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The Significance of Urinalysis in Health: A Review of Findings amongst Staff of a Teaching Hospital in South East Nigeria

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Abstract

Background: Urinalysis is a simple and cost effective medical tool used in the assessment of urinary abnormalities for early detection and prompt management of asymptomatic pathologies. **Aim:** This study assessed the urine profile of newly employed health workers of a Teaching Hospital in South East Nigeria. **Method:** A descriptive retrospective approach was employed to assess the urine parameters of 512 employees. **Results:** Abnormal findings occurred in 30.7% of the population, with ascorbic acid being the most common (11.5%) while the least was nitrite constituting 0.58% of the population. The study also revealed that only one male employee had abnormal urine pH. There was no significant association ($p > 0.05$) between gender and urine abnormalities. **Conclusion:** Routine urinalysis should be included in pre-employment medical exams for disease surveillance.

Keywords

Urinalysis, Urine Abnormality, Dipstick Test Strip, Renal Disease, DUFUTH, Ebonyi State, Uburu

1. Introduction

Urinalysis is a medical investigation used to evaluate the appearance, concentration, and content of urine to detect a wide range of medical disorders, such as urinary tract infections, kidney diseases, liver diseases, diabetes mellitus and metabolic abnormalities [1] [2]. When carried out appropriately in the right clinical context, urinalysis can yield a reasonable amount of information for disease surveillance [3]. On a general note, the greater the concentration of atypical substances in urine, such as glucose, protein, or red blood cells, the more likely it is that there is a medical condition that may need further evaluation [1] [4]. Dipstick urinalysis is effective both in community based screening, clinic settings and also in occupational health assessments [5]-[7].

It is pertinent to note that normal urinalysis findings do not guarantee a disease-free body system all the time. Many a time, some people will release a high amount of a substance early in the disease process, while some will occasionally release them later on, which implies that they may be missed by a single urine sample. Aside from its noninvasiveness, urinalysis is economical and readily available when compared to other diagnostic tools [1].

It has been revealed that when blood is found in the urine, which is also known as haematuria, it is not a normal finding [5] [7]. In such a situation, it is required that further investigation be conducted by healthcare practitioner (s) in order to determine the underlying cause of its presence [1]. Proteinuria has been seen as an early manifestation of renal disease [8]. Similarly haematuria, though not as common as proteinuria, may also be indicative of renal or urinary tract disease. Studies have shown that positive urine tests for haematuria and/or proteinuria in mass screening settings are significant predictors of end-stage renal disease [9] [10].

Studies revealed that urobilinogen, though not always a pathological finding, depending on the level of its presence, as well as bilirubin appears in urine when there are abnormalities in liver function or bilirubin metabolism [3] [11] [12]. Positive tests for urobilinogen may indicate liver diseases such as viral hepatitis, cirrhosis, liver damage due to drugs or toxic substances, or conditions associated with increased RBC destruction known as hemolytic anemia.

The nitrite test in urinalysis is a rapid, indirect method for detecting bacteriuria. The positive case or presence of nitrite in urine is suggestive of urinary tract infection (UTI) [1] [4]. This test is a screening test for possible infections caused by nitrate-reducing bacteria. Most of the bacteria that cause urinary tract infections (UTIs) can reduce nitrate to nitrite. Since not all bacteria are capable of converting nitrate to nitrite, someone can still have a UTI despite a negative nitrite test [13]. The result of this test is always considered along with the leukocyte esterase, though not part of the urine constituents or parameters that we are discussing, and microscopic examination.

When glucose is detected in urine, it could be either as a result of an excessively high glucose level in the blood, as may be seen with people who have uncontrolled diabetes mellitus or a reduction in the "renal threshold". Previous studies [1] [13]

revealed that when blood glucose levels reach a certain concentration, the kidneys begin to eliminate glucose from the urine to decrease blood concentrations. This abnormal level of sugar in urine is known as glucosuria. Some other conditions that can cause glucosuria include hormonal disorders, liver disease, medications, and pregnancy [13].

