times, wearing eye makeup had a negative connotation, as it written in Kings 2 (9:30) that women of questionable morals wore eye makeup. The Mishnah (Sotah 3:3), though disapproving of the practice of eye makeup, recognizes that the use of cosmetics was a naturally accepted custom. As the use of eye makeup evolved over time, halachic ramifications also evolved. Some examples include: the prohibition of applying makeup on Shabbat, which compels women to apply their

cosmetics prior to Shabbat (Tosefta Shabbat 9:13); and the permission to apply cosmetics on Chol Hamoed Pesach and Sukkot (Moed Katan 1:7).

Even though wearing eye makeup was frowned upon, halacha still recognized it as a mechanism to increase the attractiveness of a woman. Proof of this is found in the Talmud (Ketubot 4b), where it states that as a sign of mourning, eye makeup is not worn and that during menstruation women do not wear eye makeup to avoid enticing their husbands (Shabbat 64b). The Sages realized they could not stop the spread of the practice of applying makeup, but rather they could control certain aspects of this practice.

With the evolution of the cosmetic field, there has been an explosion in the types of eye makeup products produced from the simple blue powder puch to multiple colors and forms of mascara, eye shadow, and eyeliner. This did not just result in an increase in the variety of products available but also in an increase in the ingredients used to manufacture the product. Although as the saying goes, “beauty is only skin deep”, the effects of beauty products are more far reaching. Cosmetics now contain unnatural items that pose risks to the human body, which permeate the skin’s surface and descend as deeply as to effect our very genes. In 1938 the Food and Drug Administration (FDA) enacted the Food, Drug and Cosmetic Act of 1938 to control the application of these substances on the human body. Though this legislation did eliminate many toxins from being incorporated into eye makeup, there still are some harmful ingredients that pose genotoxic threats such as benzalkonium chloride (BAC), parabens, phthalates and titanium dioxide. These toxins are found in over 22,000 cosmetic products.

BAC is used as a preservative in cosmetic substances and it was found that upon exposure to BAC there was an increase in double stranded DNA breaks, which cause genetic mutations, and cell death [4, 5]. Parabens are another class of preservatives that are readily absorbed through the skin to inner tissues. Studies have shown that propyl paraben and methyl paraben also produce double stranded DNA breaks [6]. The stability of pigments and scents in cosmetics is maintained through the use of phthalates, industrial chemicals associated with health problems such as obesity, asthma, infertility, testicular dysgenesis, allergies, leiomyomas, and breast cancer. One study showed that elevated levels of phthalates in urine correlated with high levels of fragmented DNA [7]. Surprisingly, titanium dioxide appears in common eye makeup, even though it is a known genotoxic agent and carcinogen [8]. These added chemicals pose risks to the human body that are too great to ignore.

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Consumers have the responsibility to check the ingredients of their cosmetics and to try to find products with the least harmful substances. Hopefully cosmetic companies will follow the *derech hateva* and take the natural path to create safe products, so we can keep the tradition of cosmetology alive without any detrimental health effects. Since the wearing of eye makeup has been around for centuries, its use will not disappear overnight. We do, however, have to protect ourselves from unnatural ingredients. Since cosmetics no longer fall down from heaven along with the manna, we must be careful in what we apply to our eyes.

Perhaps we should all go back to using *puch*, which is not genotoxic, but rather comes to us through *derech hateva*.

### Acknowledgements

I would like to thank my parents for supporting my education in secular and Judaic studies at Stern College for Women and for their guidance and constant encouragement to ask questions. I would also like to thank Dr. Harvey Babich for his dedication, advice and assistance in writing this article for *Derech HaTeva*.

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With the benefit of modern technology, new medications and therapies enable physicians to save lives in ways that were not possible in the past. Although newer treatments are oftentimes more effective, sometimes their availability is limited. A facility may have fewer ventilators than patients in need of respiratory support. Life saving antibiotics against new infections may not have been produced in quantities large enough to meet the need of all affected patients. Individuals whose lives depend on receiving a donor transplant organ may succumb to death before they receive the organ that they need. These situations raise many questions. In life and death situations, how are limited resources allocated? What guidance does *halacha*, Jewish law, offer to guide physicians in prioritizing one life over another?

The issue of allocation of finite resources is not addressed directly in Talmudic law, yet the Talmud discusses two similar moral questions from which we may apply conclusions. The first discussion related to allocation of limited resources appears in a *mishna* in *Horayot*, and establishes a precedent in dire situations in which only one person can be saved at the expense of another.

"A man takes precedence over a woman when it comes to saving a life and to restoring something lost. A woman takes precedence with regard to provision of clothes and to be redeemed from captivity. When both stand equal chances of being degraded, then the man takes precedence over the woman.

A priest takes precedence over a Levite; a Levite to an Israelite; an Israelite to a *mamzer* (product of a forbidden relation); *mamzer* to a *Natin* (member of a caste of Temple servants); a *Natin* to a convert; a convert to a free slave. When [do we say this]? When they are all equal. But if there were a *mamzer* who was a sage and a high priest who was an *am ha'aretz* (one who is lax in observing tithes and purity laws), the *mamzer* sage takes precedence (*Horayot* 3:7-8)."

The second appears in the Talmud Bavli in *Baba Mezja* (62b) regarding a case of limited water needed to sustain two individuals:

"Two people were traveling on the road, and one of them has a flask of water. If both drink, they will both die; if one drinks he will arrive at the town. Ben Petura expounded it is better that they both drink and die, and one of them not witness the death of his companion. Until Rabbi Akiva came and taught [that]... your life takes precedence over the life of your brother."

While both of these texts discuss the allocation of limited resources, be it life-giving water or finite communal funds to redeem captives, commentators on the Talmud do not

apply the precedent set in *Horayot* to the case of the travelers in *Baba Mezja*. Rabbi Moshe Sokol, the dean of Lander College for Men, explains that the correlation is not drawn because of two key distinctions between these cases. In *Horayot*, a third, unaffected party is responsible for the allocation of scarce resources. In contrast, in *Baba Mezja*, one of the threatened individuals possesses the scarce commodity and bears the responsibility of allocation. In addition, the two cases differ by the very nature of the resource itself. While the water supply mentioned in *Baba Mezja* is divisible, only one life can be saved in *Horayot* [1].

The infinite value of human life is a cardinal principle in Jewish thought. Preservation of life takes precedence over the observance of all *mitzvos*, save the three cardinal sins (Rambam, *Yesodei HaTorah* 5:2). It is prohibited to shorten life by even a single moment, for all of life is precious. Both Ben Petura and Rabbi Akiva held preservation of life to be a central pillar in *halacha*, yet they arrive at contradictory conclusions in regard to these situations. What exactly is at the core of each of their arguments?

Rabbi Naphtali Tzvi Yehuda of Berlin, commonly referred to as the Netziv, explains that Ben Petura and Rabbi Akiva debate whether it is preferable to extend both lives briefly, or to save one life at the expense of the other. According to Ben Petura, regardless of who is in possession of the limited resource, either one of the individuals or a separate third party, the resource should be shared equally. Rabbi Akiva agreed that if a third party held the limited resource, it should be shared. However, if one of the affected individuals was in possession of the necessity, only one should receive it and be saved [2].

Throughout *halachic* literature, Talmudic debates tend to follow the opinions of Rabbi Akiva. Therefore, according to the Netziv's understanding, when there is a divisible resource, it is better allocated to save an individual than divided in attempt to temporarily prolong the lives of all affected. It seems that Rabbi Akiva's view follows common sense, for it is better to save one life than to lose two, while Ben Petura's argument of dividing the scarce commodity among those in need, thus saving none, is flawed and begs another interpretation.

Rabbi Chaim Ozer Grodzinski, a Lithuanian Talmudic scholar of the 19<sup>th</sup> and 20<sup>th</sup> centuries, interprets the conflict between Ben Petura and Rabbi Akiva to be related to the relevance of property ownership in life and death situations. He explains that if two individuals shared ownership of the water, Rabbi Akiva would agree with Ben Petura that the water should be divided equally between them. But, if the water were owned by only one person, Ben Petura argues that ownership is irrelevant, and the

resource should be shared. In contrast, Rabbi Akiva holds that ownership is morally pertinent, therefore the owner of the water should save his own life at the expense of his friend's rather than share and cause both lives to be lost. Rabbi Grodzinski concludes that the case in *Baba Mezria* applies only to water owned by a single party. Ben Petura and Rabbi Akiva debate the moral legitimacy of property rights in grave circumstances. While Ben Petura argues that ownership is irrelevant, Rabbi Akiva holds that ownership is morally pertinent [3].

In the medical field, resources are usually owned by a third party, namely the hospital or government. In these situations, according to both Ben Petura and Rabbi Akiva, the doctor is obligated to allocate treatments equally. Yet this apportioning of medical care may result in both patients dying, rather than allowing one to live while the other dies. Still, according to Rabbi Grodzinski's view, all authorities agree that the resources must be split. In contrast, the Netziv's reading of *Baba Mezria* dictates that the law follows the opinion of Rabbi Akiva that only one individual should receive treatment. How is it decided which patient has precedence?

In order to answer this weighty question, three *halachic* principles must be understood. The first is the basic belief that all human beings possess equal rights, regardless of socioeconomic status, religion, race, or social-standing. The second *halachic* imperative is that of extending the sum total of human life, including prolonging an individual's life and maximizing the number of individuals who can be saved. Thirdly, *halacha* tries to avoid drawing conclusions arbitrarily, especially in life-and-death situations [1].

When resources are divisible, all three principles can be upheld by equally sharing the resources among those in need. This is in accordance with Ben Petura's view according to the Netziv's interpretation of the Gemara. It also follows Rabbi Grodzinski's understanding according to both Ben Petura and Rabbi Akiva, that if both individuals share the resource, it is split equally between them.

In a case of indivisible resources, the imperative that all people deserve equal rights is in direct conflict with the attempt to extend the sum total of human life. Since only one individual may receive the resource, all those in need cannot be treated equally unless none receive the therapy. However, this would be antithetical to the imperative to extend the sum total of life. Therefore, to uphold the second imperative, extending the sum total of human life, and to avoid arbitrary decisions, prioritization is necessary.

There are six prioritization principles, many of which are derived from the *Mishna* in *Horayot* cited above, that operate in life-for-life situations. The first is *yichus*, lineage. *Horayot* details a hierarchy in which the priest is at the top of the social scale, and a freed slave is at the bottom. Although the hierarchy seems clear and straight-forward, it

is only implemented if all other qualifications are equal. *Yichus* is taken into consideration only after all other factors are weighed.

The second precedent considered is social need. Although this is not explicitly stated in rabbinic sources, many *halachot* reflect this principle. In a commentary on the *mishna* in *Horayot*, the *Tosefta* explains, "The priest anointed as a chief chaplain of the army takes precedence over the vice high priest." Although the *Tosefta* gives no explanation, Rashi explains in the Talmud Bavli on *Nazir* (37b) that this precedence exists because the chief army chaplain is needed by the community.

The third category of prioritization is the capacity to perform *mitzvot*. This category is not explicitly stated, but can be derived from rabbinic sources. In life-determining circumstances, precedence is given to men over women, as detailed in *Horayot*. Although the *mishna* does not give a reason, Maimonides explains in his commentary on the *mishna*, *ad loc.*, that men are given precedence because they are obligated in all the *mitzvot*, while women are only obligated in some of the commandments.

The fourth classification gives precedence to the learned. The *mishna* in *Horayot* teaches that a *mamzer* who is a sage has priority over a high priest who is an *am ha'aretz*. A *mamzer* is near the bottom of the social scale, and his status at birth forbids him from marrying into the congregation of Israel, except to another *mamzer* or a convert. In contrast, the high priest was one of elite who performed sacred work in the Temple. The precedence given to a learned *mamzer* over an ignorant high priest illustrates the value placed on Torah learning in *halachic* literature. Rabbi Moshe Sokol suggests that the precedence given to a *talmid chacham*, a learned individual, may in fact be a subset to the category of social need [1]. A *talmid chacham* embodies Torah and its wisdom. It is his obligation to teach and offer guidance to the community.

The fifth precedent given is in relation to the degree of those in need. *Horayot* prioritizes saving a female captive over a male because she is more likely to be raped. Yet when there is an equal chance each will be violated, rescuing the man takes precedence because the act is more shameful and will be of greater anguish to him. From this, it can be understood that if victim A is more likely to be harmed than victim B, victim A should be saved. If there is equal likelihood A or B will be violated, other considerations should be taken into account. It is important to note that these cases are not life-and-death but cases of physical and psychological harm.

The sixth precedent, a subjective category, gives priority to closer relationships between the one in need and the rescuer. The rescuer has an obligation to save his relatives prior to saving others. The Talmud in *Baba Mezria* (71a) instructs the hierarchy of giving charity, explaining one should first care for his nation prior to helping other

nations. One's family and community members should receive aid prior to others.

Although these qualifications are clear and authoritative, changes in prioritization slowly developed in *halacha* throughout the centuries. The first shift was away from the principle of a *talmid chacham* above the rest. Rabbi Moshe Isserles (the Rama) includes in the *Shulchan Aruch* (251:9) the Jerusalem Talmud's teaching in *Horayot* (3:4) that clothing for the wife of a *talmid chacham* has precedence over the life of an ignorant individual. The Shach, a 17<sup>th</sup> century commentator on the *Shulchan Aruch*, reexamined the application of this law in his day. He explains that in his time there is no sage of this caliber, and therefore saving a life takes precedence over providing clothing. The Shach's limitation is a dramatic shift away from the learned having precedence over the ignorant.

Similarly, the hierarchy in *yichus* of a priest's precedence over an Israelite's is discussed by Rabbi Yaakov Emden, an 18<sup>th</sup> century leading German Talmudist. Over the generations, there has been a decline in the priesthood and Leviteship. Rabbi Emden explains that priests have their status only because of presumption (*chazakab*), and therefore precedence should not be given based on lineage, although he remains "undecided about this matter" [4].

Rabbi Yaakov Emden also alters the category of capacity for *mitzvot*, but rather than limiting its application, as he did for lineage, he expands it. He asserts that a normal male has precedence over a minor, an individual who is deaf, or someone who is classified as a *shoteh* (fool). Unlike the Shach who limited the *talmid chacham*'s application to his era, Rabbi Emden expands it, explaining that a learned person takes precedence over an ignorant individual. He also gives priority to those who possess a longer life expectancy, including the young and healthy over the old and sick. This category also includes the potential for creating future lives and prioritizes the fertile over the sterile.

Both the Shach's shift away from giving precedence to the learned and Rabbi Emden's limitation of application of *yichus* are clear illustrations of *halacha*'s movement towards granting all individuals equal respect. Another such evolution in *halacha*, according to Rabbi Moshe Hershtler, author of *Halach U'Refuah*, is that once a

physician begins to treat a patient, he is obligated to continue this patient's treatment, even if presented with another patient who would have been given priority according to the six qualifications detailed above. He explains that although there is no *halachic* evidence, "reason dictates it" [5].

Rabbi Moshe Feinstein, one of the leading scholars of the 20<sup>th</sup> century who was renowned for his expertise in *halacha*, agrees with this principle. If patient X is mortally ill and has a short life expectancy and patient Y can be cured entirely, Rabbi Feinstein rules that if patient X comes to the emergency room first, he must be treated before patient Y. He explains that patient X may be distressed if he sees patient Y treated before him, and this distress can cause further deterioration in his health [6]. In a discussion on the precedents detailed in the Talmudic texts, Rabbi Moshe Feinstein rules that one may only implement priority to determine who should receive the limited resources when the two individuals are equal on all other accounts. Rabbi Sokol suggests, "One gets the strong impression that Rabbi Feinstein feels general reluctance to apply the classical prioritization criteria" [1]. This is not inconsistent with the earlier tradition detailed in the *mishna* in *Horayot*. Rather, the original sources do not address these detailed cases of chronological priority.

Throughout history, *halacha* has grappled with the challenge of ethically allocating limited resources while respecting the imperatives of equal rights of individuals, extension of sum total of human life, and the avoidance of arbitrary decision-making. With the advancement of medical technology, life and death weighs heavily in the balance when the demand for a new treatment outweighs supply. The wisdom of the Torah offers guidance in forming moral determinations in these life and death predicaments.

## Acknowledgments

I would like to thank Dr. Babich for his guidance throughout the process of writing this article. I would also like to express my sincerest gratitude to my parents for the unwavering love and support.

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# That Which Cannot Be Seen: Microorganisms and Judaism

By **Hannah  
Piskun**

Microorganisms cannot be viewed with the unaided eye and so a microscope, usually requiring at least one hundred times magnification, is needed for visibility. Naturally, microorganisms were unknown to our Talmudic sages and remained so until the development of the microscope by Antonie van Leeuwenhoek in 1674 and the later work of Louis Pasteur, who showed a link between microorganisms and disease. This article discusses two microbial-transmitted diseases, one that is mentioned in the Bible and one during the Middle Ages, and how they connect to the Jewish people.

