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Nicholas E. Brough  
*Grand Valley State University*

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A Comparison of the Treatments of Al-Razi to Those of His Contemporary Physicians and to  
Modern Medicine

Nicholas E. Brough

Frederik Meijer Honors College,

Grand Valley State University

HNR 499: Honors Senior Project

Dr. Carolyn Shapiro-Shapin

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## **Abstract**

Introduction: The Golden Age of the Islamic Empire was a time of great scientific advancements. Due to the support of the Abbasid Caliphate, centers of learning such as the Baghdad House of Wisdom produced translations of Greek medical texts which formed the basis of medicine in Medieval Islam. This led the Islamic Empire to produce some of the greatest physicians of all time including al-Razi. Analysis: The treatments used by al-Razi in his thirty-three case studies from *al-Hawi* are all theoretically effective through the lens of humoral medicine. Additionally, many of al-Razi's treatments are backed by research into the phytochemical components of the plants that he used, suggesting they could be used in herbal medicine. Comparison to Contemporaries: The translations of Greek medical texts to Arabic by Hunayn ibn Ishaq created the basis of knowledge for both al-Razi and his Jewish contemporary Israeli. This explains why al-Razi's treatment in case XI closely mimics Ishaq's treatment in *Ten Treatises on the Eye*. It also suggests that the similarities between al-Razi's and Israeli's writings on uroscopy are due to their utilization of the same translations of Greek texts with slight variation based on their own experiences. Comparison to Modern Medicine: Al-razi's treatments share very little commonalities with modern treatments for the same diseases because al-Razi practiced humoral medicine and modern medicine is based in science. Modern medicine also has advancements in pharmaceuticals and surgical techniques not available to al-Razi. Conclusion: Al-Razi demonstrated great clinical skill in his cases as most of his treatments may be valid in terms of humoral medicine and herbal medicine, but not in modern medicine. Additionally, al-Razi's treatments were similar to other renowned physicians of his time due to similar source

materials. Al-Razi should be known as one of the greatest and most influential physicians of all time.

## **Introduction**

The Golden Age of the Islamic Empire (~750 -1258 CE) was a time of great scientific advancement in the Medieval Period largely due to the rise of the Abbasid Caliphate in 750 CE. The establishment of the new Islamic system of government and the maturing of Islamic society led to the emergence of educational centers throughout the empire (Kaviani et al., 2012). One such center was the capital city of Baghdad which was believed to be unrivaled in terms of culture and intellect. Baghdad was home to the academy *Baytul Hikmat* which translates to the “House of Wisdom” (Kaviani et al., 2012). The House of Wisdom was founded in the 9th century by caliph Harun ar-Rashid and his son Al-Ma'mun (813-833) who sought out classical Greek works on medicine and natural philosophy to be translated into Arabic (Kaviani et al., 2012). To facilitate this effort, the caliphs set up an embassy in Constantinople headed by Ibn Masawayh who was a Nestorian Christian physician that served as a court physician to four different caliphs (Fantini, 1998). The most important work done at the House of Wisdom was done by Ibn Masawayh's pupils and successors. This included Hunayn ibn Ishaq al-Ibadi, a Nestorian Christian physician who was hired by Caliph Al-Ma'mun to be the chief translator of the House of Wisdom (Sa'di, 1934). It is from the efforts of Hunayn ibn Ishaq and the religiously diverse group of translators at the House of Wisdom that the translations of the works of Greek natural philosophers such as Hippocrates, Dioscorides, Rufus of Ephesus, Paul of Aegina, and most importantly the works of Galen were preserved (Khan, 2019).

One factor that contributed to the Abbasid Caliphate's interest in the translation of Greek medical texts was the recurrence of plagues in Medieval Islam. Early Arabic writers reference

multiple *Waba* which translates to a general notion of pestilence throughout the early history of Islam. They also write of more specific epidemic-causing diseases throughout the early history of Islam called *Ta'un* (Conrad, 1982). Some specific plagues referenced from this period include Justinian's plague (541), the plague of Shirawayh (627-28), and the plague of Jarif (670/688-89) (Dols, 1974). The prominence of these pestilences and epidemics in the region led the Abbasid Caliphate to seek out Greek medical texts that address how to treat the plagues that were afflicting them which lead to these works being translated at the House of Wisdom (Dols, 1974). Subsequently, the newly available translations of Greek medical texts were studied by physicians across the Middle East, and they began to use Hellenistic medicine to treat their patients. This style of medicine relied heavily upon the humoral system to diagnose and treat disease (Lagay, 2002). The humoral system was based on the belief that the body had four natural fluids; blood, phlegm, yellow bile, and black bile. The humoral system explained that diseases were caused by disruptions in the balance of the body's four fluids and that certain treatments could be used to restore the balance of the fluids (Lagay, 2002). Hellenistic medicine and the humoral system became imperative to the development of the medical community in the Islamic Empire, as by the end of the ninth century they formed the basis of medical knowledge in the Middle East (Hamarneh, 1974). The Abbasid Dynasty's emphasis on learning and the translation of medical texts created an environment in Baghdad and other learning centers throughout the empire that allowed physicians to flourish. As a result, the Islamic Empire produced numerous famous physicians during the Medieval Period.