Ketone bodies appear in the urine as a consequence of accelerated fat metabolism. They are produced when glucose is not available to the body's cells as an energy source [3]. In a person who has diabetes, ketones in urine may also be an early indication of insufficient insulin. With insufficient insulin, a diabetic cannot process glucose and instead metabolizes fat [1]. This can cause ketones to build up in the blood, resulting first in ketosis and then progressing to ketoacidosis which is a form of metabolic acidosis. Excess ketones and glucose are dumped into the urine by the kidneys to flush them from the body [11]. This condition, called diabetic ketoacidosis (DKA), is most frequently seen with uncontrolled type 1 diabetes and can be a medical emergency. Ketone can equally form when a person does not eat enough carbohydrates, like in cases of fasting, starvation, or high protein diets, or when a person's body cannot use carbohydrates properly [13].

People who are exposed to vitamin C or multivitamins on many occasions may have large amounts of ascorbic acid in their urine. It is required that a laboratorian test the sample for ascorbic acid (vitamin C) when this is suspected to be the case, because it has been known to interfere with the accuracy of some of the results of the chemical test strip, causing them to be falsely low or falsely negative. Examples of tests that may be affected include tests for glucose, blood bilirubin, nitrite, and leukocyte esterase.

Pre-employment medical screening is highly recommended for surveillance of disease conditions which may affect employees' quality of life and productivity in the long run, and also for prevention of diseases as well as early treatment of diseases when detected [14]. This study aimed to assess the urine examination findings of the newly employed staff of David Umahi Federal University Teaching Hospital, Uburu, Ebonyi State, Nigeria.

2. Materials and Method

2.1. Study Design

This was a descriptive retrospective hospital based study which analyzed the urine parameters of prospective staff who presented for pre-employment medical screening in the newly established David Umahi Federal University Teaching Hospital (DUFUTH), Uburu, Ebonyi State, Nigeria to ascertain their medical fitness which was a pre-requisite for completion of their documentation.

2.2. Study Area

This study was carried out at the David Umahi Federal University Teaching Hospital (DUFUTH), Uburu. It is a foremost tertiary institution birthed by the Ebonyi state Government of Nigeria in the year 2022 and later taken over by the Federal

Republic of Nigeria for proper management. It is located at Umunaga community, Uburu in Ohaozara local government area of Ebonyi state, Nigeria. DUFUTH is a health institution with a staff strength of 756 and hospital bed capacity of 500 with the state-of-the-arts facilities for modern medicine practice. The hospital is situated at these coordinates; Latitude: N 60 1' 53", Longitude: E 70 43' 10", and Altitude: 56.5 m [15].

2.3. Study Population

The study population consists of the 756 individuals who were considered during the maiden employment exercise conducted in the hospital.

2.4. Sample Size

A total of 512 laboratory results for urine parameters were assessed from the register of the Clinical Microbiology Unit, Department of Medical Laboratory Services, and they served as the sample size for this study.

2.5. Inclusion and Exclusion Criteria

Newly recruited staff of the institution who performed their pre-employment medical screening within the hospital facility and whose bio-data (age, gender and laboratory results) were contained in the register of the Department of Medical Laboratory Services were included in the study while those with missing bio-data and those who carried out their medical screening outside the hospital were excluded from the study.

2.6. Ethical Considerations

Approval to carry out this study was obtained from the Chairman, Medical Advisory Committee (CMAC), as the Research and Ethics Committee of the hospital had not been constituted as at the time this research was conducted. The assurance of utmost confidentiality of the staff medical records was given.

2.7. Urinalysis

The result analyzed was obtained by the Medical Laboratory Scientist according to the protocol briefly explained below: Every employee was given a sterile leak-proof universal bottle which was properly labelled with their unique serial numbers. They were instructed on how to carefully obtain the urine specimen. The urine specimens were examined using the Combi 9 Dipstick urine test (Macherey-Nagel, Duren, Germany) which is a dipstick test for the components of urine: Blood, urobilinogen, bilirubin, protein, nitrite, ascorbic acid, glucose, ketone, and also the urine pH. Prior to the urine sample testing, it was properly mixed in its container. The duration of the test was determined using a timer. The reagent strips were completely immersed into the fresh urine for 1 second and drawn across the rim of the container to remove excess urine. Thereafter, they were held in a flat horizontal position. After 60 seconds, the test strip was compared with

the appropriate color chart on the bottle label and the results were recorded. Color changes that appeared only along the edges of the test pads or after more than 2 minutes have passed were of no significance.

