



Case Report

Violet discoloration of urine: A case report and a literature review

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ABSTRACT

Background: Purple Urine Bag Syndrome (PUBS) is an uncommon event that can be described as purple discoloration of urine due to a series of chemical reactions induced by Urinary Tract Infections (UTIs). PUBS has been reported in the past but still remains unrecognized by healthcare givers leading to misdiagnosis and inappropriate management. We report our case alongside a literature review of previously published cases.

Case presentation: We present the first case report of Purple Urine Bag Syndrome in Jordan of a catheterized 80-year-old wheel-chaired female with a history of type 2 Diabetes Mellitus (DM), stage 5 Chronic Kidney Disease (CDK), Hypertension, and ischemic stroke. Her condition was initially misdiagnosed for hematuria but later on was correctly diagnosed with PUBS. She was treated with a course of appropriate antibiotic and by changing her urinary catheter and bag. The patient returned for a follow up visit and her problem resolved with the color of her urine in the urine bag returning back to normal.

Clinical discussion: PUBS is an uncommon event that occurs in association with UTIs. Such cases are mostly seen in elderly catheterized patients with other risk factors.

Conclusion: Purple Urine Bag Syndrome can be managed by changing urinary catheter, and by the administration of appropriate antibiotics. Such event can be easily misdiagnosed thus leading to unnecessary and consuming measures. Creating a better awareness of this condition among physicians and healthcare givers is essential for better patient outcomes.

1. Background

Purple Urine Bag Syndrome (PUBS) is considered uncommon and unrecognized by many healthcare givers. This may lead to misdiagnosis and inappropriate management [1]. It is characterized by a purple discoloration of urine associated with urinary tract infection (UTI) in patients with urinary catheter tubing connected to a bag caused by a series of chemical reactions leading to the formation of purple colored urine [2–4]. It has been described as a benign phenomenon in some cases [5] but it also has been seen in cases with serious clinical presentation [6]. Here we report a case of an unusual clinical course of PUBS and its diagnosis in the aim of creating a better awareness for healthcare givers, to prevent misdiagnosis or overmanagement and to improve the treatment of such events in the future. To the best of our knowledge, the presented case is the first case of PUBS reported in Jordan. This case report has been reported in line with the SCARE Criteria [7].

2. Case report

An 80-year-old female, known to have type 2 Diabetes Mellitus (DM), stage 5 Chronic Kidney Disease (CDK) on medical therapy, Hypertension (HTN), and history of an ischemic stroke. The patient is wheelchair dependent due to deconditioning and weakness in her lower limbs. As a result of incontinence, an indwelling urinary catheter was placed. The catheter was last replaced one month before presentation. She has a history of recurrent urinary tract infections (UTIs). When the patient presented to our clinic for follow-up, it was noticed that the color of urine in the urine bag was purple (Fig. 1). On review of symptoms, she reported having constipation but denied having fever, chills, or abdominal pain. Rest of review of symptoms was insignificant. The patient is on Amlodipine 5 mg once daily, Bisoprolol 5 mg once daily, Furosemide 40 mg once daily, Sodium bicarbonate 1000 mg twice daily, Ferrous gluconate 300 mg twice daily, and Biphasic Isophane insulin twice daily. On clinical examination, the patient was alert and oriented with no distress. She had stable vital signs. A trace of lower limb pitting

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Fig. 1. A urine catheter and a collection bag showing purple discoloration.

edema was noticed, otherwise, cardiopulmonary examination was normal. Two days before her presentation she was misdiagnosed for hematuria by a healthcare giver as a possible explanation of the purple discoloration of urine and did not receive an appropriate assessment or treatment. A diagnosis of PUBS was later on established. The urinary catheter was replaced and she was started on antibiotics and laxatives after sending a urine sample for urinalysis and urine culture. Urinalysis showed a pH of 8.0, glucose was negative, with a white blood cell count of 8–10/HPF, and a red blood cell count of 3–5/HPF. Urine culture revealed a heavy growth of *Proteus mirabilis* sensitive to Amoxicillin/Clavulanic acid, Ceftriaxone, and Ciprofloxacin. Six weeks before presentation she had a urine culture that revealed *Escherichia coli*. Blood tests showed elevated levels of Creatinine 328 $\mu\text{mol/L}$ (normal level 40–80), Urea 30.2 mmol/L (normal level 2.8–8.9), and Phosphate 1.68 mmol/L (normal level 0.84–1.45), other labs were within normal limits. The patient was started on Ciprofloxacin 500 mg one tablet orally every day for 5 days. After a week, she returned for a follow up visit and her problem resolved with the color of her urine in the urine bag returning back to normal. She was advised to change her urinary catheter regularly once a month to lower the risk of developing UTI in the future.