One of the most influential physicians to come from Medieval Islam is Abu Bakr Muḥammad ibn Zakariya al-Razi, commonly Latinized to Rhazes. The exact date of al-Razi's birth is unknown, but it is likely that he was born sometime between 854 CE and 865 CE in the

Persian city of Rayy (Ligon, 2001). Al-Razi was a musician for the first half of his life before studying medicine under Alu ibn Sahl al-Rabban. During his medical career, al-Razi was regarded as the leading figure in the field of medicine in his time and a devoted teacher of medicine (Ligon, 2001). He served as the director of a hospital in Rayy and later in Baghdad and was renowned for his clinical skill and experience. Al-Razi was also a prolific author, writing on a number of topics including philosophy, alchemy, and medicine including treatises on kidney and bladder diseases, diabetes, and food for the sick (Ligon, 2001). One of his most lasting contributions is his treatise on Smallpox and Measles, as al-Razi was the first physician to distinguish between the two diseases. He also wrote a short general textbook on medicine called *al-Kitab al-Mansuri fi al-tibb* which was later translated into Latin as *Liber ad Almansorem* and became influential in the education of European physicians until the sixteenth century (Hamarneh, 1972).

One of al-Razi's most influential works is *al-Kitab al-Hawi fi al-tibb* or *The Comprehensive Book on Medicine*, Latinized to *Continens*, contains extracts from various other medical works with al-Razi's commentary on them, and is an encyclopedia on therapeutics and how to treat diseases, and clinical cases from al-Razi's own experiences (Hamarneh, 1972). In 1935, an excerpt of *Al-Hawi* was translated from its original Arabic into English by Max Meyerhof. This excerpt contained thirty-three case studies from al-Razi's own experience including the patients ailment and the methods al-Razi used to treat the patient. The present aim of this paper is to analyze a selection of al-Razi's case studies to assess the similarities and differences between Muslim and non-Muslim medical practices in the Medieval period and to assess the influence that al-Razi has had upon modern medicine.

## Analysis

Of the thirty-three translated case studies from Al-Hawi, case I, case IX, and case XI are of particular interest because they detail the diagnosis and successful treatment of the patient by al-Razi in each of the cases. In case I, a patient consulted al-Razi because he was having feverish attacks that were preceded by slight rigor and frequent urination. Based on these symptoms, al-Razi believed that the patient had a renal abscess and his diagnosis was confirmed when the patient later passed pus in his urine. After the patient passed pus in his urine, al-Razi administered diuretics to the patient until his urine no longer contained pus. During the medieval period, there were many herbal diuretics commonly used in medicinal treatment. The most common diuretics used were haselwort, desi chickpea, saffron, watermelon, sweet flag, madder, germander, and wild carrot (Shoja et al., 2015). In the humoral system of medicine these vegetables and herbs are considered to have a drying property likely due to their purgative effects (Elgood, 1962). This suggests that al-Razi gave the patient a diuretic to increase urine flow to increase the speed in which the pus was cleared from the body and reduce the moisture in the body.

After the pus had cleared from the patient's urine al-Razi prescribed *terra sigillata*, incense, and dragon's blood to the patient and the patient was healed in two months (Meyerhof, 1935). *Terra sigillata* translates directly to "stamped earth" and refers to small tablets of clay that are meant to be eaten by the patient (Spalek & Spielvogel, 2019). Clay has been used in medicine both internally and externally since ancient times for its aseptic, astringent, and absorbing properties. Galen specifically mentions *terra sigillata Lemnia* in his book "*De simplicium medicamentorum temperamentis ac facultatibus*" for its use in the treatment of

ulcers, diarrhea, and other ailments (Spalek & Spielvogel, 2019). Due to al-Razi's familiarity with Galen, it is likely that he prescribed the clay tablets to the patient with the intent that it would have an astringent effect. Therefore, the *terra sigillata* was meant to cause a drying effect to counteract the hot and wet humors causing the disease.

In addition to the *terra sigillata*, Al-Razi also prescribed incense to the patient (Meyerhof, 1935). In Medieval Islam there was a large cultural appreciation for good scents (King, 2022). In addition to the pleasant smell that accompanied them, incense was also believed to be connected to the body's humors as scents like musk and saffron were considered hot while sandalwood and rose were cold. As a result, incense of musk and other hot scents may have been prescribed to patients who were afflicted by a cold ailment, and incense of sandalwood may have been prescribed to patients who were experiencing a hot illness (King, 2022). It is likely that the patient in case I had a hot illness as al-Razi noted that he believed that the man's fever was caused by the inflammatory process. Therefore, although al-Razi does not specify the type of incense he prescribed the patient, it can be inferred that he prescribed an incense that had cold scents in order to alleviate the patient's fever.

The last item that al-Razi prescribes to treat his patient's renal abscess in case I is dragon's blood (Meyerhof, 1935). Dragon's blood is a crimson colored resin that is secreted from the *Dracaena* genus of plants. These plants are among the oldest plant species in the world and are found throughout Africa and Asia (Liu et al., 2021). They have also been used in the traditional medicines of numerous cultures across the areas they are found. Dragon's blood was commonly used to treat dysentery, diarrhea, as an antiulcerative, and as an antiseptic (Liu et al., 2021). It was originally used in traditional Arabic medicine for its wound healing properties. These practices predate the translation of Greek medical texts to Syriac and Arabic which



suggests that al-Razi also utilized non-Hellenistic practices when treating his patients. It is likely that al-Razi included dragon's blood for its wound healing properties to treat the patient's abscess. Thus, al-Razi treated the patient in case I by prescribing a diuretic which increased the excretion of pus from the patient's urine, incense which provided a cooling effect to relieve the patient's fever, and *terra sigillata* to dry the hot wet humors causing the disease and dragon's blood which helped to heal the wound in the patient's kidney. The combined effects of each of the therapeutics prescribed by al-Razi was that the patient was cured of his ailment in about two months (Meyerhof, 1935).