2.8. Data Collection

Data were collected from the register of the Clinical Microbiology Unit, Department of Medical Laboratory Services, DUFUTH between November 2022 and March 2023.

2.9. Statistical Analysis

The statistical packages used for the data entry and analysis in this study were IBM SPSS Statistics 26 and Microsoft Excel 2013. The socio-demographic analysis of the variables was carried out by descriptive statistics. While the Chi-square test was used to test for significance of association where p-value < 0.05 was considered significant.

3. Results

3.1. Age and Gender Distribution of Participants

The result shown in Table 1 revealed that 512 employees within the age bracket of 18 and 67 years participated in this study. Majority of these employees comprising both clinical and non-clinical staff were within 28 - 32 years accounting for 165 (32.22%) of the population, followed closely by those in the age bracket of 33 - 37 years, that contributed 145 (28.32%) of the population. Furthermore, 304 females, and 208 males enrolled for the study contributing 59.40% and 40.60% of the population respectively.

Table 1. Age and gender distribution of participants.

Age group	Frequency	Percentage (%)
18 - 22	8	1.56
23 - 27	58	11.33
28 - 32	165	32.22
33 - 37	145	28.32
38 - 42	83	16.21
43 - 47	32	6.25
48 - 52	12	2.34
53 - 57	2	0.39
58 - 62	5	0.98
63 - 67	2	0.39
Total	**512**	

Continued

Gender		
No of Male	208	40.60%
No of Female	304	59.40%

3.2. Prevalence of Normal and Abnormal Urine Parameters

The abnormal urine components assessed as shown in (Table 2 and Figure 1) revealed that the number of employees that had blood in their urine were 25 (4.88%) while those with protein were 23 (4.49%). Urobilinogen, Bilirubin and Nitrite were present in 8 (1.56%), 13 (2.54%), and 3 (0.58%) persons respectively. Ascorbic Acid was the most common urine abnormality and it was found in 59 (11.52%) employees. Glucose and ketone were seen in 19 (3.71%) and 7 (1.37%) subjects respectively.

Table 2. The distribution of urine parameters.

Parameters	Frequency	Percentage (%)
Blood		
Negative	487	95.12
Positive	25	4.88
Urobilinogen		
Negative	504	98.44
Positive	8	1.56
Bilirubin		
Negative	499	97.46
Positive	13	2.54
Protein		
Negative	489	95.51
Positive	23	4.49
Nitrite		
Negative	509	99.42
Positive	3	0.58
Ascorbic acid		
Negative	453	88.48
Positive	59	11.52
Glucose		
Negative	493	96.29
Positive	19	3.71

Continued

Ketone		
Negative	505	98.63
Positive	7	1.37

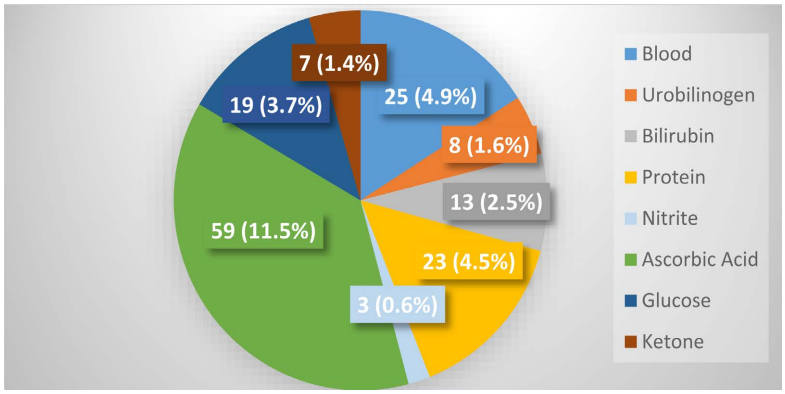

Figure 1. The abnormal urine findings.