3. Discussion

Purple Urine Bag Syndrome (PUBS) is an uncommon event that occurs in association with Urinary Tract Infections (UTIs) and was first reported by Barlow et al., in 1978 [8]. Such cases are seen in catheterized patients with a prevalence ranging between 8.3% and 42.1% [2, 9].

A literature review of previously published case reports and case series was conducted by applying the keywords (Purple Urine Bag

Syndrome) on PubMed. A total number of 160 records were obtained, 66 studies were included, 8 of which were case series. Irrelevant studies, studies that are not in English, and studies without full text available were excluded (Fig. 2). A summary of the literature review is presented in (Table 1). A total number of 87 patients were studied, 40.2% were men, 57.5% were women, and 2.3% their gender was not reported. Median age of patients was 73.8 years. Forty percent of the patients were bedridden.

PUBS occurs when the bacteria causing the UTI metabolizes tryptophan products. The source of these products is the gastrointestinal tract where the normal bacterial flora convert tryptophan to indole. Indole is then absorbed and reaches the liver through the portal circulation. In the liver it is conjugated to produce indoxyl sulfate which is secreted into the urine. In the urine, the phosphatases and sulfatases produced by certain bacteria convert it to indoxyl. Indoxyl is then oxidized to indigo (blue pigment) and indirubin (red pigment). These pigments react with the catheter tubing and the plastic urine bag to give us the purple color of the urine seen in PUBS [3,10,11].

Constipation is one of the risk factors of PUBS. It increases the gastrointestinal bacterial flora that metabolizes tryptophan. Other risk factors also include female gender, increased dietary tryptophan, increased urine alkalinity, severe constipation, chronic catheterization, high urinary bacterial load, and renal failure [12,13]. In our literature review, 32.2% of patients were constipated.

PUBS has been associated with several bacteria, namely: *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus species*, *Pseudomonas aeruginosa*, *Providencia stuartii* and *Providencia rettgeri*, *Morganella morganii*, *Citrobacter species*, and *B streptococci* [12,14]. The causative microorganisms of PUBS in our review were summarized in (Table 2). *E. Coli* was the most common microorganism associated with PUBS accounting for 35.6% of causative microorganisms, followed by mixed bacterial growth in 25.3% of cases.

PUBS can be managed by changing the urinary catheter, and administering appropriate antibiotics [15]. This approach was used in the vast majority of cases with PUBS in our review.

Alteration of urine color can be due to a variety of causes such as poisonous materials, food coloration substances, medications, UTIs, urinary stones, hematuria (blood in the urine), hemoglobinuria (hemoglobin in the urine), and porphyria [16–20]. None of the medications that our patient takes are reported to cause urine discoloration.

As in our case, misdiagnosis of PUBS can occur, leading to improper management. This can be prevented by excluding the previously mentioned causes of urine discoloration, and by using urine color tools such as the Oxford urine chart [1]. This chart illustrates the different urine colors that a healthcare staff might encounter with the potential causes for each color. Interestingly, PUBS is the only cause for purple urine shown on this chart. There were no significant limitations to our study.

4. Conclusion

PUBS remains an uncommon phenomenon that might be misdiagnosed. This can lead to inappropriate management and unnecessary workup. It is mostly seen in bedridden elderly with UTI associated with other risk factors most commonly constipation. The purple urine is the end result of the metabolism of tryptophan by bacteria to form the responsible pigments. Healthcare workers need to be aware of this phenomenon in order to provide the appropriate care for patients.