Al-Razi treated his patient in case I based on humoral theory and Hellenistic medical beliefs. The rise of modern medicine has since proved the humoral theory incorrect which may lead some to believe that al-Razi's treatments are baseless from a modern scientific standpoint. However this may not be the case, as *terra sigillata* and other types of medicinal clay from around the world have been researched for their antibacterial properties. A 2019 study by Spalek and Spielvogel found that numerous clays from around the world have proven effective against antibiotic resistant strains of bacteria. This suggests that medicinal clay could be used to treat bacterial infections in the modern era.

Dragon's blood has been studied extensively in an effort to reveal the mechanism of action behind the ancient medicine. A dragon's blood-based therapy for pressure sores was observed to increase recovery rates and facilitate wound healing in a clinical setting (Liu et al., 2021). Upon analysis, it was revealed that dragon's blood caused significant upregulation of transforming growth factor- $\beta$ 1 (TNF- $\beta$ 1) and vascular endothelial growth factor (VEGF), which are generally involved in the wound healing process. Additionally, flavonoid compounds in dragon's blood have been proven to have anti-inflammatory and analgesic effects by acting on

the dorsal root ganglions which play an important role in pain transmission. Those same flavonoids have been found to have an antimicrobial effect against strains on *Staphylococcus aureus* (Liu et al., 2021). This body of research on the medicinal properties of dragon's blood have reaffirmed the use of dragon's blood in the modern day.

A parallel can be drawn between al-Razi's use of incense to treat his patient's ailment to the use of aromatherapy in modern alternative medicine. While no known essential oils used in modern aromatherapy have been found to treat fever, there are some essential oils that have been found to have a high concentration of phenolic compounds which could have antibacterial effects. However this is highly unlikely and the majority of essential oils used in aromatherapy have only been found to be effective in increasing a person's mood by prompting happy memories and improving their general sense of well being (Lis-Balchin, 2006). Evidence from multiple studies suggests that the treatments used by al-Razi in case I to treat his patient's renal abscess, excluding incense, are supported by modern science and have a moderately high level of validity.

The second case of interest from Meyerhof's translation of al-Razi's thirty-three case studies from *al-Hawi* is case IX. In this case, al-Razi treated a man's fever with barley water (Meyerhof, 1935). In humoral theory, barley water is considered to be temperate, moist, and thin and it is meant to soothe the acidity of black bile in the body (Meyerhof, 1928). Galen himself noted that barley was a cold and dry substance with a purgative effect (Vaughan, 2020). The addition of water to the barley made it cold and wet which made it ideal for treating fevers (Hussain et al., 2020). In case IX the barley water was successful in treating the patient's fever, but it caused the patient to experience significant pain in his abdomen. When al-Razi felt the patient's abdomen he felt that it was hot and hard and the patient said that it was throbbing

violently (Meyerhof, 1935). Al-Razi diagnoses this new illness as hot swelling or an inflammatory tumor in the region, but Meyerhof expresses in his 1935 translation that he believes al-Razi was truly referring to appendicitis in this case. To treat the appendicitis, al-Razi venesected both of the patients armpits and removed about 200 dirhams or just over half a liter of blood. According to humoral theory, the hot swelling the patient was experiencing was thought to be an excess of hot and wet humors which corresponds to blood in the body. Thus, al-Razi bled the patient in an effort to purge the body of the excessive blood and restore the balance of the humors.

Following the venesection, al-Razi prescribed an infusion of the leaves of nightshade, endive, and cucumber seeds for several days (Meyerhof, 1935). Although the berries of *Atropa belladonna* or the deadly nightshade plant are poisonous to humans, the berries have still been utilized in medicine throughout history (Ivy, 2013). Nightshade leaves were thought to possess large cooling effects while its fruits contributed heat and moisture to the body (Meyerhof, 1928). The powerful cooling effects of the leaves of the deadly nightshade explain why al-Razi would prescribe a juice made of it to a patient experiencing appendicitis which he believed was being caused by excess heat in the body. Al-Razi likely intended for the juice of the nightshade leaves to work as an anti-inflammatory to treat the appendicitis which would help relieve the pain that accompanies the illness. In addition to the leaves of the deadly nightshade, al-Razi's infusion included endive, also known as chicory in some literature. In traditional medicine, the fresh parts of the endive plant are thought to be cold and wet. Mixtures containing water from endive leaves were considered very effective in soothing inflammation (Asl, 2021). This provides evidence that al-Razi included endive in his prescription in case IX to act in tandem with the juice of the leaves of the deadly nightshade to treat the inflammation. The final ingredient in al-Razi's prescription

was cucumber seeds. Cucumbers were believed to have cold and damp properties in Medieval Islamic medicine and were considered to be effective in soothing heat in the body (Elgood, 1962). This explains why al-Razi chose to include cucumber seeds in his infusion, as he believed that it would aid in the treatment of the inflammation in combination with the cooling effects of both the nightshade and endive. Al-Razi administered the infusion of nightshade, endive, and cucumber seeds for several days after the venesection was performed and the patient was cured of the appendicitis (Meyerhof, 1935).

