

Dirty renal sinus fat, a new radiological sign predicting simple urinary tract infection: sex prevalence

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Background

Urinary tract infection (UTI) is considered one of the most frequently occurring bacterial infections; however, its diagnosis is not always straightforward. Nowadays, ultrasonography (US) is the modality of choice in assessment of suspected cases of upper UTIs. Dirty renal sinus fat was diagnosed as irregular-shaped linear hypoechoic streaks that are seen arising from the renal sinus and extending laterally with haziness of the outline of the hyperechoic renal sinus fat. The aim of this study is to document a new simple radiological sign (dirty renal sinus fat) that can help in the diagnosis of UTIs.

Patients and methods

A cross-sectional study was conducted that included 46 patients visiting Hala Eisa Hospital searching for medical advice who were selected randomly during the period January–April 2019. All the patients were selected after the abdominal US that revealed the dirty renal sinus fat sign or the patients had clinical picture suggesting UTI. The sonographic appearances of all cases were analyzed by the same radiologist who was blinded to the urine culture results that were done for all patients.

Results

Using urine culture examination, 16 patients had positive urinary infection (two males and 14 females). For males, the two cases diagnosed by urinary examination were diagnosed also by US, in addition to another seven cases, with a sensitivity of 100%, specificity of 66.7%, and area under the curve of 83.3. However, for women, the US examination missed one case from the 14 cases diagnosed by urinary examination, in addition to misdiagnosis of another three cases as positive urinary infection, with a sensitivity of 92.9%, specificity of 66.7%, and area under the curve of 79.8.

Conclusion

Dirty renal sinus fat is a new reliable US finding that can help the urologist and internal medicine physicians in suspecting UTI as a hidden or unexpected finding that can explain the patient's complaint.

Keywords:

dirty sinus fat, ultrasound, urinary tract infections, urine culture

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Introduction

Urinary tract infection (UTI) is one of the most frequently occurring bacterial infections all over the world, coming second to respiratory tract infection [1]. Women are greatly more susceptible to UTI than males [2], as more than 50% of women will experience UTI during their life [3]. The estimated number of patients visiting doctors owing to UTIs is ~8.3 million visits per year [1]. The social cost owing to UTIs is so expensive that it may cost billions of dollars in developed countries [4].

Studies in Sweden and other parts of Europe reported that it is a common worldwide problem, as one in five adult women experiences a UTI at a time [5]. In USA, symptoms involving the genitourinary tract are seen to account for ~3.9% of office visits in 2007 [6]. Overall, 61% of all UTIs can be treated in the primary care

setting with considerable number of recurrence of these episodes [7].

In Egypt, a study conducted on an asymptomatic population found the prevalence of UTIs to be 58% among males, and 46.7% among females [8]. Other studies on pregnant women in Egypt found that the prevalence was within the range of 22–35% [9].

UTIs are challenging because of the large number of affections, and the diagnosis is not always straightforward. Physicians must be able to differentiate it from other diseases with similar

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clinical presentation. As some UTIs are asymptomatic or manifest itself with atypical signs and symptoms, physicians frequently depend upon some laboratory tests to clarify the diagnosis. Urine analysis and urine culture are considered with no surprise to account for one of the large part of the workload in many hospital-based laboratories. Of them, urine cultures account for 24–40% of submitted cultures, and 80% of these cultures are directed from the outpatient setting [10].

According to the Infectious Disease Society of America guidelines, urine analysis is considered the basic test for evaluation of suspected UTI with determination of leukocyte esterase and nitrite level by use of dipstick. If the urinary dipstick is negative for leukocyte esterase and nitrite, the negative predictive value is 100% and there is no need for further evaluation [11]. If pyuria or a positive leukocyte esterase or nitrite is present, we should be directed to urine culture to determine the antibiotic of choice [12].

The aim of our study was to document a new simple radiological sign that can help in the diagnosis of UTI either as a separate sign or during routine ultrasound (US) examination of the abdomen.

Patients and methods

Patients and study design

Between January 2019 and April 2019, 46 patients were selected randomly from patients visiting Hala Eisa Hospital searching for medical advice from outpatient clinics, especially internal medicine and urology departments. All the patients are selected after the abdominal US revealed the dirty renal sinus fat sign or the patients had clinical picture suggesting UTI. Dirty sinus fat was diagnosed as irregular-shaped linear hypoechoic streaks that are seen arising from the renal sinus and extending laterally with haziness of the outline of the hyperechoic renal sinus fat. Urine cultures were done for all patients in the study.