## Tzara'at

In chapters 13 and 14 of *Vayikra*, there is a very in-depth, long description of a bodily affliction referred to as *tzara'at*, often defined as leprosy, and how it should be treated. However, the physical signs and clinical symptoms illustrated in those chapters are inconsistent with leprosy known in medicine today. Part of the confusion regarding the biblical interpretation of the word *tzara'at* is due to a language barrier, as the meaning of this ancient Hebrew word cannot be determined with certainty. Scholars have pointed out that the disease of *tzara'at* described in the Torah is most likely referring to at least four different diseases, or groups of diseases. No skeletal remains of people infected with *tzara'at* were found in the geographic regions related in the Torah, and thus it cannot be said with certainty what disease *tzara'at* was. Yet, scholars believe that this biblical term was used to describe many different types of skin diseases [1].

The Talmud (*Erachin* 15b-16a) makes it clear that *tzara'at* is of a spiritual origin rather than a physical one. It gives seven possible reasons for why someone may become afflicted with *tzara'at*: slander, bloodshed, false oath, incest, arrogance, robbery and envy. Yet, many regulations listed in the Torah regarding *tzara'at* seem to be in place for preventative reasons. The methods of sanitation, hygiene and quarantine of infectious diseases, as described in the Torah, are very similar to those practices utilized in medicine today. The rules stressing the quarantine of a person with leprosy were most likely to prevent the spread of infectious skin diseases [1].

One of the most complete medical descriptions of leprosy was written during the Middle Ages was *Compendium Medicinæ* written by Gilbertus Anglicus. He described several ways a person could contract leprosy, including hereditary transmission, poor diet, inhaling the breath of a leper, or cohabiting with a woman who was promiscuous

with lepers. Anglicus's understanding of contraction of leprosy is doubtful; nevertheless, his descriptions of the clinical signs and symptoms of the disease were accurate. These accounts included loss of the ability to feel the sensation of pain, the shriveling of the skin, and the deformation of the hands and feet. Finally, in 1880, the causative agent for leprosy was discovered by Gerhard Hansen, who identified it as the bacterium *Bacillus lepræ*. Today, the bacterium is termed *Mycobacterium lepræ*. In honor of his discovery leprosy is commonly referred to as Hansen's disease [1]. Hansen's disease may be just one of the skin diseases that the Torah was referring to, the other three may have come about due to spiritual reasons.

## Netilat Yadayim

Perhaps one of the most devastating natural disasters in European history was known as the Black Death. Historians estimated that over a period of fifty years during the Middle Ages, at least twenty-five million people died of the Black Death in Europe, which was nearly forty percent of the population. In reality, what was so astonishing about this catastrophe was that it nearly wiped out Europeans, who were unaware of its etiology. The Middle Ages was an era plagued by religious extremism, ignorance, and superstition and many ideas were developed to explain this catastrophe. One belief was that the wrath of God was punishing man for his sins [2].

The bubonic plague, the most common and most important form of plague at the time of the Black Death, was spread by rats infested with fleas that were hosts of the deadly bacterium, *Yersinia pestis* [2]. Symptoms of the bubonic plague include high fever, aching joints, swelling of the lymph nodes, and dark unsightly tumors (or buboes) that ooze puss and blood. Today, we know that the plague can be spread in several ways, including being bitten by a flea carrying *Yersinia pestis*. However, microorganisms were unknown in the Middle Ages. Another mode of transmission is through person-to-person contact with a plague-infected person [3-4]. Surprisingly, the bubonic plague was actually the least harmful form of the plague, but nevertheless it killed fifty to sixty percent of its victims [5]. Scientists suggest that because the plague spread at such a fast rate, it was probably contracted through airborne transmission [6]. In the pneumonic plague, the bacterial infection spread to the lungs, resulting in severe coughing and bloody sputum. It was relatively easy to transmit *Y. pestis* from person to person by simply coughing [5]. It is inconceivable to comprehend how a

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threat that could not even be seen threatened to eliminate Europe in the fourteenth century.

Nevertheless, despite hundreds or even thousands of people dying in a single day from the plague, Jews were significantly less affected than their Christian neighbors. The death rate was lower among the Jews because of the sanitary practices instilled in Jewish law. According to Jewish law, one is required to wash his or her hands after utilizing the bathroom, before eating bread, and upon awaking up in the morning, through the ritual known as *netilat yadayim*. Jews also bathed at least once a week before Shabbat, which is in stark contrast to other people in the Middle Ages who possibly may have gone half their lives without washing their hands. Sanitary conditions in a Jewish town, though seemingly primitive according to modern standards, were in fact far superior to the conditions found in a fourteenth century town in the Middle Ages. Sanitation was primitive, with the sewage disposal system as an open pit that channeled through the middle of the street. Indeed, it was such unsanitary conditions that guaranteed the spread of the plague [2].

Jewish law requires the dead not only to be buried as soon as possible, but also to undergo *tabara*, a ritual process of caring for the body, before burial. In non-Jewish areas, where the plague was especially rampant, people left many corpses unburied and lying in the streets, due to the vast number of people dying at an unmanageable rate. This not only aided in spreading the plague, but also brought about other diseases, like typhus [2]. Those frightening times caused people to act cruelly to one another as described by a fourteenth century Italian writer, Giovanni Boccaccio, who recounted his experience living through the Black Death:

*One citizen avoided another, hardly any neighbor troubled about others, relatives never or hardly ever visited each other. Moreover, such terror was struck into the hearts of men and women by this calamity,*

*that brother abandoned brother, and the uncle his nephew, and the sister her brother, and very often the wife her husband. What is even worse and nearly incredible is that fathers and mothers refused to see and tend their children, as if they had not been theirs [5].*

In contrast, the Jews harbored a great sense of community that not only led them to tend to those sick or dying, but also to establish a formal burial society, known as *chevrah kadisha*, whose responsibility was to ensure that any Jew who died would always be treated with proper burial rituals according to Jewish law. One such example was washing the body before burial [2].

After a short while, the Christians realized that the Jews were dying at only half the rate from the plague and began to believe that it was the Jews who initiated the disaster. This perverted reasoning ignited terrible pogroms that swept through the Jewish communities in Western Europe, where thousands of Jews were murdered and some Jewish communities were completely wiped out [2]. Despite enduring massacres from the Christians, the Jews largely evaded the Black Death by keeping Jewish laws (*halacha*) commanded to them hundreds of years before. While Jews follow the dictates of *halacha* because it is the word of God, certain rituals such as washing upon awakening, washing upon eating bread, and use of a *mikvah*, contain methods of hygiene that include many subtle health benefits as seen through history.

## Acknowledgments

I would like to give a big thank you to Dr. Babich for providing me interesting sources to read. I would also like to thank my parents for their love and endless support.

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There is a clear history of false teeth and an emphasis of dental aesthetics throughout Jewish literature. In Judaism, teeth are viewed as an essential part of the body, just as important as an eye. The *pasuk* (Exodus 21:23-24) states “if there is a fatality, you shall give a life for a life; an eye for an eye, a tooth for a tooth”, where the phrase “a tooth for a tooth” is parallel to “an eye for an eye” [1]. Teeth were even viewed as essential for maintaining the health of the entire body [2]. *Cohanim*, Jewish priests, have an even greater imperative to maintain their oral health. If a *Cohen* lost a tooth, it was considered a *mum*, one of the defects making a *Cohen* unsuitable to serve in the Temple [3]. There are many other medical restrictions regarding the issue of *tumah*, or impurity, involving *Cohanim*. These restrictions are due to the prohibition for a *Cohen* to come into contact with a dead body. Ironically, a *Cohen*'s obligation to refrain from coming into close proximity with a dead body may prevent him from using dental implants as a means to maintain his teeth's aesthetics.

Today, most dental implants include cadaver grafts. This poses an array of issues concerning *Cohanim* coming into contact with such materials and could even prohibit a *Cohen* from entering a dentist's office. One of the most common dental procedures is tooth extraction, which is accompanied by tissue scaffolding. Tissue scaffolding is a bone grafting procedure where a graft is placed on an area, post-extraction, for stabilization of surrounding teeth [4].

There are various kinds of scaffolds: (a) autogenous grafts - living tissue from another area of the patient's body, (b) allografts - a graft of cadaver bone, and (c) xenografts - tissue from animals, including synthetic grafts. Most of these grafts, excluding allografts, may cause harmful host responses, including various immune system defense mechanisms upon grafting of foreign matter into a host body. According to *halacha*, xenografts are most preferable due to their safer healing period and absence of impurity issues involving cadavers. However, multiple advantages have been found using allografts including a less drastic host response, better bone remodeling, and a greater penetration of fibroblasts and osteoblasts for bone renewal [4].

Besides for the issues of *tumah* (such as being in the same building, carrying/lifting, and direct physical contact with a dead body) there are additional *halachik* issues that arise regarding the use of allografts. Specifically, there is a prohibition of *nivul hameit*, which requires a Jewish body to be buried intact. The source for this prohibition is Deuteronomy (21:22-23) which forbids leaving a body that was executed and hanged to remain hanging overnight. The Talmud (*Sanhedrin* 46a-b) adds that not burying individual body parts would also violate this prohibition [4]. The main question behind these issues that

we need to address is whether or not allografts attain the status of a dead body in the eyes of *halacha*.

There are several ways to address the posed *halachik* barriers. Rabbi Unterman, Ashkenazic Chief Rabbi of Israel from 1964-73, states that the transplanted organ is considered to “come back to life” after transplantation, and therefore would no longer have the status of “dead”. This would allow for parts of a cadaver to be used especially when benefitting a life, and would not *halachikally* be considered desecration of a dead body. The transplanted area will also eventually be buried with the transplant recipient when he or she dies, resolving the issue of *kevurat hameit* [4].

Regarding *tumah* and *Cohanim*, there are areas of leniency considering the size and source of the bone. While benefitting from the dead is a debate, benefitting from a Gentile corpse is only a Rabbinic prohibition (based on Talmud *Yerushalmi*, Shabbat 10:6) and may thus allow for leniency in a case where it is used to benefit the life of another. Furthermore, most of the bones in bone banks originated from non-Jews simply because there are fewer Jews in the world, and thus one can reasonably assume that the bone graft originated from a non-Jewish corpse. Halachik consideration of these multiple factors would allow more leniency for bone graft use on a *Cohen* [4].

The measurement used to determine an impure status of an object in the Talmud is the size of a piece of barley. If the bone size is less than a piece of barley, which is true for the amounts used in most dental grafts, then it would not transmit any *tumah*. When the graft materials originate from multiple corpses and bone is pulverized, it does not convey *tumah* according to the Brisker Rav, Rabbi Yitzchak Zev Halevi Soloveitchik (*Chiddushei HaGriz* Vol.5 *Nazir* 52a). The graft would not transmit *tumah* because the ground individual pieces are much smaller than a grain of barley and the bone is coming from multiple sources. Additionally, when the bone is dry as flour, it is considered by the Talmud (*Niddah* 56a) “*basar min hameit sheyavesh*” and is thus considered *tabor* (ritually pure) and can be used for a *Cohen* [4].

All allografts are treated with multiple solvents and acids for sterilization to produce a healthy host response upon transplantation. This changes the form of the bone and transforms the graft's essence and is therefore not considered to transmit *tumah*. Additionally, the pulverized pieces are not reassembled into their original structure and the graft now has a changed status, making it *tabor* and acceptable to be used on a *Cohen* [4].

While there is a great amount of debate concerning this issue among *Poskim*, many make the case based on the above arguments that the materials used in allografts do not have the status of transmitting *tumah*. Included in this is the *halachik* rulings of Rabbi J. David

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Bleich, Rabbi Moshe D. Tendler, and Rav Asher Weiss (among others). Rabbi Dovid Feinstein and Rav Yisroel Belsky say that it is permissible for a *Cohen* patient, but a *Cohen* dentist must take certain precautions. The specific conditions of their *pesak* can be read in the article by Rabbi Dr. David J. Katz [4]. Practically, this relieves the issues of *tumah/tahara* regarding a *Cohen* acting as a dental practitioner, entering the office of a dentist, or receiving an allograft treatment [4].

### **Acknowledgements**

I would like to thank my parents for their constant support throughout my education. I would also like to thank Dr. Babich who inspired me to write this article and helped me with sources throughout the writing process. I would also like to thank Rabbi Binyamin Blau and Rabbi Benjamin Shiller for helping me review the *halachik* content as well as providing insightful feedback.

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In the Bible, teeth are considered a very important part of the body, almost as important as the eyes. They are so important that if an indentured servant lost one tooth because his master struck him, the Torah orders that he be released. In the Midrash- Yalkut Shimony it states that the health of the body depends on the teeth [1]. This may suggest that something wrong with one’s teeth is an indication of some internal pathology.

Many people overlook the importance of their teeth, considering them only in terms of their function of chewing food and aesthetics. In the Bible, the words “tooth” and “teeth” are mentioned fifty five times, in forty-eight verses. “Tooth” and “teeth” are used in different contexts throughout the Bible, including in regard to health and appearance; culture, society, and the legal system; anatomical and physiological responses; strength, power, and the ability to conquer; and in the context of emotions, such as anger and anguish. This article will focus mainly on the use of teeth in the context of strength, power, and ability to conquer [2]. The teeth are related to strength, power, and ability to conquer due to the fact that the teeth are very strong. King Hussein, who was the “moderate” of Hashemite Jordan, told his troops to kill all the Jews of a suburb in Jerusalem during the Six-Day War in 1967. To accomplish this task, he told them to use all their weapons, including their teeth [1]. Teeth function in digestion, as they mechanically break down foods, such as tough meats, by cutting and crushing them in the oral cavity. When viewing an animal, one can tell if it is an herbivore, carnivore, or omnivore by the structure of the teeth which accommodate its diet. Carnivores have sharp teeth to rip and cut flesh, while herbivores have ridged molars and the ability to move their jaws sideways which enables them to chew their food [3].

The Bible also contains descriptions of strength, power, and the ability to conquer. In Tehillim (57:4-5) King David praises G-d for saving his life from his enemies numerous times [4]. In these verses, King David describes his enemies as “men whose teeth are spears and arrows,” indicating that his enemies are very dangerous and have much power. Rashi identifies the men to whom David is referring as either those who attacked him prior to Saul or to those who informed Saul of David’s whereabouts. Saul attempted to kill David because the kingship was taken from Saul and transferred to David [5]. Another example is seen later in Tehillim (124:6), when King David is thanking G-d for saving his life and the lives of his soldiers. David says, “Blessed be the Lord who has not given us to be torn by their teeth.”

In Mishlei (30:14) evil men are described as having “teeth like swords, jaw teeth like knives to devour the needy” [2].

This passage is discussing a generation described as a people who curse their fathers and do not bless their mothers, a generation who is haughty and conceited and think too highly of themselves, and a generation who use their teeth to eat the poor men of the land [5]. Yet another example is seen in Daniel (7:5) in which Daniel describes a dream he had the night before and remembers one of the characters in the dream as “a beast resembling a bear with three ribs in its mouth and between its teeth, devouring much meat”. This is a terrifying image because the rib cage is big and very strong, designed to protect our lungs. The image of a bear with three ribs in its mouth is not something most people would want to imagine. According to Rashi, the three ribs from Daniel’s dream represent the three cities that were constantly in a state of rebellion. Sometimes they won their independence and at other times they reverted back to Persian rule. Rashi also suggested that the three ribs may represent the three Persian emperors, Cyrus, Ahasuerus, and Darius II. In Daniel 7:7 and 7:19, the power of the Roman Empire is described as a “beast, extremely strong, having iron teeth. It devoured and crushed.” In Devarim (32:24), the mention of destruction is noted to be by the “teeth of animals” [2]. Commenting on this verse, Rashi suggests that the reason “teeth of animals” is mentioned is that there was an incident in which a sheep bit a man and the man subsequently died. Additionally, the Sifrei mentions that in this verse the Hebrew word “beheimot” refers to domesticated animals. One would expect that the word “chayot,” wild beasts, should have been used because chayot, not “beheimot,” usually bite people. The Sifrei notes that the word beheimot was used to indicate that even domesticated animals would bite people [6].

There are also examples of the removal of strength using the analogy of teeth. One example is found in Tehillim (3:7-8), “smitten on the cheek, Thou has shattered the teeth of the wicked” [2]. According to Metzudoth this verse refers to the soldiers of Absalom, the son of King David, who wanted to take his father’s throne. These soldiers lost their strength and power. According to Rashi, the phrase “smitten on the cheek” conveys a humiliating blow, and the phrase “shattered the teeth” refers to robbing the soldiers of their courage. It takes someone very courageous to attack the king, and G-d removed their courage and dauntlessness. King David thanks G-d for weakening his enemies and robbing them of their audacity and intrepidity to attack him. Similarly, later in Tehillim (58:6-7) King David asks G-d to “shatter their teeth in their mouth, break out the fangs of the young lions.” According to Radak the phrase “shatter their teeth” is a request from King David to G-d to destroy the enemy mentioned in the previous verse [5].