While the treatment used by al-Razi in case IX was based on the principles of humoral medicine, many of the same plants that al-Razi utilized have been studied for their phytochemical content and are used in modern herbal medicine. Barley contains beta-glucans, lignans, vanillic acid, and arabinoxylan which have been shown to have anti-inflammatory effects (Zeng et al., 2020). The anti-inflammatory effects of barley may have contributed to its ability to treat fevers as it was used in the case IX, as part of the inflammatory process involves the release of pyrogens. Pyrogens act on the hypothalamus in the brain and are responsible for the fever seen during illnesses (Bruslind, 2019). The ability of barley to decrease inflammation could lead to less pyrogens being released and therefore a reduced fever. Additionally, the beta-glucans in barley also have gastroprotective effects and wound healing effects due to their ability to activate immune cells and reduce malondialdehyde levels in the gut (Zeng et al, 2020). These qualities may have provided additional, unintentional benefits to al-Razi's later treatment of the patient's appendicitis. Therefore, the use of barley water in case IX is partially supported by the phytochemicals found in barley and could be a valid treatment of fever in modern herbal medicine.

Nightshade or *Atropa belladonna* has also been studied for its phytochemical properties and its use in modern medicine. All portions of the nightshade plant contain tropane alkaloids, the most well recognizable being atropine (Owais et al., 2014). These tropane alkaloids act as inhibitors of muscarinic receptors in the parasympathetic nervous system. This inhibition causes relaxation of the smooth muscle of the intestines which decreases peristalsis (Crampton, 2010). Decreased peristalsis would likely decrease the pain associated with appendicitis because the inflamed appendix would be moved around the stomach cavity with less frequency. Additionally, inhibition of muscarinic receptors in the brain have demonstrated the ability to produce an analgesic and sedative effect (Crampton, 2010). Al-Razi does not state that he intended to relieve the patient's pain in case IX, but his inclusion of nightshade in his treatment of the patient's appendicitis may have incidentally caused this effect. A study by Owais et al. (2014) also showed that high doses of nightshade extract had significant anti-inflammatory effects when used in a rat model. The anti-inflammatory effect shown may contribute to the ability of nightshade to treat the inflammation associated with appendicitis. The combination of the analgesic and anti-inflammatory effects of the nightshade plant and its ability to inhibit peristalsis contribute to the validity of its use in the treatment of appendicitis in modern herbal medicine.

Al-Razi's use of endive and cucumber seeds to treat the patient's appendicitis in case IX has also been supported by recent analysis of the plants' phytochemicals. Endive is well known for its high sesquiterpene lactone content. Sesquiterpene lactones have the ability to decrease the inflammatory response of the body giving endive anti-inflammatory qualities (Matos et al., 2020). These qualities provide support for the use of endive to treat the inflammation associated with appendicitis. A study by Sood et al. (2012) found that cucumber seeds have numerous

phytochemicals that may be beneficial in treating appendicitis including cardiac glycosides, terpenoids, and tannins. The cardiac glycosides in cucumber seeds have been found to reduce infection-induced inflammation by inhibiting neutrophils and decreasing the levels of tumor necrosis factor  $\alpha$  and interferon  $\gamma$  (Furst et al., 2017). As a result, the cardiac glycosides in cucumber seeds could be effective in treating the inflammation of appendicitis. In addition to cardiac glycosides, cucumber seeds also contain terpenoids. Terpenoids possess inhibitory effects against both fungi and bacteria due to their ability to disrupt the organisms' cell membranes (Sood et al., 2012). This antibacterial effect could be useful in treating the bacteria that is often the cause of appendicitis. The tannins in cucumber seeds have been found to hasten the healing of wounds and inflamed mucous membranes. The mechanism by which they facilitate wound healing is by activating oxidant-induced vascular endothelial growth factor in cells (Sen et al., 2006). The anti-inflammatory, anti-bacterial, and wound healing effects of the phytochemicals found in cucumber seeds are evidence for the inclusion of cucumber seeds or their extract in the treatment of appendicitis in modern herbal medicine.

The last case from Meyerhof's translation of al-Razi's thirty three case studies in *Kitab al-Hawi* that will be examined in this paper is case XI. In case XI, a young woman drank camel's milk and thereafter became bloated with gas. Al-Razi noted that the woman attempted to cure herself with musk, but she did not undergo venesection or use a purgative beforehand (Meyerhof, 1935). Al-Razi notes in his Treatise on Smallpox and Measles that smallpox is caused by the putrefaction and fermentation of excess blood in the body. He also notes the symptoms of smallpox in this treatise including a continuous fever, pain in the back, itching in the nose, terrors in sleep and more. The symptoms described by al-Razi in his treatise were nearly identical to the symptoms of the patient in case XI. A frequent complication associated with smallpox is that the

pustules can spread to the cornea of the eye causing blindness in the patient (Meyerhof, 1935).

Once the smallpox symptoms developed, the woman consulted al-Razi. His first treatment was to take “care of her eyes and strengthen them with antimony-powder rubbed in rose-water.”

