

# A Brief Review of Rhazes, Avicenna, and Jorjani's Views on Diagnosis of Diseases Through Urine Examination

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The present survey aims at studying the opinions of three famous medical scholars in history (Rhazes, Avicenna, and Jorjani) on the diagnosis of diseases via urine examination and their compatibility with modern science. Referring to original authentic sources in traditional medicine, including *Al-Hawi* (The Virtuous Life), *Zakhireh-i Kharazmshahi* (Thesaurus of the Shah of Khwarazm), and *Al-Canon fi al Tibb* (The Canon on Medicine), we compared the ideas of the authors with modern medicine. In traditional medicine, physicians would pay attention to the methods of urine collection and urinary features such as color, consistency, volume, frequency, odor, and foam as the means of diagnosis, all of which still serve as the bases for today's diagnostic approach. Moreover, symptoms of the diagnosis of the disease through urine are consistent in tradition and modern medicine; some examples are blood in the urine (hematuria), decreased urine output (oliguria), change in urine color together with headache (Alport syndrome), diluted urine (tubular dysfunction in reabsorption of water or initial polydipsy), and urinary floor with tiny bubbles (one of the main symptoms of proteinuria).

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## INTRODUCTION

Today, physicians use urine to diagnose selected conditions, but from ancient times until the Victorian era, urine was used as the primary diagnostic tool. Laboratory medicine began with the analysis of human urine, which was called *uroscopy* and today is termed *urinalysis*. Uroscopy was the mirror of medicine for thousands of years. From a liquid window through which physicians felt they could view the body's inner function. Numerous, sometimes accurate, physiologic theories arose from uroscopy. Then the importance of urinary diagnosis became exaggerated, and increasingly complex, to the extent that physicians would require only the presence of urine, not patients, to diagnose disease. Uroscopy then escaped medical control, becoming first a home health aid and then a tool of uneducated practitioners.<sup>1</sup> Before the recent

centuries, urine was the predominant body fluid used by the physician for diagnosis and prognosis.<sup>2</sup>

Urinalysis is undoubtedly one of the most common and most important tests done for many patients.<sup>3</sup> By urine examination, many urinary and systemic diseases can be tracked even before clinical symptoms are identified.<sup>4-6</sup> In traditional medicine, urinalysis is referred to as the *boul*, *tafsareh* (commentator on body condition), *dalil* (cause or sign), and *ab* (water). Metaphorically, it is also referred to as *qarooreh* (phial)—a glass jar in which urine would be collected (Figure).<sup>7</sup>

Although urine examination dates back to several centuries BC, according to the present sources, early developments in this area and first scientific steps toward urinalysis were taken by thinkers like Jorjani, Avicenna, and Rhazes whose views we compared to modern scientific findings. We found



Left, Qarooreh. Right, Rhazes looking at qarooreh.

that many of their writings are still valid enough to be used in modern medical texts.<sup>7-9</sup>

### MATERIALS AND METHODS

This study was carried out through an extensive review of the literature to conduct the literature review, keywords *Razi, Rhazes, Ibn-Sina, Avicenna, Jorjani, urine, endocrinology disease, medical history, urgency, dysuria, oliguria, anuria, and hematuria* were searched in databases alone or in groups. In this research, we studied a concise edition of the books *Al-hawi* by Zakaria Rhazes (in this case, authors reviewed kidney diseases section and specifically focused on the chapter about the fundamentals of medicine), *Al-Canon fi al Tibb* (The Canon on Medicine) by Avicenna, and *Zakhireh-i Kharazmshahi* by Jorjani. For Avicenna and Rhazes, we used one edition of their books among the available ones.

To conduct the study, content analysis was performed for each source based on central research questions. The conceptual framework of the present paper was planned on the basis of the same questions. Contents were selected on the following topics from the viewpoints of Jorjani, Avicenna, and Rhazes: (1) features of urine

(sampling, color, amount, odor, sediment, hardness, etc) and (2) ways to diagnose diseases based on the characteristics of urine. Comparisons of the views of the ancient scholars in the field of medical diagnosis were done with modern medicine's say on urine features.