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Teeth were also used as a reference in culture, society, and the legal system. Many times the phrase “an eye for an eye, and a tooth for a tooth” is mentioned [2]. This phrase is not meant to be taken literally. The Talmud (Ketubot 111a) states, “The congregation of Israel says to G-d: 'Master of the Universe, wink to me with Your eyes for that exhilarates me more than wine and smile at me with Your teeth for that is sweeter to me than milk'”. This shows that when G-d is happy with the Jewish People, then the Jewish people are happy and seek to satisfy G-d. This statement also shows the importance of teeth and a good smile. The Talmud continues, “Better is the one who shows the white of his teeth (in a smile) to his friend, than the one who gives him milk to drink”[7]. Teeth have such a strong impact on society, as it is more important to smile at someone (showing one’s teeth) than to provide them with food.

As shown, there are many important connotations associated with teeth throughout all of the Torah. The use of teeth as a symbol of strength, power, and the ability to conquer is very common in Tanach. Also, the usage of teeth is noted when describing culture, society, and the legal system.

### Acknowledgments

I would like to thank my family for their support and encouragement and Dr. Babich for his support and for providing the articles that guided my research.

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# Jacob's Epigenetics: Spare the Rod or Spoil the Flock

By Rachel Siegel

One of the most famous debates that exists in genetics is the question of nature versus nurture. Are individual differences a result of a person's innate makeup, or are differences due to one's personal experiences? Nevertheless, genetics is a lot more complicated than a simple separation between nature and nurture. To start, nature and nurture are so intertwined that there is often no clear line between the two. Additionally, Bob Weinhold, who has written about environmental health issues since 1996 as a member of the Society of Environmental Journalists, writes in the journal *Epigenetics: The Science of Change from the Environmental Health Perspectives* that a science referred to as epigenetics has recently been gaining notice and credibility. He continues that it has been linked to many phenomena, including, but not limited to, cancers, cognitive dysfunction, as well as respiratory, cardiovascular, reproductive, and autoimmune diseases [1]. Epigenetics involves changes in gene activity that get passed down to the next generation of offspring without the altering of genetic code. Such modifications are controlled by epigenetic tags located just outside the genome that turn on and off the expression of particular genes. These tags can be passed on to the next generation. Not only has the fresh focus on epigenetics transformed the conventional discourse regarding nature and nurture, but the recent revival of epigenetic research legitimizes the thought seen throughout ancient Biblical text; external stimuli can determine physical characteristics of subsequent generations.

In ancient secular and Jewish societies, it was believed that characteristics obtained during one's lifetime were passed on to his or her offspring. This is contrary to the common notion in modern science, which states that heredity is not affected by characteristics obtained from the environment itself [2]. In fact, there are quite a few cases throughout the Talmud that suggest that "what you see is what you beget" [3]. In Brachot (20a), the story is told that Rabbi Yochanan would sit outside bathing houses, women would gaze at his beauty after immersing, and as a result they would have beautiful children. The Talmud continues discussing this idea and states that after immersing in the bath house, a woman should be careful about what she looks at on her way home, so as not to affect her offspring when she conceives [2]. Similarly, in Avodah Zara (24b), the Talmud explains that in order to produce a red heifer, an Israelite placed a red cup in front of two cows as they mated, causing the heifer to be born red. Furthermore, in a story found in Bereshit Rabbah (73:10), a black man and a black woman gave birth to a white child. The black man went to Rabbi Yehuda HaNassi to question whether or not the

child was his own. Rabbi Yehuda HaNassi asked the man if he had any white mirrors in his household, to which the man answered in the affirmative. Rabbi Yehuda HaNassi consequently attributed the pale color of the child's skin to the white mirrors in the couple's home. Likewise, Gittin (58a) describes Roman behavior during intercourse before and after the destruction of the Temple. Before the destruction of the Temple, the Roman noblemen wore rings with beautiful human figures during intercourse, and after the destruction of the Temple they forced attractive Jewish slaves to stand in the room while the Roman noblemen had intercourse.

Perhaps most prominent of the "what you see is what you beget" stories in ancient literature is the narrative of how Jacob received his wealth from his father-in-law, Laban. After Jacob married Leah and Rachel, he worked for Laban so that he could leave his father-in-law's house with a livelihood. During this time, Jacob made a deal with Laban which stated that Jacob would be able to keep all the spotted sheep that were born to the flock of sheep that he was herding. To spoil this deal, Laban gave Jacob a herd of only white sheep to watch over. However, Jacob figured out a way to ensure the success of his deal. Jacob took rods from trees and peeled back their bark, revealing a streaked pattern, and placed them in the water-troughs of the sheep. As a result, "the flocks conceived at the sight of the rods, and the flocks brought forth streaked, speckled, and spotted [sheep]" (Genesis 30:39).

This partiality in texts towards the idea that heredity can be affected by a parent's experiences was validated by Lamarckian inheritance, a theory published by Jean-Baptiste Lamarck, a plant biologist, in 1809 his book, *Philosophie Zoologique*. Lamarckism is described as an organism's ability to pass characteristics that were acquired during its lifetime to its offspring, through a change in physiology due to experiences or behavior. For example, according to Lamarck, when a giraffe stretches its neck to reach leaves high up in a tree, its neck muscles are strengthened and its neck becomes slightly longer. Therefore, the offspring of this giraffe will have somewhat longer necks. However, according to the Darwinian theory of evolution, which combined with Mendelian genetics has become the accepted view of modern genetics today, a genetic mutation would engender a giraffe to have a slightly longer neck than the giraffe's contemporaries. Because the giraffe with the longer neck has the ability to reach higher leaves on trees, an advantage for obtaining food, this trait would ensure the survival of the giraffe with the mutation, and thereby, the mutated gene will be passed

on to the next generation [4]. The widespread acceptance of modern genetics casts doubt on Lamarckism, therefore Lamarckian inheritance was never seriously considered to be legitimate.

Even if the aforementioned Talmudic stories seem farfetched, the Biblical story of Jacob's inheriting an abundance of wealth from Laban can be explained through Mendelian genetics. When Jacob suggested to Laban that he would keep the spotted sheep that would come from a flock of only white sheep, Jacob must have known something significant about genetics to have the confidence to devise a plan where seemingly, he could potentially work for many years without any payment. White is a dominant trait among sheep, and although Laban only gave Jacob the white sheep, two-thirds of these sheep would be heterozygotes for speckles. This means that two-thirds of these sheep's genotypes included genetic material for white wool as well as speckled wool, but because white is the dominant color over speckled, only the white genes were expressed. If the heterozygotes mated, there would be a twenty five percent chance of the parent sheep bearing spotted sheep in the first generation. Yet, if any homozygotes mated with the heterozygotes, all of the offspring would appear white. When Jacob recounts what happened to his wives, he says that an angel came to him and said, "Lift up now thine eyes, and see, all the he-goats which leap upon the flock are streaked, speckled, and grizzled" (Genesis 30:12). In a dream, the angel reveals to Jacob how to distinguish between the heterozygous and the homozygous sheep. The heterozygotes showed "hybrid vigor," meaning they had an increased rate of conception compared to the homozygotes. In Genesis (30:41-42), it states that "the stronger of the flock did conceive, that Jacob laid the rods before the eyes of the flock in the gutters, that they might conceive among the rods; but when the flock were feeble, he put them not in; so the feeblers were Laban's, and the stronger Jacob's." The hybrids are referred to as Mekusharot, which means stronger, and the pure breeds are referred to as Atufim, or feebler. Jacob gave Laban all the homozygotes, the feebler sheep, while he kept all the heterozygotes, the stronger sheep. The speckled rods that Jacob put in the water-troughs was simply a method used by shepherds when mating their sheep. According to Dr. Yehuda Feliks, a former professor emeritus of Talmud and Botany at Bar-Ilan University, this practice had nothing to do with the birth of spotted sheep from white sheep [2]. In fact, when the angel appeared to Jacob, the angel made no mention of the need to place the spotted rods in front of the water troughs [5]. In the book, *Genesis and the Big Bang*, the renowned physicist Dr. Gerald Schroeder maintains that the sticks were strictly placed in front of the sheep to startle them backwards, increasing the rate of sexual intercourse between the sheep. He too asserts that the speckles on the rod did not contribute to the birth of speckled sheep [4]. In addition, when Jacob recounts what

happened between him and Laban, he makes no mention of the speckled rod to his wives. This implies that Jacob believed there was a genetic mechanism involved in the transfer of speckles, rather than the rods influencing the offspring [5].

On the other hand, there is one major logistical hole when reconciling Mendelian genetics and the story of Jacob and Laban. Rashi on Genesis 30:38 states that when "[t]he female animal saw the rods, it was startled at the sight of them and recoiled; its mate then pairing with it, it afterwards gave birth to young in the likeness of the rods to which they were exposed." Dr. Schroeder leaves out the part of Rashi that exclaims "in the likeness of the rods to which they were exposed" when proposing his theory. The Eitz Yosef, a commentator on the midrash that this Rashi is based off of, expounds on this idea. He emphasizes that, "[b]ecause of the recoil which came as a result of the appearance of the rods, the image of the rods remained in their imagination at the time of mating..." which "has an effect at the moment of conception." Additionally, the midrash relates the story of the black parents having a white child, immediately after its comment about "the likeness of the rods," intimating a similar phenomenon between the two stories regarding the influence of imagery during relations. Rabbi Shmuel Eidels (1555-1631), also known as the Maharsha, speculates that the story about the beautiful Rabbi Yochanan sitting outside the bathing house and the story of Jacob's sheep stem from the same principle that the image in a woman's mind during intercourse can influence her offspring. In his commentary on the red heifer, Rav Yaakov Emden relates the strange phenomenon of passing a red object in front of the cow during mating to what Jacob did with the rods [4]. Therefore, it seems that according to Rashi, the startling of the sheep during intercourse created "a hereditary imprint." This is similar to the concept of memories being encoded genetically in our DNA using electric shock, and is supported by the hypothesis that women discern colors more sharply during ovulation [3]. Altogether, the majority opinion among scholars seems to relate the incident of Jacob's sheep to Lamarckism.

The resurgence of epigenetics in the recent decade can not only help to scientifically explain the story of Jacob and Laban, but can also cast some validity on the other stories in ancient texts that relate to Lamarckism. Ernst Mayr, a major evolutionary biologist of the 1900's, explains the story of Jacob's sheep through the lens of Lamarckism. However, Dr. Schroeder vehemently disagrees with Mayr's explanation. Dr. Schroeder believes that Mayr's opinion is influenced by preconceived notions from the time when Lamarckism was believed to be true. However, now Lamarckism's viability has resurfaced [4]. As a matter of fact, Professor William Etkin, author of *Jacob's Cattle and Modern Genetics. A Scientific Midrash*, points out that all "Jewish authorities seem to accept the validity of the

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obvious inference that the visual experience of the parents may determine the pigmentation pattern of the young,” and this renewed interest in epigenetics restores the logical validity of the Jewish authorities as well [5]. An article in *Newsweek* (published on January 26, 2009) gives several examples of Lamarckism shown in research. One example is that of fleas with helmets. When a female flea is attacked, as a defense she develops a helmet for further protection, but if a female flea is not attacked in her lifetime, she will not generate this helmet. Female fleas that produce a helmet during their lifetime give life to offspring with helmets, even though their actual DNA sequence doesn't change. Furthermore, *Time Magazine* published an article in 2010 that showed the effects of one generation's eating habits on its offspring. In a 2011 issue of the journal, *Cell*, research portrayed that stress can affect offspring without any changes to DNA sequences [4].

Particularly relevant to epigenetics and the story of Jacob and the sheep is the fair amount of research relating to “the role of prenatal nutrition on epigenetic events” [6]. There are four dietary sources of methyl groups; choline, methionine, vitamin B-12, and folic acid. An abnormal amount of any of these four sources can lead to abnormal methylation of DNA, which regulates gene expression by turning on and off the expression of specific genes [7]. The color of the viable yellow agouti mouse (*Avy*) ranges from yellow to mottled to pseudo-agouti, or brown. The more methylation on the *Avy* gene, the more agouti colored mottling appears on the mouse. Feeding pregnant mice diets rich in methylated substances has shown to change the phenotype of offspring to be more mottled than the mother [8]. The passage in Genesis (30:37) specifies that Jacob peeled the bark off of poplar, almond, and plane trees. Dr. Josh Klein, a plant pathologist at the Volcani Research Institute of the Israeli Ministry of Agriculture, posits that fungi containing methionine and choline can be found underneath the bark of these trees, and can be extricated through water [6]. These substances could have been responsible for the mottling of the offspring of the copulating sheep via methylation. Additionally, the pseudo-

agouti mice also showed to live healthier, prolonged lives than the yellow mice, which is referenced in Genesis 30:41-42, where it is explained that “when the flock were feeble, [Jacob] put them not in; so the feeble were Laban's, and the stronger Jacob's” [8].

The ideas of Lamarckism do invite skepticism. After all, there are many experiences that parents have which are not passed down to their offspring, such as their moral compasses. Moreover, sheep that graze in green grass don't have green offspring. However, epigenetics is a resurrection of Lamarckism in the sense that environmental factors do affect the phenotypes of offspring. Lamarck's theory doesn't specify a mechanism through which this could be explained, but epigenetics provides a very rational system through which the effect of environmental factors on the next generation can be attained. Curiously, most articles that argue the knowledge of Mendelian genetics in the story of Jacob are written before 2000. Many of the articles written later on view the story through the lens of epigenetics. Both views are clearly influenced by the science of their times in an attempt to reconcile Torah with science. It is possible that Jacob, and the scholars who commented on this story, had very little understanding of genetics, but it is very clear that there is a scientific way to explain what occurred. The more we discover in science, the more the brilliance of G-d and His genetics is palpable during this episode between Jacob and Laban. As a result, this consciousness regarding the brilliance of G-d increases one's sense of awe towards the hidden miracles at work.

### Acknowledgements

I would like to thank Dr. Babich for his guidance in writing this paper. He has an incredible ability to make Torah come alive with science. This article would not have happened if it weren't for his perseverance and push. I would also like to thank my parents for their unwavering support, and especially my father who is my permanent editor, no matter how busy he is.

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Jewish society was agrarian for centuries, necessitating the need for animal care. Coupled with the Torah's high regard for animal welfare and the complex specifications for kosher meat, it is not surprising that there are numerous mentions of veterinary medicine in the Talmud. There are references to experts, veterinary procedures, and significant medical knowledge which vastly predate modern science. The breadth of information on this topic found in the Talmud is extensive and astounding.

One of the 613 Torah commandments is *Tzar Baalei Chayim*, the prohibition to cause unnecessary harm to animals. Some Torah laws which fall in the category of *Tzar Baalei Chayim* are feeding animals before one eats, not leaving an animal with a heavy burden for no reason, and the prohibition of preventing an animal from eating while working. This tremendous regard for the quality of animal life is echoed in the Talmud. For example, in *Masechet Shabbos* (54b), it is noted to place a collar on a donkey to prevent irritating a wound, placing bands above the hooves of an animal that takes short strides to prevent it from injuring itself, supporting a ram's tail with a wagonette to protect it from lacerations, and covering a cow's udder to prevent vermin and leeches from sucking its milk. It also mentions putting *chanunos* on a ewe; two possible interpretations are given for *chanunos*. One, a compress to keep a sheep warm, or, two, the wood of a *chanun* tree that induces sneezing so the sheep will expel parasites. However, the Talmud points out that no matter what *chanunos* are, the word it stems from is *chanun*, mercy. The message of this *Mishna* is the importance of treating every animal with compassion.