Antimony is a heavy metal that was also known as stibium in Medieval Islam. Physicians of the time period believed that antimony had cold and dry properties. It was also known to strengthen the optic nerve and strengthen the eye (Elgood, 1962). Rose water was also commonly used in Medieval Islam for its cold, dry, and astringent qualities. Tenth century physician Hunain ibn Ishaq’s textbook on ophthalmology, *Ten Treatise on the Eye*, states that “remedies of the fifth species astringent” and that astringent remedies, including rose water, are used for “checking suppuration in ophthalmia, ulcers, and pustules.” Al-Razi likely prescribed his treatment of antimony powder and rose water to his patient because of the believed protective effects that both substances have on the eyes and he was successful in preserving the function of the woman’s eyes in case XI.

After treating the patient’s eyes, al-Razi shifted his treatment towards the smallpox that was still affecting the woman. Al-Razi started by giving the woman barley water for a length of time without success. He noted that this was not uncommon when treating smallpox and that he could not expel the woman’s ill-natured humors due to her weakened state. At that point, al-Razi prescribed the patient dried apricots at daybreak and barley water at noon for about two weeks (Meyerhof, 1935). In traditional medicine dried apricots are known to be cold, damp, effective at relieving thirst (Elgood, 1962), and have been known to strengthen the patient’s body (Khatib et al., 2021). As was discussed previously, barley water is of cold and wet humors which are thought to help it cool the body and remove toxins. Additionally, barley water was known to be easily digestible and provided a moderate amount of nutrition to patients which made it ideal for

patients recovering from illness (Hussain et al., 2020). The properties attributed to dried apricots and barley water suggests that al-Razi prescribed them to his patient to help her regain her strength while purging her body of the bad humors that he believed were causing the smallpox in case XI. His efforts were successful and the woman was cured after fifty days.

Many of the components used by al-Razi in case XI have been studied for their application in modern herbal and alternative medicinal practices. Roses have been analyzed to reveal the mechanisms behind many of its biochemical activities. A study by Ulusoy et al. (2009) showed that roses have antimicrobial properties due to their high citronellol, geraniol, nerol, and phenylethyl alcohol content. Specifically, the phenylethyl alcohol is effective in disrupting the supercapsid of multiple species of viruses including poxviruses which cause their death (Roihel & Zeitlyonok, 1969). Antimony has been studied for its antimicrobial effects, but it has not been shown to be effective against poxviruses such as smallpox. In fact, antimony is highly toxic to many of the body's systems and is only utilized in the treatment of a small number of parasitic and bacterial infections (Periferakis et al., 2022). The results of these studies suggest that the rose water that al-Razi applied to his patient's eyes in case XI may have had significant antiviral effects on smallpox. However, his inclusion of antimony powder in the mixture is not scientifically supported and may have been toxic to the patient. The potential for antimony toxicity in al-Razi's treatment in case XI serves to invalidate this method of treatment for smallpox in modern herbal and alternative medicine.

The benefits of both apricots and barley have been explored in terms of their use in modern herbal medicine. As stated previously, barley contains numerous phytochemicals that contribute to its anti-inflammatory effects. Barley also has a starch content of up to sixty eight percent and a protein content of up to seventeen percent (Baik & Ullrich, 2008). These complex



carbohydrates and proteins are metabolized by the body and provide the patient with an abundance of energy. Additionally, the nutrients derived from the barley are more easily absorbed in the body because it is delivered as a liquid in barley water. This makes barley an ideal food for patients who are recovering from severe illnesses such as the patient in case XI. Apricots are high in the antioxidant vitamin A (Fратиanni et al., 2018). Vitamin A is essential for immune function as research shows that immune organs need to maintain vitamin A concentrations in order for their immunocompetent cells to proliferate, differentiate, mature, aggregate, and respond to non-native antigens (Huang et al., 2018). This suggests that prescribing apricots to patients may bolster their immune system and help them recover from their illness faster. In addition to vitamin A, apricots also contain the phenolic compound catechin. Catechin produces strong anti-inflammatory effects by binding to key enzymes in the inflammatory process and inhibiting their action (Fратиanni et al., 2018). The presence of catechin in apricots suggests that they may contribute to the treatment of the symptoms of smallpox, such as fever, due to its anti-inflammatory actions. Apricots and barley water have been shown to provide high amounts of energy, support immune system function, and provide anti-inflammatory effects. Al-Razi's use of apricots and barley water in case XI may have provided the energy and support needed for the patient's immune system to respond to the infection so that she could recover naturally over a period of time. These qualities support their use in the treatment of smallpox and other viral infections in modern herbal medicine.

### **Comparison of Al-Razi to Contemporary Physicians**

Abu Bakr Muhammad ibn Zakariya al-Razi was highly regarded as one of the greatest physicians of the Islamic Empire. Edward G. Browne called al-Razi the "greatest and most original of all the Muslim physicians and one of the most prolific as an author" in his 1921 book

*Arabian Medicine*. Many of his works continued to be influential and even authoritative in medical education up until the seventeenth century (Ligon, 2001). Where al-Razi truly excelled was in the clinical application of medicine. During his time as the medical director of a hospital in the city of Rayy and later in Baghdad, al-Razi gained the reputation of having clinical skills that were unexcelled in his time. People both rich and poor from all parts of the Islamic Empire sought his counsel due to his pioneering methods of differential diagnosis and clinical observation (Ligon, 2001). However, al-Razi was not the only skilled physician to live during the tenth century. Muslim, Jewish, and Christian physicians were all educated and worked at the House of Wisdom in Baghdad (Kaviani et al., 2012). Therefore, physicians of all three faiths that were in close enough geographical proximity to Baghdad had access to the same translations of medical texts. This common base of knowledge helps to explain the similarities seen in writings from various physicians of differing faiths within the Islamic Empire. However, the medical writings in Medieval Islam are not identical to one another due to the original thoughts and innovations of individual physicians during the period.