Ethical approval

Local ethical committee approval was obtained from Hala Eisa Hospital administrator in 2019, and patients who agreed to join the study signed a well-informed consent form before inclusion in the study. The study was conducted according to the principles expressed in the Declaration of Helsinki.

Methods

US scanning of the patient was carried out using Logic 9 (GE machine; General Electric Company GE,

Chicago, USA) using 3.5/5 MHz transducers for scanning of the whole abdomen with special examination of both kidneys to find or exclude the presence of the dirty renal sinus fat sign. The sonographic appearances of all cases were analyzed by the same radiologist who was blinded to the urine culture results.

Urine culture was done for every patient using VITEK 2 COMPACT machine (compact, automated ID/AST instrument). The urine sample is kept in the laboratory for 2–3 days and would make a note of how many types of germs or bacteria are present in the urine sample and how many are growing. The test is termed negative if there are no germs noticed in the urine sample. Positive tests are collected and matched with the corresponding US findings.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS/Windows Version 16; SPSS Inc., Chicago, Illinois, USA). Outcomes were considered statistically significant if the *P* value was less than 0.05. Parametric data (age) was expressed as mean $\pm$ SD. Frequency of participants who suffer from urinary infection; according to either urine culture or US examinations; were calculated. The validity of US in the diagnosis of urinary infection; using urine culture examination as gold standard tool; was examined by using a receiver operating characteristic curve to assess the area under the curve, sensitivity, and specificity. Sensitivity was calculated as true positives/(true positives+false negatives); specificity as true negatives/(true negatives+false positives). True-positive patients were those with urinary infection by urine culture examination and US. True-negative patients were those without urinary infection by urine culture examination and US. False-positive patients were those with urinary infection by urine culture examination and normal by US. False-negative patients were those without urinary infection by urine culture examination but had urinary infection by US.

Results

This study included 46 patients (23 males and 23 females). The mean age of the male patients was 36.57 ± 14.84 years, whereas the mean age for female patients was 22.75 ± 19.55 years. Frequency distribution of the cases with urinary infection revealed that using urine culture examination, there were 16 patients who had positive urinary infection (two males and 14 females) (Table 1).

Table 1 Frequency distribution of the cases with urinary infection using ultrasound and urinary examination

	US [<i>n</i> (%)]	Urine culture [<i>n</i> (%)]	Sensitivity	Specificity
Males (<i>N</i> =23)				
With infection	9 (39.1)	2 (8.7)	100	66.7
Without infection	14 (60.9)	21 (91.3)		
Females (<i>N</i> =23)				
With infection	16 (69.6)	14 (60.9)	92.9	66.7
Without infection	7 (30.4)	9 (39.1)		
Total (<i>N</i> =46)				
With infection	25 (54.3)	16 (34.8)	93.8	66.7
Without infection	21 (45.7)	30 (65.2)		

Using US, there was overestimation of the cases (25 cases vs. 16). For male patients, the two cases diagnosed by urinary examination was diagnosed also by US, in addition to another seven cases with a sensitivity of 100%, specificity of 66.7%, and area under the curve of 83.3 (Fig. 1).

In female patients, the US examination missed one case from the 14 cases diagnosed by urinary examination, in addition to misdiagnosis of another three cases as positive urinary infection with a sensitivity of 92.9%, specificity of 66.7%, and area under the curve of 79.8 (Fig. 2). For the total sample, using US examination had a sensitivity of 93.8%, specificity of 66.7%, and area under the curve of 80.2 (Fig. 3).

Discussion

UTI is considered one of the significant health economic burdens, as it occurs in a high proportion of the population. For its diagnosis, multiple clinical criteria as well as laboratory tests are needed [13]. Urinalysis and sometimes urine cultures are mandatory and are the gold standard in evaluation of all patients with dysuria. The best in the evaluation is the midstream clean-catch urine specimen. Bacteria or pyuria (or both) are usually found in patients with UTI. The sensitivity of leukocyte esterase in detection of UTI is ~75% (although some studies demonstrated only 48% sensitivity), and the specificity is about 98%. Regarding positive nitrite, the specificity is 90% but the sensitivity is only 30% [14].