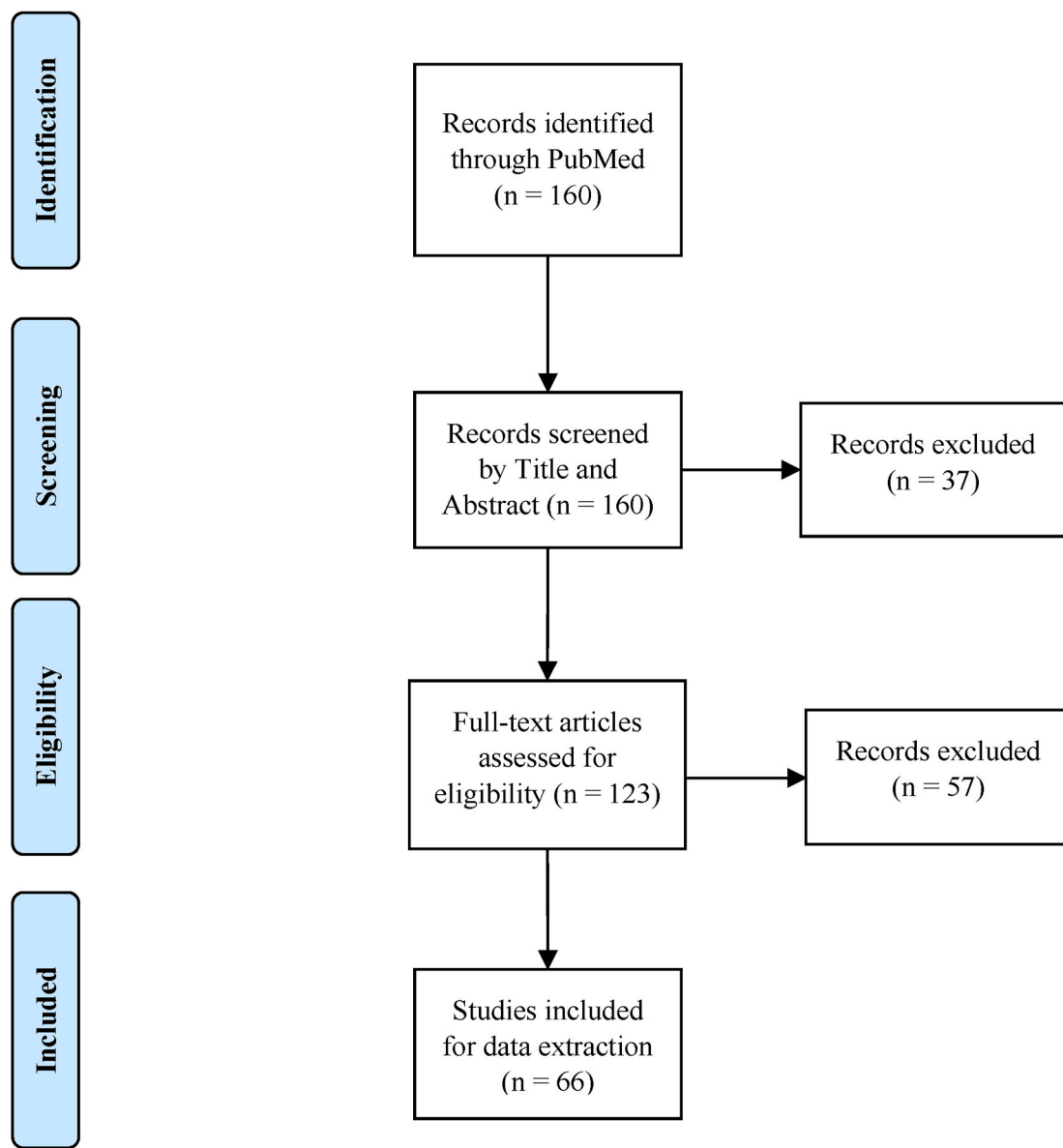


Fig. 2. PRISMA flow diagram of the article selection process.

Ethical approval

Ethical approval for case reports and case series are waived from any institutional review board approval according to the ongoing regulations of Yarmouk University.

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Author contribution

Case report design and patient medical care: M.S and S.G. Wrote the initial draft for the case report: M.S, S.A, and F.H. Data collection and data analysis: S.A, M.A, F.H, and A.A. Critically revised the manuscript: M.S and S.G. All authors read and approved the content of the submitted case report.