3.3. Gender-Based Prevalence of Abnormal Urine Parameters

The data in Figure 2 indicate that out of the 25 cases of blood in urine, females contributed 23 (92%) while their male counterparts made a contribution of 2 (8%). Urobilinogen was found in the urine of 8 participants with a gender distribution of 1 (12.5%) and 7 (87.5%) for male and females respectively. Bilirubin was present in 4 (31%) males and in 9 (69%) females. For the 23 cases of proteinuria found in the population, 12 (52%) were attributed to females, and 11 (48%) to males. No record of nitrite was seen amongst the males whereas the female gender accounted for the 3 cases seen. Furthermore, ascorbic acid which had the highest prevalence among all the considered urine parameters was also higher in females than in males with frequencies of 17 (29%) and 42 (71%) for male and female respectively. A total of 19 cases of glucose in urine were observed, 11 (58%) in females while 8 (42%) occurred in males. Furthermore, females accounted for 4 (57%) out of the 7 cases of ketonuria while the remaining 3 (43%) were found in males. Generally, female contribution to each of the constituents of urine abnormalities is higher than that of male as revealed in Figure 2. However, there was no significant relationship between gender and prevalence of abnormal urine parameters (Table 3).

3.4. Gender Distribution of Urine pH

The pH value with highest occurrence is 7.0 with a frequency of 166 (32.42%), a greater proportion of this pH was contributed by females (93) while males accounted for 73. Next in order of frequency is 6.0 pH with a frequency of 159 (31.05%). It has a gender distribution of 56 and 103 for males and females respectively. The pH of 5 had a frequency of 155 (30.27%), 66 was accounted for by males and 89 by females. Urine pH values with the least occurrence were 5.5 and 9.0 each with a frequency of 1 (See Table 4 and Figure 3).

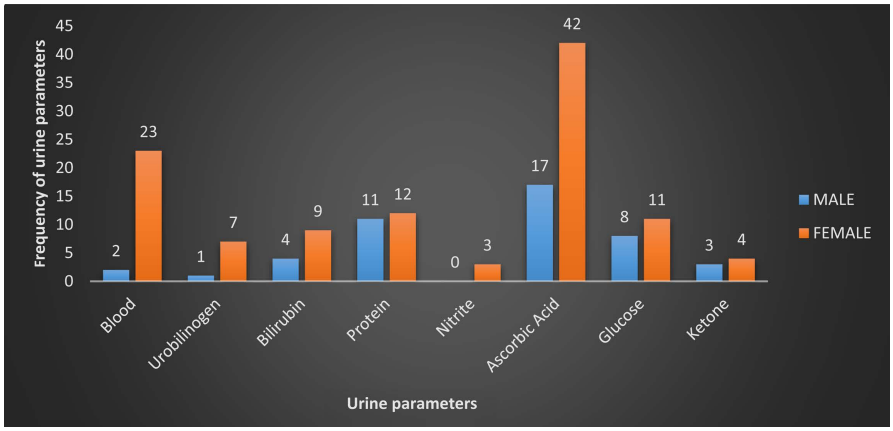

Figure 2. Distribution of urine abnormalities across gender.

Table 3. Chi-square test of relationship between urine abnormalities and gender.

Parameters	Male	Female	Frequency	χ^2-value	p-value
Blood	2	23	**25** (4.9%)	**13.675**	**0.056**
Urobilinogen	1	7	**8** (1.6%)		
Bilirubin	4	9	**13** (2.5%)		
Protein	11	12	**23** (4.5%)		
Nitrite	0	3	**3** (0.6%)		
Ascorbic acid	17	42	**59** (11.5%)		
Glucose	8	11	**19** (3.7%)		
Ketone	3	4	**7** (1.4%)		
Total	**46**	**111**	**157**		

χ^2-value = Chi-square, p-value < 0.05 is considered significant.

Table 4. The values of urine PH across gender and the corresponding percentages.

pH	Frequency	Gender		Percentage (%)
		Male	Female	
5.0	155	66	89	30.27
5.5	1	0	1	0.20
6.0	159	56	103	31.05
6.5	3	1	2	0.59
7.0	166	73	93	32.42
8.0	27	11	16	5.27
9.0	1	1	0	0.20
Total	**512**	**208**	**304**	