As mentioned briefly above, one of the greatest contributors to the translations at the Baghdad House of Wisdom was the Nestorian Christian physician Abu Zaid Hunayn ibn Ishaq al-Ibadi. Hunayn ibn Ishaq was born in 809 CE in the town of Hira in what is modern day Iraq and grew up in the city of Basra (Sa'di, 1934). He spoke Syriac and he became fluent in Arabic and Greek later in his life. He also studied medicine for a time under the great teacher Yuhanna ibn Masawayh, but was cast out by the teacher for being too curious about medicine (Sa'di, 1934). Ishaq was a skilled translator and even impressed the scholar Jabrail ibn Buhkt-Yishu enough that the scholar recommended Ishaq to Caliph Al-Mamun. As the chief translator, Ishaq gained fame for being a prolific and accurate translator of Greek texts into Syriac and Arabic. It

is largely due to his efforts, and the efforts of the other translators at the House of Wisdom, that the medical community of the Islamic Empire were able to access Greek medical texts that formed the basis of their medical knowledge (Sa'di, 1934). Many of the original works that Hunayn ibn Ishaq produced were also expansions upon the works of Greek physicians and natural philosophers. Due to the desert environment of much of the Islamic Empire, many of the physicians from Medieval Islam wrote treatises regarding the eyes and eye diseases including Hunayn ibn Ishaq and his book the *Ten Treatises on the Eye*. In this book Ishaq creates the earliest known diagrams of the anatomy of the eye (Meyerhof, 1928). The book also contains descriptions of the brain, optic nerve, diseases of the eye, simple remedies for the body, and simple remedies for the eye. The treatises on diseases and remedies are translated from the works of Galen and other Greek physicians and are based on humoral theory (Meyerhof, 1928).

One of the most interesting passages in Hunayn ibn Ishaq's *Ten Treatises on the Eye* comes from the eighth treatise on simple remedies for the eye. This passage states that ulcers of the eye should be treated with a "collyria with metallic remedies and non-biting vegetable extracted juices" (Meyerhof, 1928). A collyria is a mixture that is to be applied externally on a patient. In case XI, al-Razi uses a mixture of antimony powder rubbed into rose water to keep his patient's eyes clear of smallpox pustules. This mixture seems strikingly similar to the description given by Hunayn ibn Ishaq in his *Ten Treatise on the Eye*. In addition, Ishaq also notes that rose water was a remedy of the fifth species which was used to check the suppuration in ophthalmia, ulcers, and pustules (Meyerhof, 1928). The similarities between al-Razi's treatment in case XI and the prescribed treatment in his *Ten Treatises on the Eye* is likely not a coincidence. Al-Razi was a practicing physician slightly after the time Hunayn ibn Ishaq and studied medicine in Baghdad. This means that al-Razi likely utilized and depended upon the translations of Greek

medical texts made by Hunayn ibn Ishaq and utilized the ideas in the *Ten Treatises on the Eye* to inform his clinical treatment of patients.

One prominent figure who did not practice in Baghdad was the Jewish physician Isaac ben Solomon Israeli. Isaac Israeli was born in Egypt sometime around 832 CE although the exact year is disputed. Little is known about the first half of his life except that he was a skillful oculist before moving to Kairwan in what is modern day Tunisia in his middle age (Gottheil & Seligsohn, 2021). In Kairwan, Israeli studied general medicine under Ishaq ibn 'Amran al-Baghdadi and subsequently became quite famous for his work. In 910 CE when the Fatimid Dynasty took control of North Africa, Israeli became the court physician for the caliph Ubayd Allah al-Mahdi. Under the caliph, Israeli wrote several medical treatises that were widely regarded in the Islamic world including the *Book on Fevers* and *Book on Urine* (Levin et al., 2022).

Like al-Razi, Israeli formed his medical treatises on the basis on Hellenistic medical practices and humoral theory. In his *Book on Urine*, Israeli documents the different colors of urine and how they relate to different imbalances in a patient's humors when the patient is ill (Visi, 2015). The four main colors described by Israeli are white, yellow, red, and black each of which correspond to one of the body's humors phlegm, yellow bile, blood, and black bile. He then goes on to document mixtures of these colors and the relation of the mixing humors in the body that cause them (Visi, 2015). For example, a yolk-like color of the urine corresponds to a mixture of phlegm and yellow bile where there is more phlegm than yellow bile while the color citrine is formed when there is equal phlegm and yellow bile. In total, Israeli describes fourteen colors of the urine in the *Book on Urine* and how they are useful in diagnosing different diseases (Visi, 2015). During the late ninth and early tenth centuries, al-Razi also wrote about the colors

of urine and their importance in diagnosing diseases in chapter thirty book ten of *Kitab al-Mansuri*. In it he details seven different colors of urine including white, milk-like, yellow, fiery, saffron-like, red, and black. However, this list is just a variation on Magnus of Emesa's catalog of colors. Al-Razi also writes of thirteen different colors of urine in *al-Hawi* and quotes the work of numerous post-Galenic physicians in this section (Visi, 2015).