Research registration

This case report is not eligible for obtaining a research registry since it only contains a report of a known entity with no new surgical or medical interventions.

Guarantor

Muthanna Saraireh.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Table 1
Literature review summary of different variables considering PUBS cases.

Study ID	Year of Publication	Country	Age	Sex	Comorbidities	Indication of Foley	Duration of Foley	Constipation	Urine PH	Type of Microorganism	Treatment	Bedridden
Ito WE et al., 2019 [21]	2019	Brazil	49	F	Type 2 DM	Vesicovaginal fistula	60 days	N	9	Morganella morgagni	Meropenem	N
Hokama et al., 2019 [22]	2019	Japan	52	M	Crohn's Disease	Ureteral stenosis by ileocolic Crohn's disease	(-)	N	7.5	Providencia stuartii, Pseudomonas aeruginosa	Changed catheter and urine bag, Surgery for bowel obstruction was performed	N
Le Mouel et al., 2018 [23]	2018	France	86	F	(-)	(-)	Several weeks	Y	10	Klebsiella pneumoniae	Anti-biotherapy and laxatives	Y
Carmo et al., 2020 [24]	2020	Brazil	65	M	(-)	Pelvic trauma and hip fracture	(-)	N	6.5	Proteus mirabilis	Ciprofloxacin, Trimethoprim-sulfamethoxazole	Y
Wattanapisit et al., 2018 [25]*	2018	Thailand	89	F	HTN, Stroke	(-)	90 days	N	(-)	(-)	Changed catheter and bag	Y
			70	F	Type 2 DM, HTN, Dementia, Dyslipidemia	Acute urinary retention	90 days	N	7.5	(-)	Changed catheter and bag	Y
			88	F	Lymphoma	(-)	60 days	N	6.5	(-)	Ciprofloxacin, Changed catheter and bag	Y
			91	F	Colon cancer, Liver cirrhosis	(-)	30 days	N	6.5	Escherichia coli	Ciprofloxacin, Changed catheter and bag	Y
Rooney et al., 2018 [26]*	2018	United Kingdom	51	M	MS	MS	Long Term	N	(-)	Escherichia coli, Proteus mirabilis, Pseudomonas	Antibiotics, Endoscopic laser fragmentation, Changed catheter and bag	Y
			83	M	Type 2 DM, Lung Cancer	BPH	(-)	N	(-)	Enterococcus faecalis	Changed catheter and bag	N
Kumar et al., 2020 [27]	2020	India	60	M	(-)	Paraplegia and urinary incontinence due to spinal cord injury	2 Years	N	7.6	Escherichia coli	Ciprofloxacin, Changed catheter and bag	N
Amoozgar et al., 2019 [28]	2019	USA	61	M	Anoxic brain injury	Neurogenic bladder, Obstructive uropathy	(-)	N	(-)	Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa	Meropenem, Piperacillin-tazobactam, Vancomycin, Left nephrostomy tube replacement	N
Shin et al., 2018 [29]*	2018	Korea	81	F	DM, HTN, PUD, HF	Uncontrolled leak of urine	(-)	Y	8	(-)	(-)	Y
			88	F	HTN	Severe skin impairment of the perineum and buttocks due to frequent leakage of urine	(-)	N	(-)	(-)	(-)	Y
Khalid et al., 2016 [30]	2016	Pakistan	60	F	Type 2 DM, HTN, CKD	(-)	90 days	N	8	(-)	Meropenem, Vancomycin, calcium, vitamin D supplements	N
Barman et al., 2016 [31]	2016	India	65	F	Type 2 DM, dementia	Fracture of left femur	90 days	Y	(-)	Escherichia coli	Ceftriaxone	Y
Worku et al., 2018 [32]	2018	United Kingdom	94	F	(-)	Post-void residual volume of 750mL	14 days	Y	7.2	Escherichia coli	laxatives	N

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Table 1 (continued)