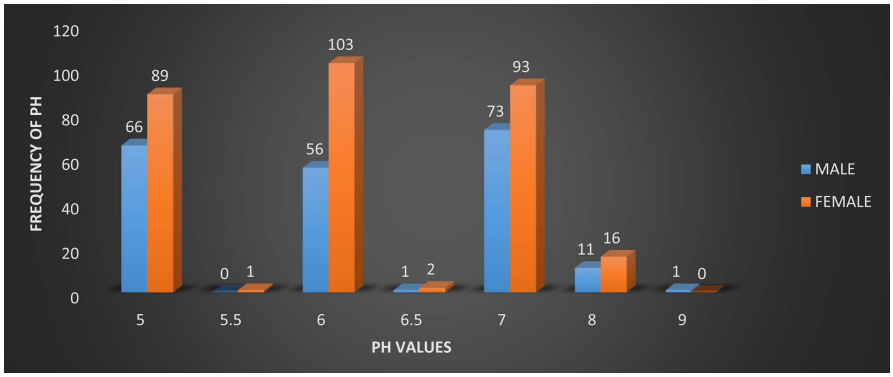

Figure 3. The distribution of urine pH across gender.

4. Discussion

Dipstick urinalysis is an economical and readily available diagnostic tool suitable for use in resource poor countries/laboratories for disease surveillance [1]. The female gender had higher preponderance of urine abnormalities relative to their male counterpart with a higher prevalence occurring within the youthful age. This could be due to the fact that young people are more likely to be considered for job placements than the elderly.

Cases of haematuria (blood in urine) and proteinuria among the population were 4.88% and 4.49% respectively. It has been revealed that presence of blood in urine is not a normal finding [5]. In such situation, it is required that further investigation be conducted by healthcare practitioner(s) in order to determine the underlying cause [1]. Proteinuria has been seen as an early manifestation of renal disease [8]. Similarly haematuria, though not as common as proteinuria, may be indicative of renal or urinary tract disease. Studies have shown that positive urine tests for haematuria and/or proteinuria in mass screening settings are significant predictors of end-stage renal disease [9] [10]. The 4.88% prevalence of blood in urine is higher than 0.55% reported by [16] and lower than 11% [17]. Female accounted for 92% of the overall blood in urine cases noticed in this study. According to Goldberg and Krause [18], women have higher tendency of developing chronic kidney disease (CKD) than men, although men are more likely to reach kidney failure. The reason women are more likely to have CKD is because of their greater likelihood of getting urinary tract infections which can lead to kidney damage. Women also have increased risk for kidney damage due to problems with pregnancy, such as high blood pressure or eclampsia.

Proteinuria was found in 23 (4.5%) of the urine samples. This is comparable to the findings of [19] that reported a proteinuria prevalence of 4.7% in routine urinalysis of asymptomatic adolescents in Nigeria. However, in a study of urinalysis in primary health care centers in Saudi Arabia [17], proteinuria was reported in 11.7% of respondents, which is higher than 4.5% prevalence in this study. Solanki *et al.* [10] noted that healthy adults normally excrete 80 - 150 mg of protein in urine daily. Normal urinary proteins include serum globulins, albumin, and proteins secreted by the nephron. Detectable proteinuria may be an early sign of

renovascular, glomerular or tubulo-interstitial renal disease. Similarly haematuria, though not as common as proteinuria, as earlier noted may also be indicative of renal or urinary tract disease [8]-[10]. Contamination of urine samples with menstrual blood could also be one of the reasons females had higher prevalence of blood in the urine than male since females who were menstruating or had recently finished menstruating were not excluded from the study [3].

The prevalence of urobilinogen, bilirubin and nitrite in this study were 1.56%, 2.54% and 0.58% respectively. Studies revealed that urobilinogen, though not always a pathological finding, depending on its level, as well as bilirubin appears in urine when there are abnormalities in liver function or bilirubin metabolism [3] [11] [12]. Positive test for urobilinogen may indicate liver diseases such as viral hepatitis, cirrhosis, liver damage due to drugs or toxic substances, or conditions associated with increased RBC destruction known as hemolytic anemia. The nitrite test in urinalysis is a rapid, indirect method for detecting bacteriuria. The presence of nitrite in urine is suggestive of urinary tract infection (UTI) [1] [4]. This test is a screening test for possible infections caused by nitrate-reducing bacteria. Most of the bacteria that cause urinary tract infections (UTIs) can reduce nitrate to nitrite. Since not all bacteria are capable of converting nitrate to nitrite, one can still have a UTI despite a negative nitrite test [13]. The result of this test is always considered along with the leukocyte esterase, though not within the scope of this study.