Interestingly, included in the commandment of *Tzar Baalei Chayim* is the need to slaughter with a perfectly smooth blade, which the *Sefer HaChinuch* (Chapter 451) says is to spare unnecessary pain to the animal. In fact, all the laws of *shechita* (kosher slaughtering) endeavor to cause the least amount of pain to the animal being slaughtered. For example, for an animal to be deemed kosher, it must be slaughtered according to ritual tradition and it must also undergo a full, postmortem external and internal examination, called a *bedika*, to ensure there are no abnormalities (*treifos*). These very detailed and extensive laws demand full knowledge of animal anatomy. In fact, Rabbi David Vital, in his 16<sup>th</sup> century work *Keter Torah*, was able to construct a detailed and accurate diagram of bovine anatomy solely based on discussions in the Talmud [1]. Because of the Torah's deep regard for animal welfare and the demand for extensive knowledge of zoological anatomy and abnormalities, it is no surprise that many of the Talmudic sages were experts in veterinary science. Rabbi Shimon ben Chalafta is one of the veterinary personalities mentioned most often in the Talmud. He was

one of the last *tana'im* who lived in the second century and was considered a naturalist, expert botanist, and animal specialist [2]. The Talmud recounts a story of a hen with a dislocated thigh. Rabbi Chalafta set the limb, fashioned a splint, and the hen's leg healed. Additionally, there was a belief that once a bird lost its down, it would be unable to regrow it and would consequently die. Rabbi Chalafta disproved this theory by giving supportive care to a hen who had lost all its feathers, resulting in the feathers' regrowth and the hen's survival (*Chullin* 57b).

One incredible example of the breadth of knowledge possessed by the *tana'im* is found in the Talmud *Bavli, Masechet Chullin* (46a). There it is stated that if an animal is found to have an abnormality, it is able to retain its kosher status if it can be determined that the abnormality is not life threatening. An animal with a damaged liver, for example, is considered kosher as long as at least an olive sized portion of the liver remains intact. *Rashi*, famous French commentator of the 11<sup>th</sup> century, explains that this amount is enough "*kidei lebalos refuah*," to produce healing. Dr. J. L. Kazenelson, a Russian physician, writer, and scholar of the latter half of the 19<sup>th</sup> century [3], points out in *Hatalmud Vechochmas Harefuah* that the specific wording of "producing healing," rather than, "enough to continue living," or "to heal," implies that the remaining liver will not only heal but will also be able to regenerate until the entire liver is completely restored. Modern science did not discover this unique and incredible ability of the liver until 1894, fifteen hundred years after written in the Talmud [4]!

Furthermore, the Talmud accurately records the identifying characteristics of rabies in *Masechet Yuma* (83b) and impressively offers a cure for a person bitten by a rabid dog. The Talmud suggests that eating from the liver of the infected dog could cure an infected person. Even though dogs are not kosher animals some Rabbis of the Talmud permit this [practice](#) since it was considered a legitimate cure. Legend has it that Rabbi Dr. Yisrael Michael Rabinowitz, a 19<sup>th</sup> century European scholar [5], was translating this part of the Talmud into French and showed it to his good friend Louis Pasteur, French chemist and microbiologist. The story is told that seeing this most unorthodox cure in the Talmud influenced Pasteur to begin his experiments that eventually led to his discovery of preventative vaccines, which have saved millions of lives [6].

Other examples of veterinary medicine in the Talmud are found in *Masechet Bechoros* (38a-b) which records that during the times of the *Beis HaMikdash* (Temple), an expert would be called to examine all the animals before they were sacrificed to ensure there were no abnormalities. Illa, an animal expert from Yavneh, was used for this and would



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charge for his services. In addition to inspecting animals to see if they were fit for sacrifice, he also charged for his expertise in animal care in general (*Bechoros* 39a). In *Bava Metziah* (38b) there is a discussion regarding the uses of objects thought to be worthless. For example, soured honey is quoted as a salve for soreness or chafing of a camel's back. In regards to *treifos*, specific abnormalities or injuries that render an animal non-kosher, Rav Ashi (4<sup>th</sup> century) would assemble all the butchers and animal experts for consultations when he had a complicated case (*Sanhedrin* 7b). There is also a reference to caesarean sections performed on animals ("one who is born from the side") and the resulting status of that animal (*Mishna Para* 2:3); hysterectomies, which are specifically mentioned in regard to any cow leaving Egypt (*Bechoros* 4:4); and obstetrics, which was reserved as "shepherds' work" and not the work of a veterinarian (*Chullin* 4:3).

A most notable example is an instance of intubation mentioned in the Talmud. R' Yose ben Nahorai performed

surgery on a ewe whose trachea had a puncture the size of an Italian *issar* (an ancient coin). He inserted the outer layer of a reed, "*keromis shel kaneh*," and the ewe survived (*Chullin* 57b). According to Eli Tratner in an article published in *The Israel Journal of the History of Medicine and Science*, this is the "first primitive kind of intubation in medical history" [7, 8].

The numerous mentions of veterinary medicine in the Talmud show the high regard Torah Judaism has for animal welfare. These examples encompass much medicine and even include scientific discoveries which predate modern science.

### Acknowledgments

I would like to thank my parents for always encouraging and supporting me. Also, Dr. Babich for his constant encouragement and advice. He truly represents *Torah U'Madda*.

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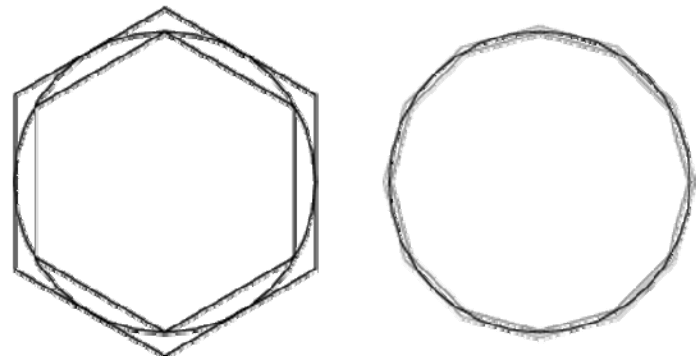
As the Torah is an all-encompassing holy work, it contains all past, present, and future histories. It is therefore not surprising that material can be found in the Torah centuries before it is “discovered.” Such is the case with pi. While there are skeptics who believe that the information found in the Torah lagged behind the knowledge of mathematicians who studied pi, others find hints within the Torah that prove an awareness to the value of pi long before mathematicians had a firm grip on its value. This latter view would give further proof of the Torah’s endless knowledge.

Shlomo *HaMelech* explains in *Kobelet* (7:29) that, "Gd has made man upright; but they have sought out many schemes." Man is programmed to think straight, but nature is not built that way. This idea is verified by the Sages of the Talmud Yerushalmi who tell us, "there are no squares in nature" (*Nedarim* 3:2). This statement is true with the exception of crystals, which have straight edges in the shape of a regular polygon. Besides for such crystals, objects in nature cannot be precisely quantified or measured. While humans try to capture nature's essence, nature can never be fully understood by man [1].

Pi ( $\pi$ ) is the Greek letter that represents the ratio between a circle's diameter (d), its length from one end to the other passing through its center, and its circumference (C), the circle's total outer perimeter. This formula is represented by  $C=\pi a$ . The area (A) of a circle is also found using the value of pi; area is equal to the radius (r) of the circle, or half of its diameter, squared, multiplied by pi. This formula is represented by  $A=\pi r^2$  [2]. And true to the plight of humans, pi helps to quantify and measure the curves of nature, attempting to make nature somewhat more understandable. However, true to the ways of nature, this task is impossible because pi has an infinite number of decimal places. Pi's value starts off with 3.14159, but cannot be quantified completely since it goes on forever [1].

Pi's history is a long and interesting one. It begins with the ancient Babylonians around the year 1900 BCE, who approximated pi's value at 3.125. The ancient Egyptians estimated its value to be 3.1605. By the third century BCE, we had a fairly precise calculation of pi, offered by Archimedes of Syracuse, one of the greatest mathematicians of the ancient world. He calculated that  $\frac{223}{71} < \pi < \frac{22}{7}$  ( $3.1408 < \pi < 3.1429$ ), based on inscribing

and circumscribing regular polygons into a circle. He was able to easily calculate the area of the two polygons, and knew that the area of the circle was a value between the areas of the two polygons (Figure 1) [2, 3].



*Figure 1. Archimedes' inscribed and circumscribed polygons allowed him to easily find the area of the inner circle.*

Over time, the approximations of pi became increasingly accurate, and in 2011, 10 trillion decimal places of pi were quantified [4].

The first mention of circular dimensions within the Torah is found during the construction of the *Bet HaMikdash*, when Shlomo *HaMelech* built "a molten sea, ten *amot* (cubits) from one brim to the other; it was round all around, and its height was five *amot*; and a line of thirty *amot* measured the circle around it" (*Melachim* I, 7:23). There is a nearly identical passage found later in Tanach, "Also he made a molten sea of ten *amot* from brim to brim, it was round, and five *amot* its height; and a line of thirty *amot* encircled it" (*Divrei HaYamim* II, 4:2). Based on these passages, one can assume that the understood ratio of diameter to circumference of a circle used during that time (around 550 BCE) was three. The problem is that by 1650 BCE, over 1000 years prior to the construction of the *Bet HaMikdash*, there was a more accurate value of pi being used. If this closer approximation of pi was being used by Shlomo and the diameter of this sea was 10 cubits, then the circumference of the sea would have been:  $C=\pi d \rightarrow 10 \text{ cubits} \times 3.14 = 31.4 \text{ cubits}$ . But the *pasuk* relates that the circumference of the sea was 30 cubits, not 31, which would have been the correct rounded value in this case.

The Talmud also presents the ratio between a circle's diameter and circumference to be three. In the Talmud Bavli (*Erwin* 14a), Rabbi Yohanan quotes the *pasuk* in

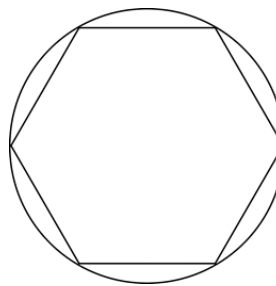
*Melachim I* to prove that the ratio is three. Rabbi Yohanan did not say that one should use the number three as pi because three is pi's exact value, but rather because three is the value given in the Torah [5]. To further validate the Torah's use of this value, the Gemara questions this *pasuk* and asks about the thickness of the brim of the pool. Rav Papa replies that the width was very thin, like a flower petal. However, the Gemara notes that even a thin width would be a fraction to be included in the measurements. The Gemara therefore concludes that the measurements were taken from the inside of the brim, and the measurement stated in the *pasuk* is the pool's inner circumference. Based on this passage, Tosafot gathers that the Sages of the Gemara took the calculation of 30 cubits to be exact; otherwise they would not have asked about the width of the brim. Tosafot concludes that this is not an accurate calculation based on actual mathematics.

This ratio of three is repeated again in the Talmud Bavli (*Baba Batra* 14b), where the rule is given that "anything which has in its circumference three *tefachim* (handbreadths) has in its diameter a *tefach*." The Talmud then discusses this rule in the case of a Torah scroll. Assuming that the circumference of a Torah scroll is 6 *tefachim*, based on the aforementioned rule, the scroll's diameter would be 2 *tefachim* ( $C = \pi d \rightarrow 6 \text{ tefachim} = 3 \times 2 \text{ tefachim}$ ). It is stated that the width inside the *Aron Kodesh*, the Holy Ark, is 2 *tefachim*. Since this is the case, the Gemara questions how such a scroll would fit into the *Aron*. The Sages give a detailed explanation of how to fold the scroll to fit it in and conclude that it would fit into the *Aron*, but with great difficulty. However, if they would have used a more accurate approximation of pi, the scroll's diameter would have been found to be less than two *tefachim* ( $6 \text{ tefachim} \div 3.14 = \sim 1.9 \text{ tefachim}$ ), and there would be no problem fitting the scroll into the *Aron*. This Gemara gives proof to skeptics who claim that the Sages of the Talmud lagged behind the mathematicians of their time in the calculation of pi [6]. Nevertheless, the Rambam, 12<sup>th</sup> century philosopher, astronomer, Torah scholar, and physician, explains how the value of three is not an error at all. Since pi is an irrational number that goes on forever, *Chazal* decided to round off the number to simplify calculations that require the use of pi. There could never be more than an approximation of the value of pi because it is endless, and thus it is simply a choice of how many decimal places one approximates.

Others suggest that there may be practical reasoning as to why the Torah uses three for pi instead of a more accurate ratio, such as 3.1. For example, a value of three instead of

a slightly higher (and more accurate) value would protect a customer from being overcharged when buying round matzah, based on complicated mathematical calculations. It is also possible that the value of three was used for everyday calculations to simplify transactions and measurements.

Rabbi Haim David Z. Margaliot, in his 1938 work *Dover Yesharim*, explains otherwise. He says that Tanach uses the ancient means of measurement to find the circumference of a circle. The circumference used to be understood as the measurement of a polygon inscribed inside of a circle. He suggests that the rabbinical use of the value three for pi is justified given this means of measuring a circumference. By using a stick the length of the radius of a given circle, they would count how many times this stick would need to go around to complete the circle (Figure 2). It took six times to go around, so the circle's circumference was six times its radius, or three times its diameter [7, 8].

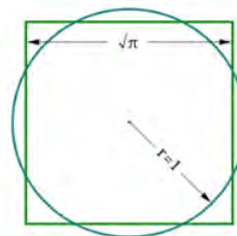


**Figure 2.**

*Hexagon in the circle made up of sides the size of the circle's radius*

The Talmud presents other cases in which the ratio of three is used for pi. Rabbi Shimon ben Tsemah (the Tashbetz), fifteenth century *posek* and student of mathematics, astronomy, philosophy, and medicine, finds evidence in one of the Talmud's discussions that the Sages may have indeed had a more precise value for pi.

The Talmud Bavli (*Sukkah* 7b-8a) gives its take on the age-old geometry problem called "squaring the circle" (Figure 3). The problem of squaring the circle attempts to find a square that has the same area as a circle. Because pi is an irrational number, there will never be an exact value for a diameter that will give a circle the same area as a certain square. In this Talmudic passage, the Sages try to find the size of a valid circular *sukkah*.

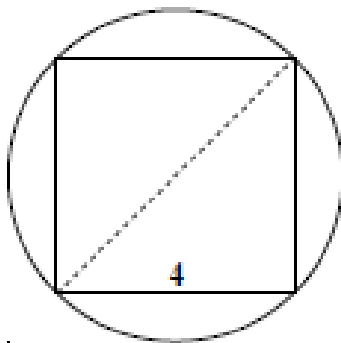


**Figure 3.**

*The ancient problem of squaring a circle*

According to Rav, a valid square *sukkah* should be a minimum of four cubits by four cubits. Based on Rav's dimensions for a square *sukkah*, Rabbi Yohanan declares that a circular *sukkah* should be large enough to fit at least twenty-four people around the circumference, assuming that each person takes up one cubit of space. Note that this does not mean that a *sukkah* is required to fit at least twenty-four people - this was just a method used to estimate circumference.

The Talmud proceeds to do the math of what minimum size a circular *sukkah* should be. After circumscribing a minimum sized square *sukkah*, it can be seen that the circular *sukkah*'s diameter is the square's diagonal (Figure 4).



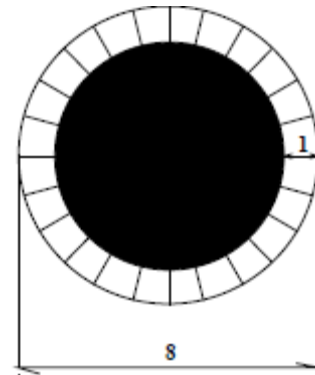
**Figure 4.**  
A minimum sized square *sukkah* circumscribed in a minimum size circular *sukkah*. The diameter of the circular *sukkah* is equal to the diagonal of the square *sukkah*.

The Talmud has a rule to calculate the length of a square's diagonal - "each handbreadth in a square is  $\frac{7}{5}$  handbreadths in its diagonal." Based on this rule, which is basically the approximation of  $\sqrt{2}$ , we find that the diagonal of such a minimum size square *sukkah* is equal to 4 cubits  $\times \frac{7}{5} = 5.6$  cubits. (This value is very close to the actual diagonal of the square found by the Pythagorean Theorem,  $4^2 + 4^2 = 32 \rightarrow \sqrt{32} = 5.66$ ). The circumference of the circle is its diameter (the diagonal) times the Talmud's value of pi  $\rightarrow 5.6 \text{ cubits} \times 3 = 16.8$  cubits. Therefore, in reality, the minimum circumference of a circular *sukkah* should be 16.8 cubits, not twenty-four.

Rav Assi, trying to give a reason for Rabbi Yohanan's value of twenty-four cubits, suggests that Rabbi Yohanan meant that twenty-four people are able to sit around the outside of the *sukkah*. The circumference of the circle that circumscribes twenty-four people would be twenty-four cubits (Figure 5). The diameter of this circle would be its circumference divided by the Talmud's pi  $\rightarrow 24 \text{ cubits} \div 3 = 8$  cubits. The diameter of the actual *sukkah* would be 8 - 2 cubits (one cubit for each person on the outside) = 6 cubits. The circumference of this *sukkah* is 6 cubits  $\times 3 = 18$  cubits. Although this value is closer to Rabbi

Yohanan's, it still does not match. This leads Rav Assi to conclude that Rabbi Yohanan was being inexact in his approximations.