### RESULTS AND DISCUSSION

According to the available sources, Jorjani, Avicenna, and Rhazes were among those pioneers who chose a scientific trend to medical diagnosis based on urine examination. We compare their ideas with those trendy in modern medical texts.

#### Rhazes 's Views

Muhammad ibn Zakariya al-Rhazes (860 to 932) showed in his book, *Al-Hawi*, some points on the anatomy and physiology of the urinary tract and kidneys and how to diagnose the related diseases, some of which we present here<sup>10-12</sup>:

On the diagnosis of diseases through urine, Rhazes explains:

*If blood in the urine is excreted after pus is discharged, it is a symptom of kidneys' progressive and degenerative irritation. One of the best indications of ulcers is the*

*presence of flesh-like tiny grains in urine which are actually small bits of kidney tissue. The quality and quantity of the seropurulent exudates which are excreted through urine are so important for clinical diagnosis. If the value of seropurulent exudates is high enough to stain the natural features of urine, it indicates that the origin of it is in the upper urinary tract. If the fusion is minimal, it is from the lower part of urinary tract and symptoms, depending on the location, will be different.*<sup>8,9</sup>

He further states that: “In some cases urinating blood is due to lung disease or the underside of the diaphragm. Although these diseases are rare, they have general symptoms such as localized pain which can lead us to the affected organ.<sup>8,9, 13,14</sup>” Rhazes believes that urinating blood is caused by different factors including an opening in a blood vessel, which is not accompanied by pain, fatigued vessel with pus in the urine, blood vessel rupture (following an impact), and failure of the kidneys in blood purification. A blunt injury to the back can also cause the rupture of blood vessels in the kidney.<sup>13-15</sup>

Rhazes lists signs of urethral injury as pain in the external genitalia, filthy discharge of urine, and burning and irritating sensation while urinating.<sup>13-15</sup> About frequency dribbling strangury (*taghtir al bouh*), he has stated that it can be a sign of the weakness in keeping the bladder wall or sustained irritation of the bladder due to infection, floppy muscles holding urine, or even a complication of other diseases such as boils, ulcers, tumors, etc.<sup>13</sup> According to Rhazes, frequency of voiding can be a sign of injury or inflammation around the vagina and bladder (It is possible that he meant inflammation of the prostate).<sup>13</sup> He believed that factors involved in retention of urine are inability of the bladder to contract and put pressure on urine expel and excessive stretching of the bladder because of refraining from urinating. If the retention is together with an empty bladder, the problem is with the urinary tracts above the bladder or kidney, and it may be caused by blood clotting, inflammation, or thick mucus or calculi in the tracts above the bladder or kidneys.<sup>13</sup>

### Avicenna's Views

Avicenna (980 to 1037) deals with urinalysis and medical diagnosis via urinalysis in the first book of *The Canon of Medicine*. In that book, he expresses a

suitable condition for urine examination. He asserts that examination should be without extra materials on a sample made in the night; urine should be in the bladder only for a short time; the subject should not take in any food which may affect the urine color (such as saffron, pomegranate, and wine); and the subject should not be in a mental and physical condition that alters his or her urine. He believes that factors such as fasting, night waking, and tiredness from work change the urine color from yellow to red.<sup>16-18</sup> On the first sight, urine sample shows the condition of the liver, bladder, urinary tract, and blood vessels, which can be used to diagnose the disease. This can be done by paying attention to urine features such as color, consistency (urine dilution and concentration), sedimentation, volume, odor, brightness (transparency or opacity of the urine while light passes through it), and froth.