Study ID	Year of Publication	Country	Age	Sex	Comorbidities	Indication of Foley	Duration of Foley	Constipation	Urine PH	Type of Microorganism	Treatment	Bedridden	
Boentoro et al., 2019 [33]	2019	Indonesia	64	F	(-)	Neurogenic bladder due to spinal cord injury	90 days	Y	8.5	<i>Escherichia coli</i>	Ciprofloxacin, Changed catheter and urine bag	N	
de Menezes Neves PDM et al., 2020 [34]	2020	Brazil	84	M	HTN, CKD, PD	Prostate Cancer	(-)	Y	9	<i>Proteus penneri</i> , <i>Enterococcus faecalis</i>	Ciprofloxacin, Laxatives	N	
Karray et al., 2018 [35]	2018	Tunisia	78	M	DM, HTN	Prostatic adenocarcinoma	(-)	N	(-)	<i>Escherichia coli</i>	Cefotaxim, Gentamycin, Changed catheter and bag	Y	
Ficher et al., 2016 [36]	2016	Brazil	83	F	HTN, CKD, HF, AF	Intubation	(-)	N	(-)	<i>Streptococcus agalactiae</i>	Piperacillin-tazobactam, Meropenem, Vancomycin	N	
Rodríguez et al., 2016 [37]	2016	Spain	83	M	DM, HTN, COPD	BPH	Long Term	N	9	<i>Klebsiella pneumoniae</i>	Ciprofloxacin, Changed catheter and bag,	N	
Vallejo-Manzur et al., 2005 [38]	2004	USA	72	M	HTN, PD, Renal failure	(-)	(-)	N	9	<i>Escherichia coli</i>	Piperacillin/Tazobactam, Levofloxacin, Ciprofloxacin	Y	
Traynor et al., 2017 [39]	2017	Ireland	90	F	Vascular Dementia	Acute urinary retention	(-)	Y	>9	Mixed organisms	Nitrofurantoin, Changed catheter and bag	N	
Wong et al., 2018 [40]	2018	Malaysia	86	F	(-)	Acute urinary retention	20 months	N	8	Mixed organisms	Cefuroxime, Changed catheter and bag	N	
Kumar et al., 2018 [41]*	2018	India	56	F	Breast Carcinoma	(-)	9 months	Y	(-)	(-)	Nitrofurantoin	N	
			75	F	NHL, Differentiated squamous cell carcinoma of the right parotid region	(-)	(-)	N	(-)	(-)	Nitrofurantoin	Y	
Pillai et al., 2009 [42]	2009	Brunei	68	F	Type 2 DM, HTN, dyslipidemia, peripheral neuropathy, retinopathy, nephrotic range nephropathy	chronic urine contamination	76 days	Y	(-)	Negative Culture	(-)	N	
Çalışkan Tür et al., 2015 [43]	2015	Turkey	79	F	(-)	(-)	(-)	N	8.5	<i>Escherichia coli</i>	(-)	Y	
Al Montasir et al., 2013 [44]	2013	Bangladesh	86	F	Osteoporosis	Neurogenic bladder	12 months	Y	Alkaline	<i>Escherichia coli</i>	Ceftriaxone, Gentamicin, Glycerol, Changed catheter and bag	Y	
Faridi et al., 2016 [45]	2016	India	76	M	(-)	(-)	(-)	N	7.6	<i>Escherichia coli</i>	Ceftriaxone	N	
Lin et al., 2008 [9]*	2008	Taiwan	72	M	DM, BPH, ESRD, Alzheimer's Dementia	(-)	36 months	N	(-)	(-)	(-)	Changed catheter and bag	Y
			72	M	DM, BPH, ESRD, Alzheimer's Dementia	(-)	24 months	N	(-)	(-)	(-)	Changed catheter and bag	Y
			83	M	DM, BPH, HTN, Alzheimer's Dementia	(-)	26 months	N	8	8	<i>Escherichia coli</i> , <i>Proteus mirabilis</i>	Changed catheter and bag	Y
			89	M	DM, BPH, HTN, Alzheimer's Dementia	(-)	33 months	N	8.5	8.5	<i>Escherichia coli</i> , <i>Proteus mirabilis</i>	Changed catheter and bag	Y
			80	M	HTN, BPH, Vascular Dementia	(-)	12 months	Y	9	9	<i>Providencia rettgeri</i>	Changed catheter and bag	Y
			80	F	(-)	(-)		N	9	<i>Escherichia coli</i>		Y	