However, it is known that Rabbi Yohanan was a very precise person. He was even quoted as saying (*Shabbat*, 145b), "if it is clear as day, say it; if not, do not say it." There must have been a reason for Rabbi Yohanan to give the value of twenty-four cubits, especially given the fact that using Rav Assi's calculations, it would be a sufficient sized circular *sukkah* with twenty-three people surrounding the *sukkah* (as this would give a *sukkah* with a circumference of seventeen cubits, which is much closer to the Gemara's 16.8 cubits).



**Figure 5.**  
A minimum size circular *sukkah* surrounded by twenty-four people, each taking up one cubit of space.

The Tashbetz therefore suggests that Rabbi Yohanan used more precise values of  $\pi$  and  $\sqrt{2}$ . Assuming that Rabbi Yohanan made  $\pi$  equal to  $3\frac{1}{7}$  and  $\sqrt{2}$  equal to a value a little greater than  $1\frac{2}{5}$ . The minimum circumference of the circle (taken from the circumscribed  $4 \times 4$  *sukkah*) would be 4 cubits  $\times 1\frac{2}{5} \times 3\frac{1}{7} =$  a little greater than  $17\frac{3}{5}$  cubits. The circumference of the *sukkah* would be (using the same math as before, but with more accurate numbers)  $17\frac{5}{7}$ . The difference between these two values is less than  $\frac{4}{35}$  cubits. The Tashbetz's explanation suggests that approximations are used when teaching students, but more exact values are used by the experts, such as Rabbi Yohanan, when doing calculations [7, 9, 10].

There is also an explanation by the Vilna Gaon, 18<sup>th</sup> century Talmudist, *posek*, kabbalist, and mathematician. He notices a discrepancy in the *pasuk* in *Melachim I* that first introduces the idea of pi. The *pasuk* writes out the word "kav" (meaning circumference) as *kuf, vav, beh*. The *beh* at the end of the word is not pronounced, so the word is pronounced just as a *kuf vav*. Using *gematria* to give value to the numbers, *kuf* is 100, *vav* is 6, and *beh* is 5. The value of the spelled out word is  $100+6+5=111$ . The value of the pronounced word is  $100+6=106$ . When dividing the former by the latter, we get the ratio  $111/106=1.0472$ .

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When taking the ratio between a more precise value of  $\pi$  and the *pasuk*'s value for  $\pi$  we have  $3.14159/3=1.0472$ . The Vilna Gaon does not take these matching values as a coincidence, but rather as a proof to the Torah's timelessness - it reveals a precise value of pi long before it was known to mathematicians [11].

Although there are those who see an erred value of pi when reading Tanach and the Talmud, there are many ways to see that the Torah is never faulted. It is an all encompassing work that contains all knowledge, past, present, and future.

## Acknowledgements

Thank you to Dr. Babich for your constant support, encouragement, and advice that you give to me and so many others here at SCW. To my parents for all the time and effort that you invested in me, and for making sure that I am the always reaching my potential. Thank you for your continuous belief and support of all of my endeavors. And of course, thank you to my sister Danielle (the mathematician of the family) for helping me review my paper. Last but not least, *bakarat hatov* must be expressed to the amazing co-editors of this wonderful journal. None of this would be possible without your hard work!

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When did God create the rainbow? Was it created on Day One with the light, or on Day Two with the sky, or maybe on Day Four with the sun? According to the Rabbis, (*Pirkei Avos* 5:6) the rainbow was one of ten items created in a moment known as *erev shabbos bein ha'shemashos*, Friday Eve before twilight. This time period seems to have a special status, a moment caught in the balance between day and night. Perhaps the distinction of being created during this time gives the rainbow a supernatural status, or perhaps it ascribes a natural status to the rainbow by virtue of being connected to Creation. This discussion can be found in the biblical commentators on the verses describing the rainbow shown to Noah following the Flood. Additionally, a scientific explanation of rainbows and the physics of refraction will help in understanding this discussion.

## Noah and The Flood

The first time the rainbow is mentioned in the Torah is in Genesis, in the narrative of the Flood. Upon exiting the ark after the Flood has subsided, God commands Noah to have children and to populate the world. As Rashi comments (Genesis 9:9), Noah was obviously hesitant to bring children into the world out of fear that they would sin and be destroyed in a flood. Therefore, God makes a covenant with Noah that even if mankind sins in the future, there will never again be a flood that destroys the entire earth. The symbol of this covenant was the rainbow. God tells Noah, "And it shall happen, when I place a cloud over the earth, and the rainbow will be seen in the cloud, I will remember My covenant between Me and you and every living being among all flesh, and the water shall never again become a flood to destroy all flesh." Thus the rainbow has religious significance as "an everlasting covenant between God and every living being" (Genesis 9:12-16). It seems from these verses that rainbows were only seen after the Flood and appear as a Divine message. This presents a challenge to science that will be addressed by biblical commentators.

## Scientific Explanation of Rainbows

One of the first scientists to explain the refractive property of light was Sir Isaac Newton in the seventeenth century. Newton demonstrated that when a beam of light passes through a glass prism, the light is bent and disperses into a spectrum of colors. Based on this, Newton concluded that white light is composed of all the colors in the visible spectrum [1]. Just a few years prior to Newton, Rene Descartes discussed the properties of light, mainly the mathematical properties of rainbows. The historical account of his hypothesis and experiment are recorded in Carl Boyer's book, *The Rainbow: From Myth to Mathematics*. Descartes relates his scientific observation: "Considering

that this bow appears not only in the sky, but also in the air near us, whenever there are drops of water illuminated by the sun...I readily decided that it arose only from the way in which the rays of light act on these drops and pass from them to our eyes." Based on this observation, Descartes goes on to hypothesize that "knowing that the drops are round, as has been formerly proved, and seeing that whether they are larger or smaller, the appearance of the bow is not changed in any way, I had the idea of making a very large one, so that I could examine it better" [2]. These early scientific hypotheses and the later experiments they led to have proven that while sunlight appears as white, it is actually a mixture of the entire visible spectrum. This idea of polychromatic light is the basis for the beautiful colors observed in a rainbow [1].

A rainbow can only occur under very specific conditions. When sunlight passes from one medium into another, such as from the air to a water droplet, some of the light rays are scattered. This is due to the spherical shape of a raindrop, which bends and disperses the light in a specific manner. As a result, the color components in this sunlight are refracted by different amounts [1, 2]. If this refraction happens under multiple conditions – the observer is facing away from the sun, the sun is at about a forty-two-degree angle from the horizon, and there is falling rain nearby – a rainbow can be observed in the sky [1].

A primary rainbow is the most common form of rainbow, which occurs with a red streak on the outermost portion and a blue streak closer to the center of the rainbow [2]. This ordering of colors is a direct result of the difference in wavelength. The visible spectrum of light is very small, from about 400-700 nm, with each color traveling at a different wavelength. In this narrow band of wavelengths, red light has the longest wavelength at around 700 nm, and violet has the shortest wavelength at 400 nm. As the wavelength of light increases, it becomes infrared light. On the lower end of the spectrum, as wavelength decreases, it becomes ultraviolet light. However, only the electromagnetic radiation in the visible light spectrum is detectable by the human eye [3]. Through this process, one can detect the majestic wavelengths of visible color that comprise a rainbow.

## Commentaries on the Rainbow Covenant

Even before this scientific understanding, biblical commentators debated the source of rainbows. Many commentators believed that the rainbow shown to Noah was supernatural. Rabbeinu Behaye, a thirteenth century commentator, came to this conclusion based on the wording in the verse (Genesis 9:13) in which the rainbow is described as "in the clouds," as opposed to "amongst the

clouds.” He explains that the rainbow was literally *inside* the clouds, and was therefore supernatural. Additionally, in his commentary to *Pirkei Avo*s (5:6), Rabbeinu Behaye explains that the rainbow created *bein heshemashos* was the supernatural rainbow shown to Noah, while he believes all other rainbows are natural. However, Rashi believes that not only was the rainbow shown to Noah supernatural, but every rainbow in all generations is similarly supernatural. He writes that a rainbow does not appear on every cloudy day or on every occasion that it rains, but only when the generation deserves destruction. Only then will the rainbow appear as a reminder of God’s covenant not to destroy the world. Rashi’s explanation seems to defy science and the laws of nature involved in the formation of rainbows. One possible resolution to this dilemma was presented by Rabbi Shlomo Ephraim Luntschitz, more commonly known as *Kli Yakar*. The *Kli Yakar* states that it all depends on the perceiver. While there were generations reported to not have had rainbows (see Rashi 9:13), the reality is that the natural occurrence of a rainbow most likely occurred. The difference was that a generation that did not report seeing a rainbow knew they were morally righteous and therefore did not need to look for a sign to warn them to repent. Thus, the rainbow is a self-fulfilling prophecy of sorts.

Other commentators believe that the rainbow shown to Noah was a natural phenomenon in existence since Creation. The Ramban notes the language used in the verse as proof that rainbows were in existence prior to Noah’s Flood. The verse states, “The rainbow which I have placed,” with the term “placed” in the past tense, implying that rainbows existed prior to this event. Rabbi Elie Munk, twentieth century French Rabbi and author, supports the view that the natural phenomenon behind a rainbow existed since Creation [4]. As described earlier, this natural phenomenon refers to the refraction of the sun’s rays as they change mediums to create what appears as a rainbow.

Yet other commentators argue that the rainbow shown to Noah was natural, but it was the first time a rainbow had existed on Earth. They explain that the phenomenon of a rainbow and refraction of light was not placed into nature until after the Flood. From a spiritual angle, the Lubavitcher Rebbe suggests that the world required a cleansing process of forty days, similar to the requirement of forty *se’ab* (unit of measurement) of rainwater in a *mikvah* (ritual bath), to make an environment pure enough to create a rainbow [5]. Abarbanel, a fifteenth century biblical commentator, explains from a scientific vantage point that people were able to see the rainbow only after the Flood because of changes in cosmic conditions. This Abarbanel is beautifully expounded on by HaRav Yisroel Belsky zt”l, previous Rosh Yeshiva of Torah Vodaath and senior *halachic* consultant for the OU [6].

Rav Belsky explains changes in the quality of light

following the Flood based on the Talmud in *Berachos*. The Talmud describes how when God wanted to bring the Flood, He took two stars from *Kimab* (a constellation) and brought rainwaters onto the world. When God wanted to close the gap in *Kimab* to end the Flood, He took two stars from *Ayish* (another constellation) and closed up the gap (*Berachos* 59a). Based on his vast knowledge of science and astronomy Rabbi Belsky writes that *Ayish* is the Pleiades, “a small bright cluster of stars midway between the horizon...boast[ing] a dozen bright young stars enveloped in a fluffy patch of nebula.” This cluster of stars can be understood as a scar from when God removed stars from *Ayish* to fill the gap in *Kima*. This explains a physical change in the cosmos that resulted following Noah’s Flood, and this change in cosmos altered the quality of light. Rav Belsky writes, “the intensity and quality of light in the world before the Flood was such that it was not subject to the process of refraction [and] thus rainbows could not have existed at that time.” Yet he adds that “with the removal of two stars from the firmament, the level of light was weakened, thus making light refractable” [6]. This explanation resolves certain commentaries, such as Ibn Ezra, who say the rainbow did not exist until after Noah’s flood and shows how this approach can be considered consistent with nature.

As seen through this discussion, there are varied opinions in Jewish thought regarding the origins of the rainbow. While no consensus is reached, it is apparent from the verses in *Parshas* Noah that rainbows are a reflection of God within nature. It is for this reason that Jewish law requires one to say a blessing upon sighting a rainbow and forbids one to stare at a rainbow [7]. Rabbi Munk explains that this is because a rainbow is a reflection of the Divine, which when encountered warrants hiding one’s face (such as Moses by the Burning Bush) [4]. Therefore, while a rainbow is a result of certain principles of physics, it is up to the viewer to interpret this natural event as a message from God to improve one’s ways (*Kli Yakar*, quoted above). With this deeper appreciation of nature and God’s world, one can live a more meaningful life.

## Acknowledgements

I would like to thank my parents for their continuous support and for providing me with a deep love and enthusiasm for Torah. Thank you to Dr. Babich for not only encouraging me to get involved with Derech HaTeva, but for also being a mentor to me in many ways. I would also like to thank Rabbi Dr. David Shabtai for reviewing the Torah content of this article and for his fascinating seminars on bioethics and *halacha*.

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# A Halachic Analysis of Science and DNA Profiling in Orthodox Jewish Life

By Adina Wakschlag

As history has shown us, progression in the scientific realm has led to confrontation with *halacha*, Jewish law, by a modern, technological world which did not exist in the days of the *Rishonim*, the rabbinic scholars of the 11<sup>th</sup>-15<sup>th</sup> centuries, or in the times of the Torah. It has therefore been the job of present-day *poskim*, rabbinic authorities who render Jewish legal decisions, to determine the proper Jewish responses to these challenges through insights rooted in numerous principles of the Written and Oral Law.

With the advent of DNA technology in the mid-1980s, the turn of the 21<sup>st</sup> century brought advancement and increased acceptance of one of the most groundbreaking techniques of forensic science - DNA profiling (also known as DNA typing or fingerprinting) - and a subsequent abundance of *halachic* questions. In particular, the striking tragedy of September 11, 2001 left many individuals deceased and widowed, and brought on a historic eruption of comprehensive *halachic* discussion on DNA profiling. In the aftermath of the calamity, the Orthodox Jewish community found itself in an unfortunate need of a *halachically* sound method of identification of the dead, and DNA technology played a chief role in meeting this demand.

Our discussion on the acceptability of DNA technology in Jewish law must begin with its premise - the biological nature of DNA and how it is used in profiling. DNA is an acronym for deoxyribonucleic acid, a biochemical molecule that contains regions called genes, which code for proteins that facilitate the living function of an organism. DNA also contains non-coding regions, or sequences which do not produce any proteins. It is the non-coding sequences in DNA, unique to individuals, which DNA profiling technology utilizes to identify a person. In the profiling process, the DNA of interest is compared to reference DNA samples via a variety of biochemical means, thereby positively or negatively identifying the individual whose DNA is tested. Rabbi Zalman Nechemia Goldberg, a distinguished *posek* and *rosh yeshiva* in Israel, points out that the greatness of *Hashem* is observed through the magnificent phenomenon that although all humans descend from *Adam HaRishon*, every person has a distinct DNA sequence, which allows for the success of DNA profiling [1].

DNA fingerprinting has been widely addressed in regard to the *halachic* establishment and identification of the deceased for purposes of determining the status of an *aguna* (a Jewish woman whose husband is unwilling or unable to give her a *get*, a Jewish divorce contract). DNA fingerprinting has also been used in *halacha* to determine if family

members must observe *aveilut* and if they are entitled to an inheritance claim. DNA profiling has also been the subject of deliberation in the context of verification of lineage to confirm if an individual is a *mamzer* (illegitimate child) or a *kohein* (priest). Moreover, civil and criminal jurisprudence has raised important *halachic* questions when it comes to using DNA profiling to identify the guilty. As a final area of interest, DNA typing has unfortunately been a common and useful resource in Israel, for the identification of body parts of victims of terrorist attacks, in order to be assembled for proper burial. Although we will touch upon many of these areas, this essay serves as a critical analysis of DNA profiling, focusing on the general *halachic* considerations that are relevant.

The first subject that must be explored is the extent to which *halacha* attributes authority to science as a whole.

One basic example of *halachic* acknowledgement of science is found in a Talmudic discussion about the distance required between two plants in order to ensure that they do not become *kilayim*, a *halachically* prohibited admixture. The Mishna in *Shabbat* (85a) cites scientific information which is noted in the Gemara by Rabbi Shmuel bar Nachmeini to be from the scientists of Seir. He explains that the Torah lends credence to these scientists as experts, and their professional insights dictate the *halacha* in this case [2].

Approaching science from a broader angle, some *poskim*, such as Rabbi Eliezer Waldenberg, 20<sup>th</sup> century author of the *halachic* medical work, *Tzitz Eliezer*, embrace a skeptical attitude towards science. Rabbi Waldenberg implies that at times, science backtracks and “changes its mind,” so when *halachically* questionable scenarios arise, science must be given credence appropriately reflective of this reality [1]. The *Chatam Sofer*, a leading Orthodox Rabbi in Europe in the 19<sup>th</sup> century, similarly posits that scientific or medical knowledge should be treated “as a maybe” but not as certainty. Interestingly, some of the *Chatam Sofer*’s students disagree with this view [3].