According to Avicenna, normal urine is the one with mild appearance, subtle colors like bergamot (light yellow), which settles well, and a mild odor (neither odorless nor the smell of the putrefaction). He believes that if a person with a serious illness has such urine specifications, the condition is getting better.<sup>17</sup>

**Color of urine.** Yellow urine comes in different types, each of which represents a special case; it is the indicator of hot temperament. Items such as hard movements, pain, hunger, and thirst cause yellow urine, too. Red urine indicates blood dominance and can be the result of gallbladder disease. According to modern nephrology, red urine is caused by hematuria, rhabdomyolysis, or hemoglobinuria.<sup>19</sup> Green urine is the symptom of cold nature, while urine in sky blue color is a sign of severe cold nature. In modern nephrology, if the urine is green, the patient is suspected to suffer from pseudomonas infection of the urinary tract.<sup>19</sup>

Avicenna considers black urine a symptom of severe cold nature, severe burning of humours, or a sign of a crisis in which the waste black bile is removed from the body. Dark urine, can be seen in severe kidney and bladder disorders. In modern nephrology, black urine suggests alkaptonuria.<sup>19</sup> In his view, white urine (transparent as glass or crystal) is a sign of cold temperament. But white urine (like milk or paper) is a sign of phlegmatic dominance and shows that a chronic disease has emerged in the body. If it is white with froth and passes with pus, it is a sign of the presence of ulcers

in the urinary tract.<sup>16-18</sup> In today's nephrology, white urine mostly implies severe pyuria (urinary tract infection); however, in severe proteinuria and phosphaturia, the urine turns white, too.<sup>19</sup>

**Diluted urine.** Very diluted and sparse urine represents the closure of blood vessels (narrowing of blood vessels in the kidneys), kidney and urinary tract dysfunction (dysfunction of the tubular reabsorption of water or diabetes insipidus), or drinking excessive water (initial polydipsia).<sup>17</sup>

**Smell of urine.** If the urine has no smell, it is the sign of frigidity (cold nature) and extreme failure of humour. The putrefaction odor of urine may be due to sepsis or wound infection in the urinary tract.<sup>17</sup>

**Urine froth.** When the froth on the urine is low with tiny and quick passing bubbles, it shows sticky winds and humours (which is one of the main symptoms of proteinuria in modern medicine).<sup>17,19</sup>

**Urine sediments.** Natural sediment of urine is white and settling and shows normal digestion and ballanced humours. Red, yellow, and white are natural and good sediments. Slimmy people, especially those who work hard or do a lot of exercise, have urine with less sediment when they are healthy. Abnormal sediment such as a gray one is often a sign of lasting purulent sputum (phlegm), which changes as time passes. Red sediment in the urine can be caused by blood disorders and bulimia. Yellow sediment is symptom of severity of the disease and extremity of hot temperament.<sup>16,17</sup>

### Jorjani's Views

Hakim Sayyed Ismail Jorjani (1136 to 1040) puts different names for urine, in his book, *Thesaurus of the Shah of Khwarazm*, including *boul*, *tafsare* (commentator on body condition), *dalil* (sign), and *ab* (water). He asserts that "by examining *boul*, we can learn about warm and cold nature, codition of organs, the quality of digestion in stomach, change in the body matters, and also humour infections."<sup>20,21</sup>

Urine (*boul*) should be taken in the morning after a mild sleep and when still fasting. The sample should not be taken after the subject has had night waking or after he or she has eaten or drunk. *Boul* of a fasting subject is not valid unless the person is used to fasting. All the urine should be kept in *qarooreh* (phial) or in the urine collection containers. After obtaining the urine, *qarooreh* should not be

shaken too much. *Qarooreh* should be examined in the light without the sun falling on it. After 6 hours, the urine collection is not valid for examination any more, because the gravity and the quality of froth (*zabad*) changes during this time.<sup>21</sup>

**Features of urine (*boul*).** According to Jorjani, a physician usually takes urine sample to examine 7 features: color, consistency, purity and turbidity, sediment, scarcity and abundance, odor, and froth (*zabad*). However, Muslim physicians would not touch or taste urine as it was prohibited by Islamic teachings.<sup>21,22</sup>

Yellow urine (*asfar*) indicates indigestion or lack of bile, which is sometimes accompanied with shortage of urination. Red (*ahmar*) indicates the predominance of blood or mucus infection and green (*akhzar*) indicates froideur temperament and extreme heat. Black (*aswad*) indicates the predominance of black bile (melancholy), blood (sanguine), or phlem, while white (*abyaz*) is also the implication of froideur temperament and tumor in urinary tracts as the diluted part can pass but the thick materials deposit there.