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Table 1 (continued)

Study ID	Year of Publication	Country	Age	Sex	Comorbidities	Indication of Foley	Duration of Foley	Constipation	Urine PH	Type of Microorganism	Treatment	Bedridden
					Alzheimer's Dementia, Anemia, pulmonary fibrosis, hepatitis, and hypercholesterolemia		24 months				Changed catheter and bag	
			76	F	Vascular dementia, Anemia	(-)	71 months	Y	8	<i>Klebsiella pneumoniae</i>	Changed catheter and bag	Y
			66	F	HTN, Vascular dementia, hepatitis, hypercholesterolemia	(-)	48 months	N	8	<i>Klebsiella pneumoniae</i>	Changed catheter and bag	Y
			60	F	Alzheimer's Dementia, Schizophrenia, poliomyelitis	(-)	60 months	N	9	<i>Providencia rettgeri</i>	Changed catheter and bag	Y
			75	F	DM, HTN, Vascular Dementia, hypercholesterolemia	(-)	24 months	Y	8	<i>Klebsiella pneumoniae</i>	Changed catheter and bag	Y
Mondragón-Cardona et al., 2015 [46]	2015	Colombia	71	F	HTN, stroke	Urinary incontinence	(-)	N	9	<i>Escherichia coli, Proteus mirabilis, Enterococcus faecalis</i>	Ciprofloxacin, Laxatives, Amikacin, Changed catheter and bag	Y
Chang et al., 2007 [47]	2007	Taiwan	61	F	(-)	Intubation	(-)	N	7.5	Negative Culture	(-)	N
Keenan et al., 2011 [4]	2011	USA	97	M	(-)	Urinary retention from prostate hyperplasia	(-)	Y	(-)	<i>Klebsiella pneumoniae</i>	Ciprofloxacin	N
Su et al., 2009 [48]	2009	Taiwan	81	F	(-)	(-)	Long Term	N	(-)	<i>Proteus mirabilis</i>	Antibiotics, Changed catheter and bag	Y
Yau Ong et al., 2020 [49]	2020	Singapore	50	M	DM, subclinical hypothyroidism	BPH, Neurogenic bladder	Long Term	N	(-)	(-)	Laxatives, Changed catheter and bag	N
Wu et al., 2009 [50]	2009	Taiwan	95	F	CKD, Dementia	(-)	Long Term	Y	8.5	<i>Escherichia coli, K. pneumoniae, Proteus mirabilis</i>	Changed catheter and bag, Relief Constipation	N
Iersel et al., 2009 [51]	2009	Netherlands	72	M	(-)	Metastasized bladder cancer	(-)	Y	(-)	<i>Klebsiella pneumoniae</i>	(-)	N
Yaquib et al., 2013 [52]	2013	Pakistan	83	F	(-)	(-)	3 months	Y	8	<i>Escherichia coli</i>	Cefixime, Lactulose, Changed catheter and bag	Y
Tan et al., 2008 [53]	2008	Taiwan	58	M	(-)	(-)	(-)	N	7.8	<i>Proteus mirabilis</i>	Ceftazidime	N
Ihama et al., 2011 [54]	2011	Japan	93	F	Advanced gastric cancer	(-)	7 days	Y	9	<i>Providencia stuartii, Alcaligenes spp</i>	Changed catheter and bag	Y
Karim et al., 2015 [55]	2015	USA	83	M	Alzheimer's Dementia, myelodysplastic syndrome, bladder cancer, COPD, hypothyroidism, GERD, hiatus hernia, osteoarthritis	Bladder Cancer	(-)	Y	7.5	<i>Pseudomonas aeruginosa</i> (left NT and UB), <i>Staphylococcus epidermidis</i> (right NT and UB)	Cefepime, Both Changed nephrostomy tube and urine bag	N
Alex et al., 2015 [56]	2015	India	83	M	BPH, CKD	(-)	Long Term	N	7	<i>Klebsiella pneumoniae, Morganellamorganii, Enterococcus, Citrobaterdiversus, Pseudomonas aeruginosa</i>	Antibiotic, catheter changed to silicone tubing	N
Delgado et al., 2014 [57]	2014	México	60	F	Type 2 DM, HTN, CKD, primary hypothyroidism	Fluid output monitoring	24 hours	N	8.5	<i>Klebsiella pneumoniae</i>	Co-trimoxazole	N
Wang et al., 2005 [58]	2005	Taiwan	61	M	Type 2 DM, ESRD, retinopathy, neuropathy	Neurogenic bladder	35 days	Y	8	<i>Klebsiella pneumoni, Escherichia coli, Enterococcus faecalis, proteus vulgaris</i>	Cefuroxime, Changed catheter and bag	N