A more difficult question arises when scientific principles actually contradict statements of *Chazal*, the rabbinic scholars who codified the Oral Law. In such a case, do we heed the word of *Chazal* or that of scientists? In the context of using a blood-type paternity test in a particular child-support case, Rabbi Ben Zion Chai Uziel, Sephardic Chief Rabbi of Palestine and Israel, 1936-1953, made an extraordinary statement regarding the *halachic* permissibility of such tests whose underlying principles contradict statements made by *Chazal*. The Gemara (*Nida* 30a) states that in the creation of a fetus, the mother contributes the

red parts of the child's body and the father contributes the white. Rav Uziel holds that because the Gemara states that the father does not contribute to the creation of the child's red blood cells, we must not rely on inspection of the father's blood tissue to confirm or disconfirm a paternal relationship. He wrote, "Any scientific test is void in the face of *Chazal* because their words stem from *ruach hakodesh*" (*Sharei Uziel* II, *Shaar* 40). While Rav Uziel's position encounters opposition from some authorities (mainly the famous medieval Jewish scholar and philosopher, Rabbi Moshe ben Maimon [Rambam]) on the basis that, over time, understanding of science changes and thus *Rabbanim* of each generation have the prerogative to institute new *halachot* which reflect the scientific realities of the time [4]. Several prominent *halachic* authorities including Dayan Ehrenberg, Rabbi Shalom Messas, and Rabbi Yaakov Rosenthal share Rav Uziel's outlook [5, 6].

From a different angle, some rabbinic authorities reject the admissibility of certain scientific techniques based on the methodology of the specific techniques. Rabbi Shlomo Aviner, distinguished Rabbi and *rosh yeshiva* in Israel, suggests, based on *Aruch HaShulchan* (*Yoreh Deah* 84:36), that microscopic tests are not admissible in *halacha* since *halacha* does not consider microscopic objects significant in the framework of a larger subject, and the objects of such tests are not visible to the naked eye. For instance, one need not use a magnifying glass to determine the *kasbrut* of an *etrog* that may contain miniscule blemishes or a *sefer* Torah whose letters may be touching one another (*Teshuvot Doveiv Meisharim* 1:1). Based on this principle, Rabbi Chaim Jachter, renowned Rabbi and member of the Rabbinical Council of America, asks if it is permissible to utilize DNA profiling given the microscopic nature of DNA. Although Rabbi Jachter does not seem to conclude on the general permissibility of DNA in light of this principle, he presents an answer from Rabbi Mordechai Willig. Rabbi Willig, a respected *rosh yeshiva* of Yeshiva University, expresses that in the case of an *aguna*, in which more lenient standards of proof may be applied to prove her husband's death (a phenomenon known as "*takanot agunot*"), DNA evidence would bear *halachic* weight when it otherwise may not [7].

Similarly, Rabbi Aharon Levine, a prominent scholar and *dayan* for the Beit Din of America, explains in his *sefer*, *Arnei Cheifetz*, that the Torah does not necessitate Jews to initiate utilization of novel equipment and techniques that are not natural. While not necessarily excluding *halachic* admissibility of a scientific test once already employed, Rabbi Levine suggests that scientific developments in general are not required by *halacha* since they transcend human capability [1]. This ruling has direct implications on the use of DNA fingerprinting, and in particular serves as a counterargument to the view that a suspected case of *mamzeirut* must be determined if the process is not inconvenient (see Rabbi Hershel Schachter's position on this below).

The other side of the science vs. *halacha* debate, noted earlier as the position of Rambam, is marked by a progressive attitude towards reevaluating the body of *halacha* which governs the ever-changing realm of science. This approach implies that, given the permissibility of applying *halacha* based on logic, *poskim* may expand the application of *halacha* into new areas, including the scientific realm [3].

As mentioned previously, Rambam is a proponent of the progressive viewpoint, in disagreement with Rav Uziel's position regarding contradictions between science and *Chazal*. Most present-day authorities, including Rabbi Hershel Schachter, starkly endorse modern science as an acceptable springboard for making *halachic* conclusions. Correspondingly, Ashkenazi Chief Rabbi of Palestine and Israel, Rabbi Isaac Herzog, famously wrote, "Things which are well known do not need proof. It is too bad that while science is progressing and conquering worlds and revealing the deepest secrets... we stick our heads in the sand..." [8]. Rabbi Herzog seems to imply that our perception of *halacha* and tradition need not rule out scientific developments which conflict with conclusions of old that were founded upon scientific principles that no longer prove correct.

Moving along with the popular view that scientific principles in general are to be integrated into Jewish law, scientific evidence should accordingly be valid in support of determining *piskei halacha*. However, not all scientific evidence can be used in all circumstances. One critical aspect of the evidence which determines its admissibility in the process of making a *halachic* decision is, of course, the accuracy of the evidence. In Jewish law, determinations generally must be made with as much accuracy as possible; a person cannot be condemned to capital punishment if there is even the slightest possibility that he is not the murderer (*Rambam Sefer Hamitzvot*, Negative Commandment #290), and identification of persons or items for other legal circumstances requires trustworthy *simanim* (identifying marks) in the absence of witnesses. This essay addresses the underlying issues of whether a DNA profile qualifies as satisfactory evidence; specifically, to what extent and in which circumstances evidence must be certain.

Renowned 20<sup>th</sup> century *posek* and *rosh yeshiva* in Israel, Rabbi Shlomo Zalman Aurbach, states that *halacha* can accept DNA testing if it is established in society and proven reliable [1]. (The general consensus on DNA typing in the American legal world is that it is reliable, and most experts around the world agree [9].) Regarding the extent to which DNA profiling is recognized as credible by *halacha*, Rabbi Shmuel Vosner's *beit din* in *Bnei Brak* stated that although "statistically [DNA profiling] constitutes absolute verification, nevertheless, from the *halachic* perspective [it cannot reflect] absolute certainty" [10].

Specifically in regard to an *aguna*, Rav Yosef Shalom Elyashav, well-known *posek* in Jerusalem until his passing in 2012, is quoted as saying that DNA testing can be relied upon to establish the death of an *aguna's* husband just as fingerprinting and dental x-rays (*i.e.* other types of evidence) are considered valid [1]. Additionally, Rabbi Goldberg deemed DNA testing completely reliable on two conditions. First, the husband's tissue sample must be large enough to prove that he actually died and did not simply scratch the sampled spot with his finger. Second, the sample must be compared with the man's own DNA from an independent, known source. This is scientifically more reliable than performing the comparison on a relative's DNA sample, which will contain differences in DNA sequence. Similarly, Rabbi Vosner's *beit din* interprets DNA evidence in the case of an *aguna* as a *siman beinoni*, an identifying mark possessing an intermediate degree of *halachic* credibility, when the subject's DNA is compared to that of a relative, and a *siman muvhak*, an identifying mark possessing nearly the highest degree of *halachic* credibility, when compared to his own DNA from a different source [10].

The Mishna in *Yevamot* 120 states that recognition of the forehead and nose of a corpse confirms the death of a husband. Rabbeinu Tam adds that identification of bodily features (*simanim*) is acceptable as well if *tevi'ut ayin*, overall recognition of the body, is apparent (*Sefer Hayashar* #92). Interestingly, Rabbi Goldberg posits that DNA evidence is even stronger than a *siman*, which is a secondary means of corpse identification in the case of an *aguna*. Rabbi Goldberg compares identification of a person by his DNA to the identification of a person by his face, which is noted in the Mishna mentioned above as the ideal method for recognition of a husband's corpse [11].

In contrast, some interpret a statement by Rambam in *Nachalot* 7:3 as maintaining that even *simanim muvhakim* are not admissible when identifying a deceased husband in the case of an *aguna* [12]. (This would not be surprising given Rambam's firm advocacy for admission of nothing less than 100% certain evidence in a typical court case.) The rejection of *simanim muvhakim* based off of this interpretation of Rambam would rule out admissibility of DNA evidence. (However, commentaries on Rambam such as the *Kesef Mishna* [*Gerushin* 13:21] disagree and posit that Rambam in this context was not actually referring to *simanim muvhakim*.)

Most other authorities accept evidence that is less than 100% certain to prove a husband's death and free the *aguna*, since *Chazal* tried to be lenient on *agunot* ("takanot *agunot*"). Thus, some argue that even if a DNA profile is not considered a *siman muvhak*, it may still be admissible for the case of an *aguna* when presented with other supporting factors [13]. On the same note, Rabbi Willig maintains that because the requirement of evidence to free an *aguna* is dictated by more lenient standards, DNA

evidence is valid and should be permitted in such a scenario [7].

According to those who consider DNA a *siman muvhak*, what renders it so? Rabbi Eliyahu Mizrachi, Talmudic scholar and *posek* in the 15<sup>th</sup> and 16<sup>th</sup> centuries, asserts in *Shu"t Ree"m* 37 that a *siman muvhak* is an identification mark that is objectively unique to one particular person only [14]. However, since it is impractical to check every individual in the world to ensure a particular *siman* is completely unique, Rabbi Binyamin Aaron Selnick, a late-16<sup>th</sup> century Jewish scholar, in his work, *Mas'at Binyamin* 63, quotes an assertion by Rabbeinu Yerucham that the distinctiveness of even a *siman muvhak beyoter* (a *siman* that is more distinctive than a *siman muvhak*) need only be "zur umuflag barbe" (very distinctive), appearing in one in 1,000 or 2,000 subjects. Therefore, in a situation in which a DNA analyst determines that a particular DNA match excludes 99.9% (and better yet, 99.95%) of the population, the DNA sample may be considered a *siman muvhak beyoter* [13]. Conveniently, the majority of DNA profiles encompass a much higher statistical value of distinction than 99.95%.

Where do the statistics of DNA profiling come from? Population genetics is employed; the allelic frequencies (measure of uniqueness of certain DNA sequences) of each locus (specific segment of the DNA sequence) in a profile of interest are estimated based on comparison to these loci in other profiles from only a sample of the population [15]. Even though these statistics do not reflect the comparison of a particular profile to every single other profile in the world, Rabbi Goldberg nevertheless renders this point inconsequential because the Torah only requires our judgement to be based upon our limited network of human contacts. For this reason, we can rely on a DNA test [2].

It is worthwhile to note that a DNA non-match (termed an "exclusion") in a case only requiring an exclusion (for example, a man protesting a child support case, claiming he is not the father) should theoretically be acceptable as the strongest of *simanim* because a non-match indicates more distinctiveness than any positive match. One secular source [16] explains this phenomenon as follows:

[A] "match" resulting from DNA typing represents only a statistical likelihood. Thus, the results of DNA typing are not considered absolute proof of identity. A DNA non-match is considered conclusive, however, because any variation in DNA structure means that the DNA samples have been drawn from different sources.

This principle emphasizes the greater accuracy of a non-match over a match, perhaps lending a DNA non-match a superior measure of *halachic* acceptability.

On this subject, in cases like the paternity example mentioned above, many authorities advocate that DNA

paternity/maternity testing not be taken further than determining a non-match, since establishment of an actual parent may indicate that a child (whose DNA is compared to that of a particular man or woman) is a *mamzer*, and rabbinic authorities generally endorse a more lenient/avoidant approach when it comes to determining if a potentially illegitimate child is actually a *mamzer*. (This is based on the Gemara in *Kiddushin* 71a as well as several *Rishonim*. See the relevant discussion in [5].) In fact, Rav Elyashav is one of several *poskim* who oppose the use of DNA profiling altogether to confirm a *mamzer's* status [1].

Interestingly, however, Rabbi Hershel Schachter, a well-known *rosh yeshiva* at Yeshiva University, citing the *Shulchan Aruch* (*Yoreh Deah*, *Siman* 98), implicates that if a DNA test is convenient to acquire, then ascertaining through such testing whether a potential *mamzer* is in fact a *mamzer* would actually be required [3]. In a similar fashion, Rabbi Moshe Feinstein, famous 20<sup>th</sup> century scholar and *posek*, writes in regard to DNA testing for genetic diseases, that because nowadays “this testing can be easily done, we have to conclude that if one does not test oneself it is akin to closing one’s eyes so as not to see that which can be seen” (*Iggerot Moshe*, Even HaEzer IV, 10). This statement cannot necessarily be applied to *mamzeirut* or any circumstance other than genetic testing, since Rav Moshe might rule differently if asked about these other circumstances. At minimum, however, Rav Moshe’s statement underscores the general position mentioned earlier, described by Chief Rabbi I. Herzog, which endorses utilization of today’s advanced scientific technology.

Aside for the debatable external limitations on DNA testing, there are several internal *halachic* concerns which could possibly discourage use of DNA profiling. One is the possibility of laboratory error (such as a mix-up of DNA samples); *poskim* who ascribe acceptability to DNA evidence evidently do not consider this concern overridingly significant. Another concern which pertains to the case of an *aguma* in particular is the theoretical possibility of a DNA analyst compromising the results of a profiling test. Out of sympathy for the woman, an analyst may falsely declare that the DNA sample from an unidentified corpse does in fact belong to the woman’s husband in order to enable her to remarry in the future. However, a few factors annul this potential problem. One factor, a *halachic* concept termed “*uman lo marei anafsbei*,” is that we need not be concerned that the analyst will compromise the profiling results since professional misconduct with the risk of losing one’s job is highly unlikely, especially with regard to a matter that does not *personally* concern the professional. A second factor that outweighs potential concern for falsified results is the presence of other circumstantial evidence which suggests the husband’s death; the “non-absolute” DNA analysis can possibly be strung together with other evidence to present a valid *halachic* case [2, 14].

Regarding criminalistics, DNA as a *siman* in the context of forensic evidence is an important topic. Other than an interesting approach of the Ribash on circumstantial evidence, use of DNA profiling towards a capital case would generally be regarded as insufficient to convict due to the nature of capital punishment. The same applies even to civil and less offensive criminal cases. Rabbi Wosner’s *beit din* maintained that criminal convictions must only be carried out based on the testimony of two witnesses, which the Torah says straight out (*Dvarim* 19:15) [10].

In regard to civil jurisprudence, the mainstream approach as endorsed by Rambam is that, rather than *simanim*, two witnesses are required (*Rambam Sefer Hamitzvot*, Negative Commandment #288). In fact, in regard to a civil monetary case, *Tosafot* in *Chulin* 96a seem to take for granted that even if witnesses testify that a person with certain *simanim* which appear on the defendant borrowed money from the plaintiff, this testimony is still insufficient for a verdict in the plaintiff’s (the lender’s) favor [6]. This *Tosafot* would seemingly imply that *simanim* are inadequate evidence in a civil case.

Regarding capital jurisprudence, practical rabbinic discussion on this topic is minimal since *batei din* today do not practice it. Among the limited discussion, Rambam very strongly posits that capital punishment be carried out based on no less than 100% certainty of a crime and its perpetrator. Rambam writes, “We are forbidden to punish one on the basis of strong or even virtually conclusive evidence. Thus, if A pursues B with intent to kill[,] and B takes refuge in a house into which the pursuer follows, and we enter after them and find B in his last gasp and his pursuing enemy, A, standing over him with a knife in his hand, [and] both of them are covered in blood, the Sanhedrin may not find A liable to capital punishment, since there are no eye witnesses to the actual murder” [17]. Rambam’s example parallels the Talmudic story (*Sanhedrin* 37b) about Rabbi Shimon ben Shetach, who accused a person of a murder. Rabbi Shimon almost witnessed the murder, but he was *halachically* unable to pronounce the suspect a murderer because of this very principal mentioned by Rambam. Therefore, according to Rambam, DNA evidence without actual witnesses cannot convict a suspect of murder.

While most authorities require two witnesses in capital jurisprudence, there is a controversial approach based on *Tosafot* in *Shvuot* 34a which a few *poskim* take, to allow a capital judgement to be based upon indirect, although completely irrefutable, circumstantial evidence [6]. Among others, Rambam opposes this possibility in the interest of saving lives; his viewpoint is explained as follows [17]:

The fear is that if circumstantial evidence is accepted as sufficient, we might go too far, to the point where “we would be punishing and executing people on the basis of a judge’s speculative evaluation of evidence.” It is,

therefore, preferable to insist on direct evidence, even if, as a consequence, we may free a guilty person, for it is “better... that a thousand guilty persons go free than that a single innocent person be put to death” (*Rambam Sefer Hamitzvot*, Negative Commandment #290).

In any case, forensic DNA evidence would probably not qualify as completely irrefutable evidence since a DNA profiling match only constitutes a probability.

Interestingly, 14<sup>th</sup> century Talmudic scholar, Rabbi Isaac Bar Sheshet (Ribash), allows circumstantial evidence on the grounds that Jewish courts have an extrajudicial prerogative to punish suspected wrongdoers, even murderers, as a cautionary demonstration for the public. In a capital case, Ribash indicates that when the case lacks solid proof, yet “there is no doubt as to the circumstances of the victim’s death, a conviction may be based on circumstantial evidence that provides ‘convincing proofs and valid grounds’” (Resp. Ribash #251) [17]. The latter aspect of Ribash’s ruling is consistent with the ruling in the *Shulchan Aruch* (*Yoreh Deah* 17:30) that if one sees a person jump into a *keivshan ha’eish*, he can assume the individual died, even if he did not see the person physically expire. Similarly, the *Shulchan Aruch* continues, for any case of this nature in which it is impossible for an individual to survive but will definitely die within a short amount of time, we may testify that he has died [18]. Relating back to circumstantial evidence, Ribash’s position would seemingly apply to our discussion, possibly indicating that a DNA match can attribute criminal activity (even murder) to a suspect, so long as independent of the DNA evidence there is “no doubt as to the circumstances of the victim’s death” (which probably implies the necessity of a strong, independent

belief that the particular suspect actually committed the crime).