Research on Isaac Israeli's philosophical work has demonstrated that Israeli was familiar with work that was published in ninth century Baghdad. Israeli's familiarity with this work could be related to his master's *nisbat*, an associative name, al-Baghdadi which implies that his master was originally from Baghdad. Both of these factors suggest that Israeli may have had access to the translations of the Greek medical texts made by Hunayn ibn Ishaq in the later portion of the 9th century. These translations likely served as the basis of Israeli's medical knowledge and are the same translations that were formative in al-Razi's work in medicine. It also suggests that Israeli had access to some of the work of the same post-Galenic physicians that were quoted in al-Razi's *Kitab al-Hawi*. This provides evidence that both al-Razi and Isaac Israeli derived their medical knowledge from the same works when writing their separate treatises on urine (Visi, 2015). Due to their similar influences, geographic areas and the medicinal plants available to them, it is likely that both al-Razi and Israeli held similar, but not identical, beliefs on how to treat renal diseases such as the renal abscess seen in Case I of Max Meyerhof's translation from *al-Hawi*. The differences between al-Razi's treatment and Israeli's treatment are likely due to the individual thoughts and innovation that each of the physicians had about uroscopy that they developed over their careers.

## Comparison of al-Razi's Treatments to Modern Medicine

The treatments that al-Razi used in his clinical practice of medicine were considered to be the highest quality in Medieval Islam. His methods were even highly regarded and used in the education of new physicians up until the seventeenth century. Then in the seventeenth and eighteenth centuries, a number of intellectuals began to reject the ideals that society had held for thousands of years. Francis Bacon created the scientific method and scientists began to value empirical evidence over the tradition that had informed them previously. This scientific revolution led the medical community to shift away from Hellenistic practices and humoral theory and move towards the modern era of medicine. From then on, medicine advanced relatively quickly with the invention of vaccines, new surgical techniques, and manufactured drugs to treat diseases. While the goal of al-Razi's treatment and the treatments of modern medicine are the same, modern medicine approaches the diseases seen in al-Razi's case studies from a different perspective and with tools that were not available to al-Razi in Medieval Islam.

Modern science has revealed that the usual cause of renal abscesses like the one seen in case I from Meyerhof's translation of *Kitab al-Hawi* is gram negative bacteria. For small abscess the standard treatment is to administer intravenous (IV) antibiotics to the patient for at least two months. Generally, the first choice of antibiotics in the treatment of renal abscesses is fluoroquinolones (Rubilotta et al., 2013). Fluoroquinolones work by disrupting the deoxyribonucleic acid (DNA) replication and cellular division in rapidly dividing cells like the ones found in bacterial infections. However, fluoroquinolones cause patients to have an increased risk of tendinitis and tendon rupture (Burchum & Rosenthal, 2022). Using antibiotics to treat bacterial infection is unlike any of the treatments used by al-Razi in case I. This is because al-Razi practiced under the humoral theory of medicine and was unaware that his

patient's renal abscess was caused by bacteria. Modern science has revealed that the terra sigillata and dragon's blood that al-Razi used to treat his patient in Case I may have had some antibacterial effects, but these were not intended by al-Razi. The treatment for larger abscesses is to surgically insert a catheter to drain the pus out of the abscess (Rubilotta et al., 2013) While al-Razi did not use surgical methods to relieve his patient's renal abscess, he did administer a diuretic once the abscess began to drain normally. This diuretic helped to clear the pus from the body faster than normal, so it can be said that the diuretic acted much in the same way as surgically draining the abscess would.

The modern treatment for appendicitis of a non-ruptured appendix differs greatly from the treatments used by al-Razi in case IX. Most patients with appendicitis present to the hospital with abdominal pain, nausea, and dehydration. Therefore, pre-surgical treatment starts with IV fluids and IV antibiotics to help treat the dehydration and the bacteria causing the appendicitis (Morrow & Newman, 2007). Al-Razi's use of barley water in the treatment of would be analogous to the use of IV fluids in modern medicine to the hydrating effect of barley water. The antibiotic of choice in the modern treatment of appendicitis before surgery is a combination of Piperacillin and Tazobactam (Morrow & Newman, 2007). Piperacillin is a the penicillin family and works by inhibiting the cell wall synthesis and septum formation in bacteria. The role of the Tazobactam is to inhibit enzymes that would negate the Piperacillin such as penicillinase which makes the Piperacillin more effective in treating the bacterial infection. The major adverse effect associated with the Piperacillin and Tazobactam mixture is allergic reaction to penicillin-like antibiotics (Drugs.com, 2022). Due to al-Razi's understanding of humoral theory, he believed that the fever associated with the bacterial infection of appendicitis was the hot humor that caused the disease. This explains why he would give the patient items that he believed would

cool them such as nightshade, endive, and cucumber seeds. Many of his prescribed treatments in case IX are oriented towards treating the patient's fever, but not the root cause of the illness whereas modern medicine treats the bacterial infection itself and removing the appendix all together with an appendectomy.