The commonest urine parameter was ascorbic acid seen in 11.52% of the population. This is lower than 24% positive cases recorded by [20] and higher than 10.2% obtained by [21]. This could be as a result of the high intake of vitamin C or multivitamins present in many foods today. When this is suspected to be the case, a laboratorian may test the sample for ascorbic acid (vitamin C) because it has been known to interfere with the accuracy of some of the results of the chemical test strip, causing them to be falsely low or falsely negative [1].

Glucose and ketone respectively recorded 3.71% and 1.37 % prevalence of the study population. When glucose is detected in urine, it could be either as a result of an excessive high glucose level in the blood, as may be seen with people who have uncontrolled diabetes mellitus or a reduction in the "renal threshold". Previous studies [1] [13] revealed that when blood glucose levels reach a certain concentration, the kidneys begin to eliminate glucose from the urine to decrease blood concentrations. This abnormal level of sugar in urine is known as glucosuria. Some other conditions that can cause glucosuria include hormonal disorders, liver disease, medications, and pregnancy [13].

Ketone bodies appear in the urine as a consequence of accelerated fat metabolism. They are produced when glucose is not available to the body's cell as an energy source [3]. In a person who has diabetes, ketones in urine may also be an early indication of insufficient insulin. With insufficient insulin, a diabetic cannot process glucose and instead metabolizes fat [1]. This can cause ketones to build up in the blood, resulting first in ketosis and then progressing to ketoacidosis which is a form of metabolic acidosis. Excess ketones and glucose are dumped into

the urine by the kidneys to flush them from the body [8]. This condition, called diabetic ketoacidosis (DKA), is most frequently seen with uncontrolled type 1 diabetes and can be a medical emergency. Ketone can equally form when a person does not eat enough carbohydrates, like in cases of fasting, starvation, or high protein diets, or when a person's body cannot use carbohydrates properly [10].

For the urine pH which is a reflection of the concentration of hydrogen ion in urine, Hiren [17] noted that it is normal in a healthy individual when the urine pH falls within the range of (5.0 - 8.0) and from the result, only one person had abnormal urine pH and it was a male employee. Urine pH determines the degree of acidity or alkalinity of urine sample. A low urine pH promotes the formation of uric acid and cysteine stones, whereas high urine pH promotes calcium-phosphate precipitation [9] [22]. Neutral pH of urine is seven (7). If the solution pH is less than seven (7), then it is acidic. While it is basic when the pH solution is greater than seven.

The overall abnormal urine component was detected in 157 urine samples (30.7%) in this study. This finding is lower than the prevalence of 52.8% and 35% reported in previous studies [3] [19]. It is much higher than the prevalence of 5.25% and 15.4% obtained by other researchers [19] [23]. Other researchers reported the prevalence of urinary abnormalities in young adults in south eastern part of Nigeria to be between 20.7% and 54% [4] [24]. It can be inferred from the above findings that the prevalence of urine abnormality varies from one study to another. These variations could be due to differences in methodology and socio demographic characteristics of the study cohort, or due to epidemiologic variations between the study areas [25].

The finding of a higher frequency of urine parameters among females than male could be a reflection of the architecture of their urogenital system which predisposes them to higher rates of infection. However, there was no significant association (p-value > 0.05) between sex distribution and urine abnormalities, despite the fact that more abnormalities occurred among the female participants than their male counterparts in this study.

5. Conclusion

The prevalence of urine abnormality seen among the new employees of David Umahi Federal University Teaching Hospital, Uburu, Nigeria was 30.7% as detected by dipstick urinalysis. It was revealed that the most prevalent urine was Ascorbic acid (11.5%). The result of this study revealed that more abnormalities occurred among the female participants, than the males, even though there was no significant association (p-value > 0.05) between the sex distribution and urine abnormality. The study also revealed that only one person (a male participant) was reported to have abnormal urine pH.

Recommendations

Routine urinalysis is strongly recommended as part of medical examination when

considering prospective employees for job recruitments in any organization because of its importance in disease surveillance. It is also recommended that positive dipstick test for some of these urine constituents like haematuria and proteinuria should prompt further evaluation for the presence of renal disease and other diseases, provided false positive results have been ruled out.

Conflicts of Interest

There is no conflict of interest with respect to authorship, and/or publication of this article.

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