Regarding other relevant miscellaneous matters, Rabbi Wosner’s court ruled that DNA evidence for *avielut*, burial of dispersed body parts, and claims of inheritance is generally acceptable, with a few caveats.

Science is extremely important, and its application to Torah is endless. DNA alone is an infinite area of study, due to its sophisticated nature and broad applicability. These factors reflect the incredibly intricate organization of the most microscopic elements of G-d’s Creation. This idea is expressed in a creative adaptation from *Tebillim*: “DNA proclaims the handiwork of the Creator” [19]. As scientific findings and DNA technology in particular progress, new factors and questions on DNA evidence will surely emerge and elongate this discussion. May we continue to discover and explore G-d’s beautiful world through science, one molecule at a time.

## Acknowledgements

I would like to thank Dr. Babich for his constant support and encouragement, and for the many sources he provided me with to get started on this paper. I would like to thank Rabbi Yitzhak Grossman of The Greater Washington Community Kollel for all his time and effort in reviewing drafts of this paper and providing me with further insights and sources. I would also like to thank my parents for their support and encouragement, and particularly my father for the sources he shared with me for this composition.

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During the time of the Second *Beit Hamikdash* many sacrifices and rituals took place on a daily basis. Jewish priests (*kohanim*) played a big role in these procedures, supervising the sacrifices of different types of cattle or birds, and consuming parts of the animals for food. Although it was an honor to serve in the Temple, two factors caused digestive ailments. First, as a result of continuously eating burned or, perhaps, ill-properly handled meats, many priests developed gastrointestinal illnesses and needed medical treatment. Second, in addition to the large amount of meat ingested, the manner and time frame in which it was consumed manifested as certain diseases. For instance, the priests were required to boil or roast the meat on the same day the sacrifice was completed, and precisely in the Temple courtyard. These constraints often led to difficulties in the digestion of the food.

The Talmud elaborates on the reason as to why these intestinal issues arose so severely. Due to the harsh working conditions of their job, the *kohanim's* immune systems were weakened. The priests were not permitted to wear footwear while in the Temple area, causing cold feet from walking on the stone floor. The 12<sup>th</sup> century rabbi and physician, Maimonides, adds that only four garments were worn by the priests during a ritual service, of which only the light coat provided them some warmth and protection, and thus, their systems were weak and their organs suffered [1].

In response to these issues, during the Second Temple, *Ben Achiya*, a special official, was put in charge of treating these health cases experienced by the priests. He was adept at herbal medicine and the health benefits that some wines provided to the digestive tract. The Talmud (*Berachoth* 51a) suggests that aged wine is beneficial for the bowels, as opposed to fresh wine which causes intestinal difficulties [1, 4]. A plausible reason for the positive effects provided by aged wine is its ethanol content, which is low enough dosage to stimulate gastric secretions. Fresh wine, however, can inhibit these secretions and even irritate the gastric mucosa. Additionally, the purple pigments, or anthocyanins, in wine have antiseptic activity towards pathogenic microorganisms, which is why wine is commonly used to treat infections. Although consumption of such wines would have aided the digestive processes, the priests were forbidden to drink wine on Temple grounds during their Temple worship, *Avodah* (*Vayikera* 10:9). Thus, while performing their duties, their only beverage was water [1, 2]. Therefore, *Ben Achiya* must have treated these men at a location outside the Temple [1, 3, 4].

The natural question bothering many sources is why eating the meat would cause digestive harm and suffering if the priests were following the commandments and performing

*mitzvos*. This seems to contradict the verse in *Kobeles* (8:5) which states, “*Shomer Mitzvah Lo Yeda Davar Ra*”-- “He who performs a *mitzvah* will know no harm.” The *Kuntras Divrei Torah* explains that perhaps the meat from the *Korbanot* only caused pain and illness when the priests did not eat it with pure intentions. Similarly, the Talmud (*Pesachim* 8b) implies that when one does a *mitzvah* for his own personal benefit and intention, the protection principle does not apply [2].

Although the *Talmud* clarifies this case, it does not specify the gastrointestinal ailments these men suffered. Current medical research indicates that ingestion of undercooked meat can lead to infectious diarrhea, caused by *Campylobacter enteritis*, and shigellosis. *C. enteritis* is a bacterial pathogen known to cause diarrhea and to be associated with meat, often proving to be an infectious agent in digestive illnesses. A study in Tanzania by Komba *et al.* reviewed research articles on the mechanism through which these bacterial pathogens cause diarrhea [5]. Although the research is still in its early stages, it is known that bacterial pathogens are the leading causes of enteritis in developing and newly developed countries. Interestingly, the bacteria grow in various animals without harming their hosts, yet humans are infected through direct contact with the animal host or consumption of the contaminated meat. These infections have a stronger link to meat that is raw, undercooked, or barbecued [5, 7].

The Center for Disease Control and Prevention explains that *campylobacteriosis* manifest as diarrhea, cramping, abdominal pain, and fever after exposure to the bacterium. In individuals with a weakened immune system, such as the priests, *Campylobacter* can migrate to the bloodstream and cause serious life-threatening infections. This organism is isolated more commonly in men than in women. The bacterial species that often causes *campylobacteriosis* in humans is *Campylobacter jejuni*, spiral-shaped bacterium that grows best at 37°C to 42°C, the body temperature of birds. Birds often carry the disease without themselves becoming ill. It is no wonder that the priests during the Second Temple could have been sick with this type of infection. With their weakened immune system and direct exposure to and consumption of large quantities of birds and cattle, the priests could have easily been infected and may have developed severe illnesses [6].

The prescribed remedy for treating *choli me'ayim* (*Sotah* 42b), intestinal illness, which include diarrhea with fever, is drinking a lot of water, specifically “one cupful per loaf of bread or other food,” rubbing the abdomen with oil and wine, and applying warm towels to the abdomen. For internal medications, the Talmud prescribes 70 year old apple wine, very old grape juice, fresh chamomile cooked in water as an astringent, and dried chamomile for a

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purgative purpose. The Talmud (*Sotah* 39a) also suggests paying close attention to the food eaten. For example, leek is good for the intestines and should be swallowed, and a broth of mangold is good for the stomach and intestines. The same benefits are found in cabbage sprouts wine, and one glass of it should be taken early in the morning on an empty stomach [3].

In retrospect, the fact that the Talmud was able to provide explanations, as well as treatments, to these types of diseases is itself a miracle from G-d. As we know nowadays, digestive illnesses are among the hardest to identify and treat. Scholars of that time had no way of

seeing inside the digestive tract to know what the cause of the pain was. The knowledge they possessed to cure these ailments allowed the priests to serve G-d and the entire community better. Perhaps the phrase from *Kobeles* is correct; doing good deeds commanded to us by G-d can serve as a protection against suffering.

### Acknowledgments

I would like to thank Dr. Babich for his help with this article as well as my parents and twin sister for supporting my education and for the endless guidance in my life.

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# Ancient pathologies with current medical diagnoses: “There is nothing new under the sun” (Koheles 1:9)

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In *Ta’Nach*, only brief mention is made of ailments and pathologies experienced by various personalities, without providing an in-depth description of the underlying etiologies of such health issues. *Ta’Nach* is not a medical textbook and the lack of such descriptors of health issues is therefore appropriate. However, it is interesting to delve into such pathologies using current medical terminology and understanding. This article focuses on cardiovascular health issues, sugar-related diseases, and cancers that possibly were experienced by individuals noted in *Chumash*, *Nevi’im*, and the Talmud. The original text, as interpreted by commentators, provides some insight into the health ailment, allowing for the formulation of an educated guess as to the specific ailment and pathology. Obviously, medical analyses of ancient pathologies cannot draw upon current biomedical technology, e.g., radiology, electrocardiograms, MRIs, CAT scans, blood and urine chemistry, or clinical specimens [1].

## I. Heart disease

The unexpected death of Sarah may have been caused by the sudden stoppage of her heartbeat. The *parsha* of the *Akeida* (Bereshis 22) is physically close to the *parsha* of Sarah’s death (Bereshis 23) and, as there are no coincidences in the Torah, Rashi (Bereshis 23:2) connected these two events, with the *Akeida* being the trigger for the demise of Sarah. Although there are many versions as to how Sarah was informed of the *Akeida* (see: Bereshis Rabbah 58:5; Me’Am Lo’ez; Tanchuma), the simplest version is that a messenger informed her that Avraham had taken Yitzchak to the mountain, bound him, and prepared an alter upon which to sacrifice him. Upon hearing the unraveling of these events, Sarah became confused, not allowing the messenger to finish the story and to relate that Yitzchak was not sacrificed. The sudden shock of hearing that Yitzchak was to be slaughtered caused Sarah’s soul to fly from her body, and she died (Sifsei Chachamim, Bereshis 23:2). Rabbi Chaim Shmulevitz [2] suggested that the sudden shock of learning that Avraham presumably slaughtered Yitzchak caused Sarah’s heart to stop beating, possibly referring to the cardiopathology termed a sudden cardiac death (SCD). This cardiac pathology encompasses many unexpected natural deaths, with or without warning symptoms, occurring in persons without known non-cardiac fatal conditions. Among the factors that trigger SCD are emotionally charged experiences, with a correlation noted between the recent loss of a family

member and an enhanced risk of SCD [3-7].

Sarah died at the age of 127 years, and SCD is more common in elderly women in the general population. On March 11, 2011, northeast Japan experienced an earthquake and a tsunami, causing loss of life, massive destruction, and dislocation of populations. Physical and emotional stressors, such as distress and anxiety, experienced by the affected populations led to a doubling of the incidence of SCD, with the more pronounced increase among elderly women [8].

Avraham, however, was not adversely affected when commanded by *HaShem* concerning Yitzchak and the *Akeida*. Rabbi Shmulevitz [2] suggested the reason was that *HaShem* gradually approached the subject of the *Akeida* with Avraham, rather than suddenly shocking him as happened with Sarah. The flow of words was as follows (*Bereishis* 22:2): *HaShem* said to Avraham, “Please take your son, your only son;” Avraham responded that he had two sons. *HaShem* continued, the son “who you love;” Avraham responded that he loved both his sons. Finally, *HaShem* specified, “Yitzchak.” Rashi explained that *HaShem* gradually related this message to Avraham so as not to confuse or disorient him. With Sarah the opposite occurred and, quite possibly, it was the unexpected shock of hearing about the *Akeida* that caused Sarah’s demise as a result of SCD.

Medically, SCD is the sudden, unexpected death caused by the loss of heart beating, resulting in no blood flow to the brain and to other vital organs. In the United States, SCD is responsible for half of all heart disease deaths and is the largest cause of natural death, resulting in about 325,000 adult deaths each year. SCD is not a heart attack (a myocardial infarction), but can occur during a heart attack. Heart attacks occur from blockage in one or more of the coronary arteries leading to the heart, preventing the heart from receiving sufficient oxygenated blood. If oxygen in the blood cannot reach the heart muscle, the tissue dies. In contrast, SCD occurs with malfunction of the electrical system to the heart, causing irregular heartbeats, perhaps beating too fast or too slow. The ventricles may flutter (ventricular fibrillation) and blood will not be delivered efficiently throughout the body. Within the first few minutes, the blood flow to the brain is reduced so that a person loses consciousness and faints. Death follows, unless emergency treatment is begun immediately [9].

The hardened heart of Pharaoh is mentioned three times in



*Parshas Va'iera*, each time with a different adjective. In *Shemos* 7:3, "*kasheh*" was used and may refer to Pharaoh's heart remaining unimpressed by *HaShem's* actions; in *Shemos* 7:13 the word "*chazak*" was used and may imply that Pharaoh consciously opposed submission to the will of *HaShem*, and in *Shemos* 7:14 Pharaoh's heart was described as "*kaved*," perhaps suggesting that although Pharaoh was impressed by *HaShem's* miraculous plagues, he delayed a positive, submissive response. Dr. L. Hoenig [10], citing Me'Am Lo'ez, noted that the term "*kaved*" is used in conjunction with the liver, the only organ that when roasted over a fire becomes tougher and harder. He speculated, perhaps tongue-in-cheek, that this is a subtle reference to an actual pathology and perhaps Pharaoh suffered from hardening of the coronary arteries. In support of this theory, Hoenig cited studies by Magee [11] of 3,000 year old mummified human remains that showed signs of arterial disease. While intriguing, this does not explain why the hardening of the heart caused Pharaoh to refuse to send the Jewish people. As can be noted in the text (*Shemos* 7:14), *HaShem* told Moshe, "Pharaoh's heart is heavy, he refuses to send the people," implying a direct correlation between the two phenomena. Thus it is most likely that the term "heart" is used in the Torah to describe the mind and a psychological stubbornness, rather than a specific cardiovascular ailment.

Cardiac arrhythmia is the condition in which the electrical impulses to the heart that coordinate the heartbeat function improperly and cause the heart to beat too fast or too slow. This abnormality may be hinted in *parshas Vayigash* (Bereishis 45:23-27) regarding the incident when the brothers related to their father, Yaakov, that Yosef - who was presumed dead for the past 22 years - was still alive and, more so, was ruler over the entire land of Egypt. The brothers realized that suddenly announcing this unexpected good news to Yaakov may be detrimental to his health. Thus, Serah, the daughter of Asher and an expert harpist, was recruited to sit before Yaakov, play the harp, and sing the following, "Yosef, my uncle, is still alive. He rules the whole of Egypt, for he did not die" (Sefer HaYashar cited by Munk [12]). However, this plan was not entirely effective. Some commentators suggest that upon hearing that Yosef was still alive, Yaakov experienced cardiac arrhythmia and fainted [13]. Rashbam postulated that Yaakov missed a heartbeat. S'forno noted that upon hearing the mention of Yosef, Yaakov's pulse rate dropped and his heartbeat slowed, causing him to faint. Ibn Ezra, Rabbeinu Bachya, and Ramban opined that Yaakov's heart stopped beating briefly, causing him to faint. The Ramban, who was a physician, noted that the frail and elderly cannot tolerate sudden joy and that many of them faint when happiness, unexpectedly and suddenly, comes to them. Only later, when the brothers related to Yaakov all the words that Yosef had spoken to them and that he saw the wagons that Yosef sent to transport him, did Yaakov revive.

A similar incident, related in Talmud Kesubos (62b), concerned Rabbi Chanina ben Chachinai who studied in an out-of-town yeshiva and was absent from his family for 12 years. When he returned suddenly and his wife saw him standing in the doorway, her heart gave such a "leap" that she died from the shock (Rashi). Her husband, stunned that this should be her reward for allowing him 12 years of unhindered Torah study, prayed for her revival and she was restored to life.

The events surrounding the capturing of the Ark of the Covenant, containing the Tablets, is the setting of Chapter 4 of I Samuel. The P'lishtim and Israel, led by King Shaul, are about to enter battle, even though the prophet, Shmuel, foretold of Israel's defeat. In the initial encounter, the P'lishtim were victorious, killing 4,000 Jewish soldiers. Eli HaKohen's sons, Chafni and Pinchus, decided to battle again, but this time, the Ark of the Covenant would lead the Jewish soldiers in battle. The ensuing battle was disastrous, with the Ark captured and Eli's two sons, along with 30,000 Jewish infantrymen, killed. King Shaul escaped and ran to Shiloh to tell Eli HaKohen of the events. "When he (King Shaul) came, Eli was seated in a chair next to the road, looking out, for his heart was pounding (according to Radak; Me'Am Loez) about (the fate of) the Ark of God" (verse 13). Upon being informed that the Ark was captured, Eli (verse 16) "fell backwards off his chair, opposite the site of the city gate, breaking his neck (*i.e.*, one of the cervical vertebrae); he died, for the man was old and heavy, he had judged Israel for 40 years." Mezudath David explained "heavy" as slow in motion, either because of his age or because he was heavy in weight. From verse 13 and 16 we learn that Eli was a prime candidate for a heart attack - his heart was racing, he was very old (98 years of age), overweight, and stressed over the events of the war. Perhaps, Eli did experience a heart attack and when he arose from his chair, he lost balance, fell backwards, and severed his cervical vertebrae - causing his death.