**Consistency of urine.** Diluted urine shows nonmaturing urine, separation of food nutrients from it, kidney failure (force of attraction and force of repulsion), since if the force of attraction is weak, the kidney cannot absorb the humours which are solved in water, and if the repulsion force is weak, it cannot excrete the absorbed humours. Other reasons include too much drinking, formation of calculus in the kidney and bladder, as well as tumor in the vessels of the urinary tract, which results in excretion of water and deposition of the dense part of the urine behind the tumor.<sup>21-24</sup>

**Dense urine.** The reasons for dense urine are body crisis in getting rid of impurities and cleansing itself, maturity of swelling, injuries of urinating organs, severe inflammation in which the sediment takes the color of the organ which is suffering inflammation, too much eating, inactivity, and calculus formation in the kidney and bladder, in which a lot of sediment is made from urine and severe pain is felt in the pelvis and pudendum.<sup>25</sup>

**Zabad (urine froth).** *Zabad* (froth) or small bubbles in urine can be caused as the result of fusion of moisture and the "wind" which is originated in the body. This froth (*zabad*) is valid and is the sign and cause of wind in the body.<sup>21</sup>

**Urine sediment.** It is the separation of dense

materials from the water in urine which deposits in the bottom or above or in the middle of the phial (qarooreh). This sediment can be either normal or abnormal. The normal one indicates moderation in temper and digestion and ultimate improvement. This white sediment gathers at the bottom of the phial (qarooreh) and is unified and delicately porous. When the phial (qarooreh) is shaken, it quickly disperses but does not deposit and gather together soon.<sup>21</sup>

Jorjani has classified abnormal urine sediments into 4 groups; (1) *Kharrati* (woodturning): the sediment is like sawdust which separates from wood while wood turning. If it is white, it indicates the shedding of the inner lining of the bladder and if it is red, it is the sign of scratch in the kidneys. (2) *Nokhali* (bran): it is in particles and not in red color, indicating a scab or ulcerated bladder or peripheral vessels which may be accompanied by itching at the end of phallus and strong odor and pus. It is pure white. (3) *Moddi* (pus): it is purulent sediment and shows the “explosion of ulcer.” The pus comes out when urinating and mostly is caused by swelling and injuries of urinating organs. In this case, sediment is deposited at the bottom of the phial (qarooreh; Figure). (4) *Damavi* or *olghi* (of blood): it is the sediment which is like a leech and is formed by blood that is clotted and solidified. It is mostly indicator of liver failure and injury of the urinary tract.<sup>21,22</sup>

### Perspective of Modern Medicine Versus Traditional Medicine

According to the texts mentioned above, Muslim scholars did not look at urinalysis only as a means of learning about the urinary tract. Moreover, they believed that systemic diseases may affect the urine, too. A good example is Avicenna’s statement that: “primary features of urine indicate the conditions of the liver, bladder, urinary tract, and blood vessels.” Muslim physicians have also tried to adapt a differential diagnosis of colors in the diagnosis of disease through urine, as Avicenna asserts: “In severe blood diseases, the urine color changes to the color of blood while there is no opening in the vessels,” which is a clear reference to hemolysis. Similarly, when he describes the color change in “hard movements,” he is actually referring to rhabdomyolysis.