The treatment of smallpox has improved greatly in recent history when compared to the treatment used by al-Razi in case XI. The current recommended treatment for smallpox is the antiviral drug Tecoviromat. Tecoviromat was created in 2017 and was the first antiviral drug approved by the Food and Drug Administration to treat smallpox. The drug works by inhibiting the F13L gene of the smallpox virus. The F13L gene is key in the spread of the virus from cell to cell and is highly conserved throughout all species of orthopoxviruses (Merchinsky et al., 2019). Tecoviromat is a large development for even modern medicine which explains why it shares no similarities with the treatment's used by al-Razi in case XI. His antimony powder and rose water mixture likely had a slight antiviral effect due to the phenylethyl alcohol content in roses and may have been poisonous to the patient due to the toxicity of the antimony. The only portion of al-Razi's treatment in case XI that shares similarities to modern medicine is his use of barley water and dried apricots. The barley water and dried apricots provide nutrition and hydration to the patient which is recommended in modern medicine for a patient recovering from a severe illness such as smallpox.

## **Conclusion**

Primary and secondary source information provides evidence that al-Razi's treatments described in cases I, IX, and XI of the thirty-three case studies from the *Kitab al-Hawi* are effective according to the principles of humoral medicine which served as the basis for medical practice in Medieval Islam. In case I, al-Razi treated his patient's renal abscess with *terra*



*sigillata* which helped to dry the bad humors causing the disease, cooling incense, a diuretic to increase the rate of pus excretion in the urine, and dragon's blood to help heal the wound from the abscess. In case IX, al-Razi used barley water to cool the patient's fever, and when that caused the hot humors to move to the patient's abdomen he performed venesection to relieve the patient of the hot and wet humors in the blood. To finish his treatment he prescribed a juice of nightshade, endive, and cucumber seeds, all of which possess cooling effects on the body. In case XI, al-Razi prescribed antimony powder mixed with rose water to strengthen the optic nerve and protect the patient's eye from smallpox. He then prescribed barley water and apricots which possess cold and damp qualities to treat the hot humors associated with smallpox.

Modern studies on the phytochemical makeup of the different treatments used by al-Razi in cases I, IX, and XI show partial support for the use of his treatments in modern herbal and alternative medicine. In case I, *terra sigillata* and dragon's blood have been found to have antibacterial properties. Studies on dragon's blood have also demonstrated its analgesic, anti-inflammatory, and wound healing effects on the body. These qualities make them suitable choices for treating a renal abscess using herbal medicine. However, studies have not provided evidence for the ability of incense to treat fevers. In case IX, all components of the treatment were shown to have anti-inflammatory effects on the body. In addition, barley possesses antioxidant effects, gastroprotective effects and has been shown to accelerate wound healing. Phytochemicals in nightshade have been proven to have antimuscarinic effects as well as analgesic effects on the body. The last component of case IX, cucumber seeds have been shown to have antibacterial and wound healing effects on the body. The numerous beneficial effects of the components of al-Razi's treatment of his patient's appendicitis suggest that it could be a valid treatment in modern herbal medicine. In Case XI, rose water contained high levels of

phenylethyl alcohol which have slight antiviral properties. The use of barley water to provide energy to the patient was supported by the high starch and protein content of barley which are large sources of energy in a liquid medium. Studies provide support for the anti-inflammatory effects and immune system support provided by apricots due to their high vitamin A and catechin content. The use of antimony in the treatment of smallpox is not recommended by any studies as it is a toxic heavy metal that has not been proven to have any antiviral properties.

The translations of Greek medical texts made by Hunayn ibn Ishaq in the mid to late 9th century helped to form the basis of medical knowledge for both al-Razi and Isaac Israeli. Al-Razi's treatment to protect his patient's eye from smallpox in case XI is nearly identical to the recommendation of Hunayn ibn Ishaq for the treatment of pustules near the eye in his book the *Ten Treatises of the Eye*. Al-Razi likely has access to Hunayn ibn Ishaq's translations and writings as al-Razi practiced medicine in Baghdad slightly after Ishaq. This means that al-Razi likely relied upon and utilized Ishaq's translations to inform the clinical treatment of his patients. Additionally, al-Razi and his Jewish contemporary Isaac ben Solomon Israeli have both written about the principle of uroscopy in their medical treatises. Their individual ideas are not identical, but have many commonalities. This may be because both al-Razi and Israeli had access to Hunayn ibn Ishaq's translation of Greek medical texts which informed both of their medical knowledge. However, al-Razi and Isaac Israeli had different individual experiences in their treatment of diseases involving urine throughout their time practicing medicine. This caused them to form their own individual thoughts and innovations and may explain why there are some differences in the two physician's beliefs on uroscopy.

As a whole, al-Razi's treatments do not share many similarities with modern medicine. This is due to the shift away from the humoral theory of medicine towards the scientific theory

of medicine in the seventeenth and eighteenth centuries. This shift led to scientific discoveries such as the discovery of bacteria, new surgical techniques, sanitation, and the development of synthetic drugs which drastically changed the way that physicians treat disease. Specifically, al-Razi tended to treat the fever associated with infections because he believed that they were the cause of the illness, whereas modern physicians know that fever is caused by the body's response to infectious microorganisms and they try to treat those microorganisms to cure the fever.

However, it should be noted that Abu Bakr Muhammad ibn Zakariya al-Razi's works were of great importance to the advancement of medicine. This is why he should be known as one of the greatest and most influential physicians of the Medieval Islamic period.

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