Heart palpitations are feelings of a pounding or racing heart caused by, among other factors, anxiety, stress, panic, fear, and depression, and they differ from cardiac arrhythmias which are experienced as sensations of an abnormal heart rhythm [14]. Both Dovid and Shaul may have experienced heart palpitations. Chapter 24 of I Samuel commences with the death of the prophet Shmuel, followed by King Shaul's defense of the land against the P'lishtim. Upon finishing with the P'lishtim, Shaul resumed his pursuit of Dovid. Told that Dovid was in the Wilderness of En-gedi, Shaul traveled with 3,000 troops to that rocky area in search of Dovid. A cave was noted and Shaul entered to relieve himself. Seeing that the entrance to the cave was covered by an unbroken spider web, Shaul felt secure to enter by himself. However, he was unaware that Dovid and his troops were hidden deep within the cave. Seeing this as an ideal opportunity, Dovid's troops

encouraged him to kill Shaul. Dovid declined, but instead stealthily approached and cut off a corner of Shaul's robe. Verse 6, translated according to the Mezudath David is as follows: "And it was afterwards, Dovid's heart was pounding in his chest, for he had severed Shaul's robe." Apparently, Dovid experienced heart palpitations that began only after cutting the robe of Shaul. What emotional stress triggered Dovid's heart pounding? Perhaps, it was depression. "Rabbi Nechemyah said: This is why Dovid's heart began pounding, for he had denied Shaul the *mitzvah* of *tzitzit*," which was not applicable if one corner of a four-cornered garment was missing (Me'Am Lo'ez, I Samuel).

In a later incident, Shaul also may have experienced heart palpitations. I Samuel 28 described Shaul's final battle against the P'lishtim. "And Shaul saw the camp of the P'lishtim. And he feared and his heart trembled greatly" (28:5). Heart trembling could refer to heart palpitations brought about by the strong emotion of distress. Shaul, seeing that his army was greatly outnumbered by the army of the P'lishtim (Mezudath David), lost confidence. To add to his anxiety, Shaul understood that *HaShem* was not with him because he sinned regarding the complete destruction of Amalek, for which he was chastised by Shmuel, who recently died. Shmuel's death left Shaul as a broken and frightened man (Abarbenel). The loss of his mentor Shmuel, the impending battle with the P'lishtim, and *HaShem*'s disassociation with him were psychological factors that could trigger heart palpitations.

The death of the prophet Shmuel was also noted previously in chapter 25 of I Samuel. While all of Israel were mourning over the loss of Shmuel, Nabal, a wealthy man of low character, was celebrating his sheep shearing. Apparently, the following incident between Dovid, Nabal, and Nabal's wife, Avigayil, occurred shortly before Rosh HaShannah. Dovid and his soldiers, hiding from Shaul and his army, were in need of food and drink, especially as the holiday was approaching. Dovid assigned 10 soldiers to go to Nabal's festive party and to request provisions. Dovid was not asking for a free handout, but rather for payment, as his soldiers protected Nabal's sheep from attack by wild beasts. Nabal's refusal to provide provisions was told to Dovid, who then mobilized his troops to attack Nabal. A youth within Nabal's camp relayed these events to Avigayil, who, without informing her husband, quickly brought loaves of bread, wine, sheep for slaughtering, flour, roasted grain, raisins, and figs to Dovid and his army. These provisions placated Dovid, and the attack against Nabal was canceled. The next morning Avigayil informed Nabal of her actions and "his heart died within him and he became like a stone" (I Samuel 25:37). Several commentators noted that Nabal was paralyzed and lifeless, resulting from the shock of learning of his loss of the provisions given to Dovid. "And it was just ten days later (*i.e.*, on Yom Kippur) that *HaShem* inflicted a stroke on Nabal and he died" (I Samuel 25:38). Apparently, during

these ten days (*i.e.*, the Ten Days of Repentance) Nabal was semi-conscious, awake enough to potentially do *teshuvah*; it was his lack of repentance that led to the death sentence on Yom Kippur. Dr. Moshe Steier [15] suggested that Nabal suffered a myocardial infarction (*i.e.*, a heart attack) on Rosh HaShannah, followed by 10 days of tension and anxiety which induced a second and fatal heart attack on Yom Kippur. A heart attack occurs when there is a blockage of the coronary arteries, perhaps caused by a blood clot or by the accumulation of fatty deposits. Such blockage, if not quickly resolved, can cause sections of heart muscle to die.

Chest pain, termed angina pectoris, occurs when the heart muscle does not receive sufficient oxygen due to the narrowing or blockage of the coronary arteries. It is usually precipitated when the heart muscle needs more oxygen than it is receiving, for example, during physical exertion, such as walking, running, exercising, *etc.* [16]. Angina pectoris may explain the following passage in Talmud Shabbos (11a): "And Rava bar Mechasya said in the name of Rav Chama bar Gurya who said in the name of Rav, [I can tolerate] any sickness, but not a sickness of the bowels, any pain, but not heart pain, and any ache, but not a headache." Nitroglycerin is the classical medication, used for over 130 years, to treat angina pectoris. Its mode of action is based on its metabolic conversion to nitric oxide, a free radical gaseous vasodilator. Nitric oxide causes the smooth muscle of blood vessels to relax, thereby widening the blood vessels (vasodilation) and increasing blood flow [17]. A natural source of nitric oxide is derived from the chemical pathway operating through the chemical reduction of dietary nitrate in dietary vegetables to nitric oxide. Beetroot is particularly rich in nitrate and has been shown to increase cardioprotective levels of nitric oxide with a corresponding reduction in blood pressure [18] and an increase peripheral oxygenation [19]. These scientific findings elucidate the following passage in Talmud Nedarim (49b). Rav Tarfon said to Rav Yehudah, "Your face shines today." Rav Yehudah responded, "Yesterday your servants went out to the field and brought me beets. We ate them without salt and that is why my face shines today." Beets are a source of nitrate, which when metabolized to nitric oxide, causes vasodilation, including that of the peripheral blood vessels of the face. The Talmud concludes with the statement, "And if we had eaten them with salt, our faces would shine all the more." Ingestion of salt causes the body to retain water, thereby expanding the extracellular fluid volume. Perhaps, as stated by the Talmudic anecdote long before the medical pathology was known, the ingestion of beets with salt caused vasodilation of venous blood vessels with a concomitant increase in extracellular fluid volume. This would cause the face to shine even more.

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## II. Sugar-mediated diseases

### a. Diabetes mellitus

“And if men quarrel, and one strikes the other with a stone or with a fist and he does not die but is confined to bed. If he gets up and walks about outside on his support, the assailant shall be cleared; he shall give only payment for the loss of his time and he shall provide for his cure” (Shemos 21:18, 19). If person A strikes person B, person A must compensate person B for loss of wages and for the medical expenses to treat the wound. This is discussed in tractate Bava Kamma (85a), with the focus on the word, “only,” which is an exclusionary word. The Tanna Kama raised the question about secondary sores which developed subsequent to the wound, which already may have healed. Should person A compensate person B for such secondary sores? The Talmud clarified the case, in that person B disobeyed his physician’s advice and ate “honey or all types of sweets,” which are harmful to a wound. The wounded area worsened to a condition termed *gargusni*. So the Tanna Kama’s question was - should person A be obligated to compensate person B, who did not follow his doctor’s advice, causing the condition to progress to *gargusni*. The answer can be found in the word “only,” which teaches that person A only needed to compensate person B for the initial wound, and not for the subsequent secondary sores, termed *gargusni*, which arose because person B refused to follow the physician’s medical advice. The Talmud inquired to the identification of *gargusni*. Abaye (as explained by Rashi) defined it as “dead tissue.” The *gemora* inquired of the cure for *gargusni* and answered that the curative agents were aloe, wax, and resin found in wine barrels, which were smeared on the affected area. Tratner [20] and Jacobi [21] suggested that *gargusni* refers to gangrene and person B was a diabetic. In the medical literature a case study was presented in which a gangrenous sore was treated with aloe [22].

Experimental and observational studies have identified a link between the development of type 2 diabetes with high sugar intake, usually associated with obesity and lack of exercise. Until recently, little was known of whether alterations in sugar intake, independent of obesity and exercise, can account for type 2 diabetes. Basu *et al.* [23] found that the prevalence of diabetes within a population increased by 1.1% for every 150 kcal/person/day increase in sugar availability (about one can soda/day). The impact of sugar intake on the prevalence of type 2 diabetes was independent of alcohol use and of a sedentary life style and was modified, but not confounded, by being overweight. Yet a direct correlation was noted between the duration and degree of sugar intake with the prevalence of diabetes within the population. Declines in sugar intake correlated with declines in the rate of diabetes, independent of changes in the prevalence of obesity. In the scenario described in Talmud Bava Kamma (85a), the only information provided is that person B ate sweets and was

prone to ulcers, nothing is known of whether he was obese or whether he followed a sedentary life style. The study by Basu *et al.* noted that development of the type 2 diabetes correlated primarily with sugar intake. If person B was a type 2 diabetic, the advice of the physician to curtail the intake of honey (a concentrated source of sugar) and other sweets was the correct prescription, as their consumption would lead to diabetic ulcers. As noted in Mishlei (25:27), “Eating honey to excess is not good.”

Type 2 diabetics may exhibit recurrent infections (*e.g.*, boils and carbuncles; skin infections) and dysfunctional, prolonged wound healing. Optimal nutrition is needed for wound healing. Leukocytes (*i.e.*, the white blood cells involved in destroying invading microorganisms) require sufficient glucose to produce the ATP needed for chemotaxis and phagocytosis to fight microbial infection. Thus, the wounds of diabetics lacking sufficient insulin heal poorly because they are prone to microbial infection. In addition, diabetics are at risk for ischemic wounds, because they are likely to have both small-vessel diseases that impair microcirculation and to have altered hemoglobin with an increased affinity for oxygen and not readily releasing oxygen to the tissues [24]. In the case noted in Talmud Bava Kamma (85a), if person B had uncontrolled diabetes, dysfunctional wound healing would be an expected symptom. If left untreated, diabetic ulcers could result and progress to tissue necrosis (Rashi), possibly leading to gangrene.

Rambam may have seen patients with diabetes. Dr. F. Rosner [25] suggested the Rambam was describing diabetes mellitus when he stated, “Individuals in whom sweet white [humor] occurs are very somnolent [hyperglycemic?]. To those who have an excess of sour white [humor], hunger occurs, then they become extremely thirsty. When this white liquid is neutralized, the thirst will disappear.” In Aphorism no. 69, chapter 8 of *The Medical Aphorisms of Moses Maimonides*, Rambam described his encounter with diabetics as follows: “Moses says: I, too, have not seen it (diabetes) in the West (Spain, where Rambam was born or Morocco, where he fled Almohade persecution), nor did any of my teachers under whom I studied mention that they had seen it. However, here in Egypt, in the course of approximately ten years, I have seen more than twenty people who suffered from this illness. This leads to the conclusion that this illness occurs mostly in warm countries. Perhaps the waters of the Nile, because of their suaveness (sweetness?), may play a role in this.”

### b. Reactive (postprandial) hypoglycemia

Chapter 7 of tractate Gittin (67b) commences with the following case. “If one was seized with *kurdiakos* and said, ‘Write a bill of divorce for my wife,’ he did not say anything,” and he is to be disregarded. Rashi explained that *kurdiakos* was a type of delirium caused by a demon who possessed someone who drank large quantities of new

wine. Rambam, in his commentary to the Mishnah described *kurdiakos* as a type of epileptic seizure that rendered the person incoherent. Hankoff [26] postulated *kurdiakos* to be delirium tremens, a severe form of alcohol withdrawal that caused severe mental or nervous system changes.

Yerushalmi Gittin (7:1) described a person with *kurdiakos* as an individual exhibiting insane behavior, such as sleeping overnight in a cemetery, tearing his clothes, and destroying what is given to him. The mental confusion of this individual is explained using an example of a weaver. While working with black thread the weaver was given a red thread and, apparently being unaware of the change in thread color, continued weaving. In tractate Gittin (67b) the remedy for *kurdiakos* is for the person to consume lean meat broiled on coals and to drink fresh, watered-down wine.

Dr. Leo Levi [26] provided a novel approach to diagnose *kurdiakos*, analyzing the features noted in the Talmud as follows: (1) symptoms: transient mental confusion (cannot distinguish between black and red thread); (2) etiology: excessive intake of glucose (via grape juice, as “new wine” mentioned in the Talmud was, as yet, unfermented and lacked a significant alcohol content, but had a high sugar content); and (3) treatment: a diet high in protein (lean meat) and low in carbohydrates (highly diluted fresh wine). From his analysis, Levi concluded that this person exhibited the condition termed reactive (postprandial) hypoglycemia. This pathology occurs after consuming a large carbohydrate-based meal, evoking the pancreas to over-secrete insulin. The secretion of insulin leads to the removal of glucose from the blood stream and its storage in the liver. Insulin secretion continues much after the digestion of the meal, causing the level of blood glucose to decrease to below normal (*i.e.*, hypoglycemia). [Interestingly, the low level of blood sugar resulted from the over consumption of carbohydrates.] Symptoms of hypoglycemia include, amongst others, blurred vision, confusion, and light headedness. The accepted treatment for reactive (postprandial) hypoglycemia is a high-protein, low-carbohydrate diet, as noted in the Talmud.

### III. Cancer

Several personalities in *Nach* exhibited pathologies that were postulated to have been cancerous tumors. The Roman emperor, Titus [27-30], and the giant, Goliath [31-35], were diagnosed with brain cancer and King Jehoram [36] with colorectal cancer. For an in-depth analysis of this topic, the reader is directed to the article, Tumors in Tanach and Talmud, authored by my colleague Dr. Alyssa

Schuck (nee: Reisbaum) [37], Department of Biology, Stern College for Women.

*Raasan* is an interesting disease (Kesubos 77b), possibly a brain tumor. The symptoms of *raasan* include tearing eyes, a runny nose, saliva dripping from the mouth, and being surrounded by flies. Abaye explained that therapy is via brain surgery. A concoction was prepared by mixing pennyroyal (a type of mint), wormwood, bark of a nut tree, shavings of a dressed hide, a lily, and calyxes that cover an immature red date, which were mixed and boiled. The patient was brought to a marble house (*i.e.*, the operating room) and 300 cups of the boiled concoction were poured over his forehead, apparently, to soften the cranium. A portion of the softened cranium was removed, thereby exposing a parasite on the brain. Using a tool, each of the organism’s four legs were lifted and a myrtle leaf placed below each leg, thereby preventing the parasite from digging into the brain of the patient. Tongs were used to remove the parasite, which was burned. Considered to be an infectious disease, Rabbi Yochanan cautioned to avoid contact with the flies that swarmed around a person infected with *raasan*. Consumption of mangold (or beet) and drinking beer made from cuscuta of the *hizmi* shrub prevented contracting this ailment.

After conducting a medical analysis of the Talmudic description of *raasan*, Dr. J. Preuss [38] concluded that no known modern medical illness conformed to its clinical manifestations. Dr. F. Rosner [39], however, suggested that *raasan* was a brain tumor. He explained that although Rashi referred to its etiology as an insect on the brain, the Talmudic text can equally be understood to refer to a tumor whose outgrowths resembled the feet of an insect and whose removal must be performed with much care and caution.

### Concluding statements

Heart disease, diabetes, and cancer are the leading causes of mortality in the United States. These pathologies, apparently, are not new, but may have been health issues thousands of years ago. The various pathologies noted herein and the individuals in which they were hypothesized to occur are conjectures and cannot be taken as fact. It is interesting and thought provoking, however, to relate these ancient illnesses to current medical diagnoses and knowledge. When a Torah thought can be made more relevant to the generation, it becomes more meaningful and tangible.

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**Dedication:** This article is dedicated to the memory of Dr. Shoshana (Roseanne Greenberg) Schmerer, who passed away suddenly on Monday, June 8, 2015. Shoshana's journey to Torah began at NCSY's weekly program at Stuyvesant H.S. After high school she enrolled in Neve Yerushalayim. Rabbi Smith of Neve Yerushalayim wrote about Shoshana: "What made Shoshana stand out, even amongst Stuyvesant girls, was that she never stood out, because angels don't leave footprints. Angels come into the world with a mission and they leave when the mission is done." Shoshana's next stop was SCW. She majored in Biology and upon graduation continued at Mount Sinai

School of Medicine and received her Ph.D. My memory of Shoshana includes her being an extremely fine and refined individual, her sweetness, her sense of humor, and her sincerity and dedication to the principles of Torah. May the *nesama* of *Shoshana Naomi bas Dov Beryl* have an *aliyah*.

**Acknowledgment:** Appreciation is expressed to Louis ("Eliyahu") Goldberg, Esq. ("Rebbe Eli," 5:30 A.M. *Daf HaYomi*, Agudath Yisrael of Madison) for reviewing this manuscript.

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