The present study documented the role of US as an easy, accessible, low-cost examination with no radiation hazard in the assessment of simple UTI, in addition to assessment of a new sign that is named as dirty renal sinus fat. This sign is considered present if there are linear hypoechoic streaky lines radiating from

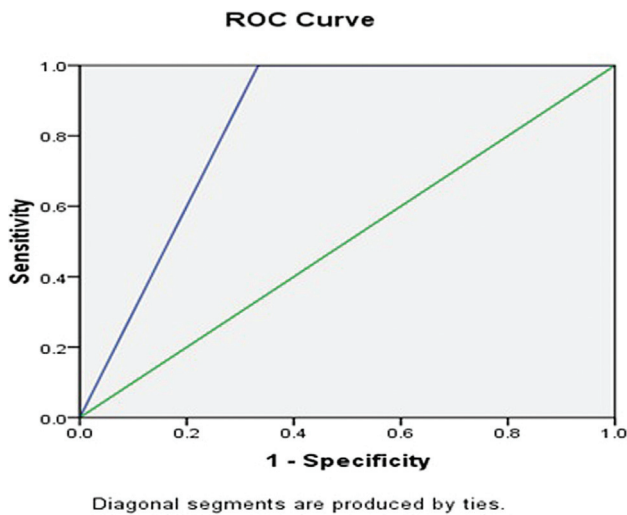
the renal sinus fat that has blurred outline with extension and direction laterally. The sign is considered of value if it is detected unilaterally or bilaterally. To simplify the description, one can say that when studying the renal sinus fat by US there were small irregular-shaped hypoechoic areas within not rising to the level of minimal back pressure changes with blurring of renal sinus fat (as shown in Fig. 4). The term dirty sinus fat is derived from the old name of dirty chest on plain radiograph film.

The present study demonstrates a high frequency of this US sign which is dirty renal sinus fat that is documented to be found on screening of the urinary tract in patients with positive urine culture. For male patients, the sensitivity was 100% and specificity 66.7%, whereas for female patients, the sensitivity was 92.9% and specificity was 66.7%. For the total sample, using US examination had a sensitivity of 93.8% and specificity of 66.7%.

Women are more affected than men in all age groups. The incidence in young sexually active women ranges from 0.5 to 0.7 per person-year, whereas in young men aged 18–24 years, the incidence is 0.01 per person-year [15]. The occurrence of UTI diminishes during middle age and increases in older adults [16]. Approximately 10% of American women with age more than 65 years old had been reported to get UTI within the past 12 months with increased incidence to almost 30% in women with age over 85 years ($P<0.05$) [17].

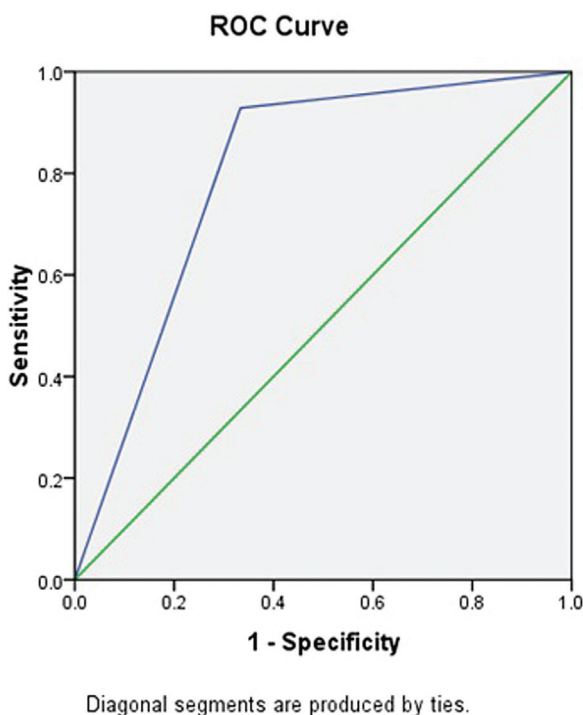
In the USA, the clinical and financial burden of UTIs upon health is great. Approximately 62.7 million adults aged 20 years and older have reported at least one attack of UTI or cystitis [18], with the female section representing ~50.8 million (81%). In 2000, patients aged 20 years and older with a UTI represent ~11 million office and outpatient hospital visits, and of them, approximately nine million are

Figure 1



Receiver operating characteristic (ROC) curve to identify cases with urinary infection among male participants. The area under the curve is 0.833 ($P>0.05$) with 95% confidence intervals ranged between 0.640 and 1.026. The straight line is the line of identity, corresponding to an area under the curve of 50%.