The technique of collecting urine was thought

to be important for accurate interpretation. Jorjani recommended collecting the full amount over 24 hours in a large clean vessel and keeping it away from the sun or heat, which could alter color. The vessel was to be shaped in the form of a bladder, in the belief that a more accurate diagnosis would arise if the urine could form in the vessel in the same way that is formed in the body. Jorjani also recognized that food and aging altered urine, and recommended the patient to have a good night sleep and empty stomach before collecting urine. He wrote about this in his most comprehensive instructional book on urine collection and examination. These teachings from Persia dispersed throughout the world and for centuries, they were thought to be the best medical system.<sup>1</sup>

In the words of the ancients, “dense urine” refers to the modern term of oliguria. Based on current knowledge, oliguria is the bad symptom of a kidney disease that occurs in later stages of the disease and is one of the symptoms of end-stage renal disease—a fact that Avicenna referred to in this sentence: “In severe diseases, concentrated urine is a bad symptom for the patient.<sup>26,27</sup>” Moreover, when medical scholars like Jorjani and Avicenna stated that: “If in hyperpyrexia, immediate and concentrated urine is passed, it is a sign of recovery,” they are referring to the kidney function in the recovery phase of acute kidney failure. A fact that shows they were aware of the relation between volume and color of urine with general condition of the body. In modern science, it is clear that in most cases of kidney failure, only water can be excreted and kidneys cannot excrete other wastes and water is odorless—a fact that is possibly referred to by Avicenna and Rhazes when they say: “The odorless urine in cases of severe disease may be a sign of instinctive force of mortality!”

By integrating urinary tract symptoms and other symptoms, Avicenna has proved his genius in detecting and recognizing rare illnesses.<sup>17,21,22,27-29</sup> Avicenna refers to a fine point when he says: “Urine color changes belong to different parts of the body. So, it frequently happens that the urine color implies headache, night wakings, deafness, and disturbed mind. If the color of urine changes following symptoms like night waking, deafness, headache, and anxiety, nose bleeding will occur and it may be the sign of kidney stones.” These

notions of mind disturbance (anxiety), headache, and discoloration of urine, if there is deafness in advance, remind us of Alport syndrome which is the most common hereditary kidney disease among men with symptoms such as glomerulonephritis, hematuria, progressive hearing loss, and eye problems such as cataracts, which may cause death in middle-aged patients with kidney problems (Table).

In traditional medicine, urinalysis was practised as a means of detection of diseases. As today, urine test is done to detect kidney disease or urinary tract disorders (proteinuria as a sign of glomerulonephritis), to monitor renal or urinary tract illnesses (urine culture to evaluate the effectiveness of antibiotic treatment for urinary tract infections), and to identify systemic or metabolic disease (diabetes and Cushing syndrome).<sup>27-29</sup>

#### Time for Urine Collection in Modern Medicine

In modern medicine like the traditional one, it is advised to collect urine in the early morning. The patient should pass before going to bed and the urine sample should be collected immediately after waking up. This sample is an accurate reflection of the patient's condition in the last 24 hours. As it is taken immediately after waking up, alterations induced by body condition do not affect it. This

is in concordance with what Jorjani and Avicenna had already mentioned.<sup>17,22,21,29,30</sup>

#### Interpretation of Urine Color in Modern Medicine

Urine color is one of the basic ingredients of urinalysis, which alters as body condition changes. The range of normal urine color is from pale to dark yellow. While red color may show there is blood in the urine, excessive B vitamins are responsible for the orange color of the urine. Some drugs such as rifampin or phenazopyridine can also turn urine orange. Dark orange to brown may be a sign of liver disease such as hepatitis or rhabdomyolysis (damage to muscle cells). Eating beet may change the color of urine to mild pink. Sometimes eating foods containing artificial colors can cause discoloration of urine. Excessive sweating and fluid loss may change the color of urine to dark yellow.<sup>30,31</sup>

#### Causes of Pus in Urine and Dysuria in Modern Medicine

Pus and dysuria are seen in the presence of urinary tract irritants like spicy foods, acidic foods, urinary tract infections, sexually transmitted diseases (gonorrhoea and chlamydia), inflammation or infection of the bladder and urethra, prostate inflammation or cancer, kidney calculus, and