Figure 2

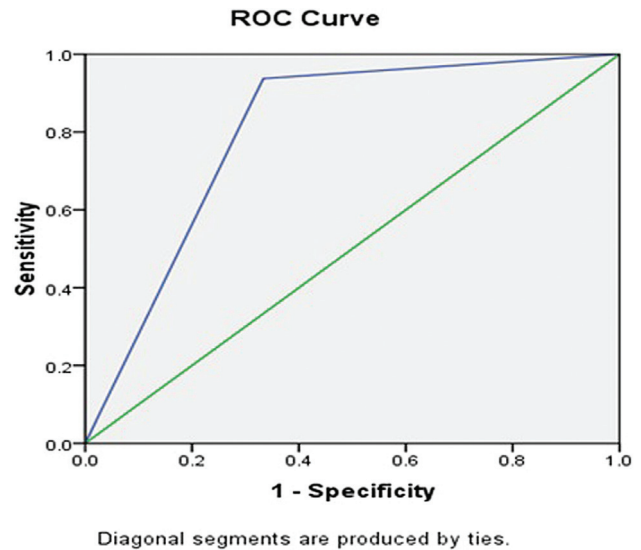


Receiver operating characteristic (ROC) curve to identify cases with urinary infection among female participants. The area under the curve is 0.798 ($P<0.05$) with 95% confidence intervals ranged between 0.589 and 1.006. The straight line is the line of identity, corresponding to an area under the curve of 50%.

females. Evaluation and treatment of UTI in 2000 costed ~3.5 billion dollars [18,19].

In agreement with the previous studies, it was found that the randomly selected patients with UTI in this

Figure 3



Receiver operating characteristic (ROC) curve to identify cases with urinary infection among total participants. The area under the curve is 0.802 ($P>0.01$) with 95% confidence intervals ranged between 0.672 and 0.932. The straight line is the line of identity, corresponding to an area under the curve of 50%.

study are also more documented in females more than males.

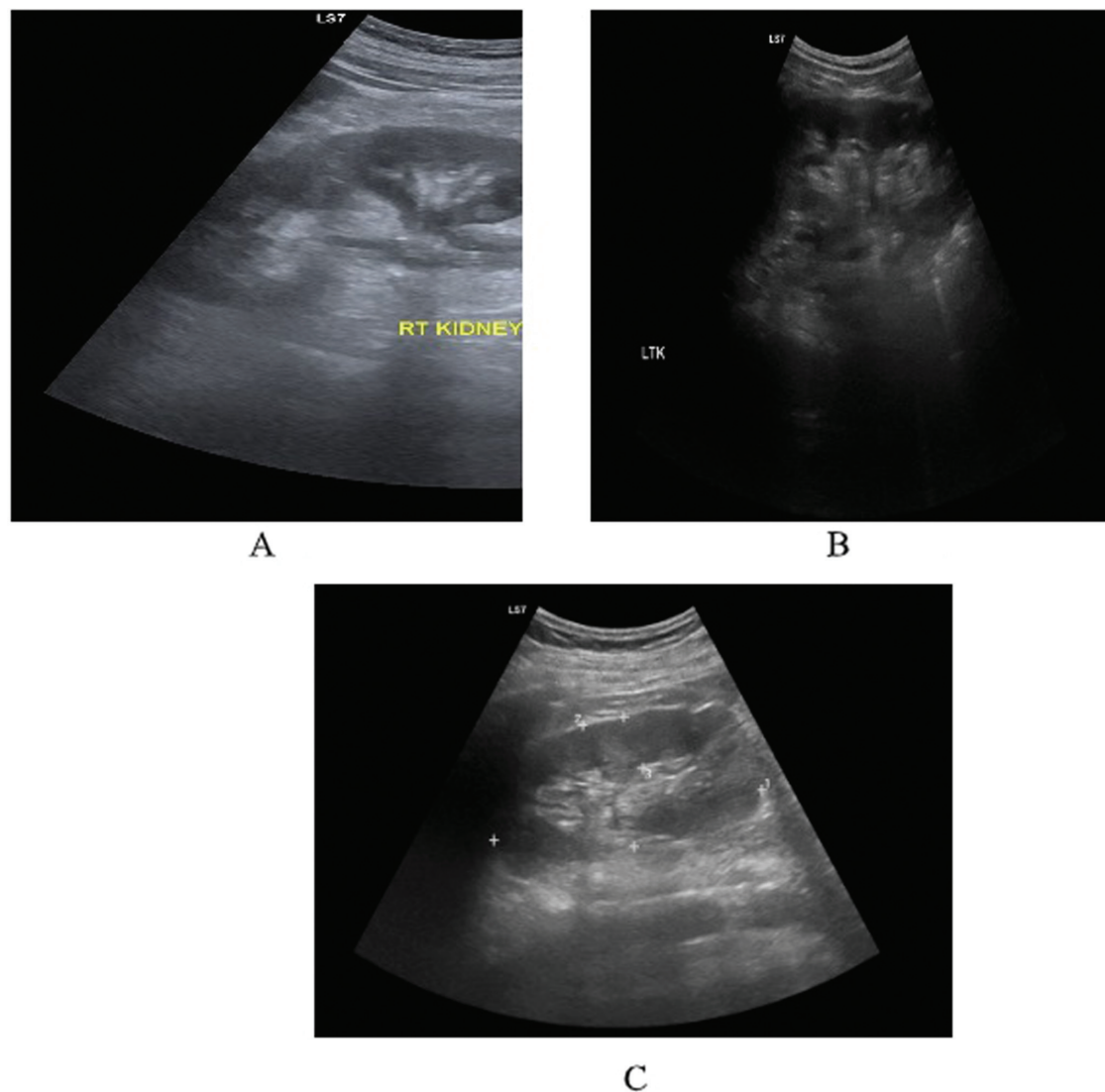
According to the CDC, 8.6 million ambulatory care visits that need medical treatment at 2007 are owing to UTIs with 23% of them occurred in the emergency department (ED) [20]. In between 2006 and 2009 in the USA, more than 10.8 million patients with UTI asked for medical care in the ED, with 1.8 million (16.7%) of them admitted to acute care hospitals [21]. The economic burden for treatment of UTI at the ED is estimated to be about \$2 billion annually. In addition, UTI is considered the infection no. 1 that leads to an antibiotic prescription by the physician [22]. Each year in the USA, ~10% of women have one or more attack of symptomatic UTIs with the highest incidence among young, sexually active women 18–24 years of age. Approximately 25% of them have spontaneous resolution of symptoms. The incidence of UTIs in males are significantly lower than in females with more affection in older adult men [23].

During recent years in Germany, the resistance of pathogens to commonly used antibiotics has significantly increased. Half of all women will experience a UTI in their lifetime. Approximately 20% of them who have one UTI will have another UTI [24].

Conclusions

Dirty renal sinus fat is a new reliable US finding that can help the urologist and internal medicine doctors in

Figure 4



Different pictures with dirty sinus fat sign (A, B, C) with hypo-echoic linear echogenicities at the renal sinus fat.

suspecting UTI as a hidden or unexpected finding that can explain the patients' complaints. We recommend documentation of this sign in a larger group study.

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Author contributions

Mohamed S. El Hussieny: conceived and designed the study. He was responsible about Ultrasound examination. Sahar A. El-Masry: statistical analysis and interpretation of the data. Emad El-Masry

responsible about laboratory investigations [urine culture]. All authors contributed to the collection of references, drafting of the article and final approval of the version to be submitted. All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

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Nil.

Conflicts of interest

The authors declare that there are no financial and personal relationships with other people or organizations that could inappropriately influence [bias] the present.

References

- 1 Pushpalatha KS. Urinary tract infection and management. J Nighting Nursing Times 2008; 4:28–32.