Similarities Between Traditional Medicine (Rhazes, Avicenna, and Jorjani) and Modern Medicine About Diagnosis Through Urine Examination

Ancient Medicine	Modern Medicine
Red urine indicates blood dominance and can be the result of gallbladder disease.	In modern nephrology, red urine is caused by hematuria, rhabdomyolysis, or hemoglobinuria
Green urine is the symptom of cold nature urine in blue sky color is a sign of severe cold nature.	In modern nephrology, if the urine is green, the patient is suspected to suffer pseudomonas infection
Black urine is the symptom of severe cold nature, severe burning of humours, or sign of a crisis in which the waste black bile is removed from the body. Dark urine can be seen in severe kidney and bladder disorders.	In modern nephrology, black urine suggests alkaptonuria.
White urine (transparent as glass or crystal) is a sign of cold temperament. However, white urine (like milk or paper) is a sign of phlegmatic dominance and shows that a chronic disease has emerged in the body. If it is white with froth and passes with pus, it is a sign of the presence of ulcers in the urinary tract.	In today's nephrology, white urine mostly implies severe pyuria (urinary tract infection); however, in severe proteinuria and phosphaturia, the urine turns white, too.
Diluted urine	Polydipsia
Dense urine	"Dense urine" refers to the modern oliguria.
When the froth on the urine is low with tiny and quick passing bubbles, it shows sticky winds and humours.	One of the main symptoms of proteinuria
Urine color changes belong to different parts of body. For example, it frequently happens that the urine color implies headache, night wakings, deafness, and disturbed mind.	In modern medicine, Alport syndrome which is the most common hereditary kidney disease with symptoms like glomerulonephritis, hematuria, progressive hearing loss, and eye problems such as cataracts, may cause death in middle-aged patients with kidney problems.

fungal infections. Some of the urethra and bladder infections, kidney or bladder calculi, inflammation of the bladder surroundings (probably swelling of the prostate) have been already mentioned by Muslim physicians in lay terminology.<sup>13,17,21,31,32</sup>

### Polyuria and Reduced Urine Flow in Modern Medicine

In modern medicine, polyuria is sometimes natural, for example in cold weather, in altitudes, and after drinking plenty of fluids. Reasons for polyuria in modern medicine are the use of diuretics, diuretic foods (coffee, tea, and acidic fruit juice), diabetes insipidus, mental load, bladder interstitial inflammation, and lupus—some of which have been noted by Rhazes in his comments on diabetes and bladder disease.<sup>13,31-33</sup> Modern medicine also counts the reasons for reduced urine flow as bacterial infection, chemical irritation, toxication of the kidney by medication (eg, penicillin and gentamicin), brain tumor secreting antidiuretic hormone, and obstruction caused by an enlarged prostate.<sup>31-33</sup> In traditional medicine, many of the causes of urine obstruction are mentioned by Zakaria Rhazes which are highly compatible with modern medicine.<sup>13</sup>

### CONCLUSIONS

In the present study, according to the literature reviewed, it was found that the principles of detecting illnesses through urine (in modern and traditional medicine) are highly similar, even sampling in that time (in a container called *qarooreh*) was much the same as today. Comparing the views of Avicenna and his successor, Jorjani, we interestingly noticed that traditional medicine had rapidly improved during that short period of about 100 years. Jorjani, as compared to Avicenna, added more factors in the diagnosis of diseases through urinalysis and as it was already mentioned, he built up his detection on 7 types of urine. This shows the dynamic and progressive nature of the traditional medicine. Medical history has proven that many of today's advances, innovations, and creativities have had their roots in the opinions of great scholars of the past. However, the traditional medicine is a missing chapter in the history of medicine.

Today, by advanced techniques, many diseases can be detected by the clinical testing of urine;

however, after a thorough analysis, we can see that there are some simple and clear instructions in the works of the ancient physicians that, if used properly, can still be beneficial with minimal side effects.

### CONFLICT OF INTEREST

None declared.

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