- 2 Al Khikani FH, Kadim BJ, Ayit AS, Abidalali MH. Evaluation cephalosporins resistance in pathogenic bacteria isolated clinical. *World News Natl Sci* 2020; 31:110–119.
- 3 Al-Badr A, Al-Shaikh G. Recurrent urinary tract infections management in women: a review. *Sultan Qaboos Univ Med J* 2013; 13:359–367.
- 4 Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol* 2015; 13:269–284.
- 5 Naber KG, Schito G, Botto H, Palou J, Mazzei T. Surveillance study in Europe and Brazil on clinical aspects and Antimicrobial Resistance Epidemiology in Females with Cystitis (ARESC): implications for empiric therapy. *Eur Urol* 2008; 54:1164–1175.
- 6 Hsiao CJ, Cherry DK, Beatty PC, Rechtsteiner EA. National Ambulatory Medical Care Survey: 2007 summary. *Natl Health Stat Rep* 2010; 27:1–32.
- 7 Medina-Bombardó D, Jover-Palmer A. Does clinical examination aid in the diagnosis of urinary tract infections in women? A systematic review and meta-analysis. *BMC Fam Pract* 2011; 12:111.
- 8 Sayed HA, Hammam O, Sabryb H, Akl M, Amin T, El Lithy T, Roshdy M, El Ganzoury H. Epidemiologic approach for early detection and control of renal and urinary tract diseases in rural populations. *J Egypt Soc Parasitol* 2004; 37:313–328.
- 9 Badr AFK. Bacteruria in Egyptian pregnant women: a clinical and bacteriological study. *J Egypt Public Health Assoc* 2007; 82:3–4.
- 10 Michael L. Wilson Loretta Gaido laboratory diagnosis of urinary tract infections in adult patients. *Clin Infect Dis* 2004; 38:1150–1158.
- 11 Juthani-Mehta M, Tinetti M, Perrelli E, Towle V, Quagliarello V. Role of dipstick testing in the evaluation of urinary tract infection in nursing home residents. *Infect Control Hosp Epidemiol* 2007; 28:889–891.
- 12 High KP, Bradley SF, Gravenstein S, Mehr DR, Quagliarello VJ, Richards C, Yoshikawa TT. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2009; 48:149–171.
- 13 Moustafa A, Li W, Singh H, Moncera KJ, Torralba MG, Yu Y, Manuel O, Biggs W, *et al.* Microbial metagenome of urinary tract infection. *Sci Rep* 2018; 8:4333.
- 14 Litza JA, Brill JR. Urinary tract infections. *Prim Care* 2010; 37: 491–507.
- 15 Griebing TL. Urologic diseases in america project: trends in resource use for urinary tract infections in men. *J Urol* 2005; 173:1288–1294.
- 16 Jackson SL, Boyko EJ, Scholes D, Abraham L, Gupta K, Fihn SD. Predictors of urinary tract infection after menopause: a prospective study. *Am J Med* 2004; 117:903–911.
- 17 Eriksson I, Gustafson Y, Fagerstrom L, Olofsson B. Prevalence and factors associated with urinary tract infections (UTIs) in very old women. *Arch Gerontol Geriatr* 2010; 50:132–135.
- 18 Griebing TL. Urologic diseases in america project: trends in resource use for urinary tract infections in men. *J Urol* 2005; 173:1288–1294.
- 19 Griebing TL. Urologic diseases in America project: trends in resource use for urinary tract infections in women. *J Urol* 2005; 173:1281–1287.
- 20 CDC. Vital and Health Statistics. Ambulatory medical care utilization estimates for 2007. Series 13, Number 159. Hyattsville, MD, 2011.
- 21 Sammon JD, Sharma P, Rahbar H, Roghmann F, Ghani KR, Sukumar S, *et al.* Predictors of admission in patients presenting to the emergency department with urinary tract infection. *World J Urol* 2014; 3:813–819.
- 22 Abbo LM. Antimicrobial stewardship and urinary tract infections. *Antibiotics* 2014; 2:174–192.
- 23 Sobel JD, Kaye D. Urinary tract infections. In Mandell GL, Bennett JE, eds. *Principles and practice of infectious diseases*. 8th ed. Philadelphia: Elsevier Saunders 2014; 886–913.
- 24 Kranz J, Schmidt S, Schneidewind L. Current evidence on non antibiotic prevention of recurrent urinary tract infections. *Eur Urol Focus* 2019; 5:17–19.