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Table 1 (continued)

Study ID	Year of Publication	Country	Age	Sex	Comorbidities	Indication of Foley	Duration of Foley	Constipation	Urine PH	Type of Microorganism	Treatment	Bedridden
Evans et al., 2014 [59]	2014	UK	75	F	Radiation enteritis	Chronic urinary tract obstruction	Long Term	N	(-)	<i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Morganella morganii</i> .	Antibiotics, Changed catheter and bag	N
Harun et al., 2007 [60]*	2007	Brunei	45	F	(-)	Cervical carcinoma invading bladder	(-)	N	(-)	Negative Culture	Coamoxiclav	N
			75	F	AF	(-)	N	7	<i>Escherichia coli</i>	Antibiotics, Changed catheter and bag	N	
Bocrie et al., 2012 [61]	2012	France	87	F	(-)	Acute urinary retention	6 days	N	(-)	<i>Escherichia coli</i>	Changed catheter and bag	N
Sulaiman et al., 2016 [62]	2016	Malaysia	65	F	Stroke	(-)	long term	N	7.5	<i>Klebsiella pneumoniae</i>	(-)	N
Chung et al., 2008 [63]	2008	Taiwan	85	M	HTN, CKD	(-)	long term	Y	5.5	<i>Pseudomonas aeruginosa</i> , <i>Enterobacter cloacae</i>	Ciprofloxacin	N
Richardson-May et al., 2016 [64]	2016	UK	94	F	stroke, sinusitis, hemorrhoids, age-related macular degeneration, BPPV, polypoidal ileocecal valve tumor	Urinary retention	21 days	Y	8	Gram-negative coliforms	Antibiotic, Changed catheter and bag	N
Lin et al., 2009 [65]*	2009	Taiwan	50	(-)	DM, HF, Respiratory failure	(-)	90 days	N	8.5	<i>Escherichia coli</i> and <i>Acinetobacter baumannii</i> .	(-)	N
			78	M	DM, COPD	(-)	60 days	N	7.5	<i>Proteus mirabilis</i>	(-)	N
Gautam et al., 2007 [66]	2007	India	70	(-)	(-)	Acute urinary retention	90 days	N	(-)	<i>Escherichia coli</i>	Netilmicin, TURP, catheter removal	N
Kenzaka et al., 2015 [67]	2015	Japan	72	F	(-)	Bladder cancer	(-)	N	(-)	<i>Escherichia coli</i>	Cefaclor	N
Ting et al., 2007 [68]	2007	Taiwan	72	F	DM, ESRD	Residual urine drainage	(-)	N	7.5	<i>Escherichia coli</i>	Ciprofl Oxacin	Y
Pandey et al., 2018 [69]	2018	India	70	M	(-)	BPH	6 months	Y	8	<i>Escherichia coli</i>	Antibiotics, Changed catheter and bag	N
Tul Llah et al., 2016 [70]	2016	USA	58	M	Spastic partial quadriplegia	Neurogenic bladder	5 years	Y	8.5	<i>Proteus vulgaris</i>	Ceftriaxone, TMP/SMX	N
Duff et al., 2012 [71]	2012	USA	57	F	Transverse myelitis	Transverse myelitis	21 days	N	7.5	<i>Klebsiella pneumoniae</i>	Ciprofloxacin, Changed catheter and bag	N
Redwood et al., 2015 [72]	2015	USA	90	M	(-)	BPH	(-)	N	(-)	<i>Escherichia coli</i>	(-)	N
Mohamad et al., 2013 [73]	2013	Brunei	78	F	HTN, Dementia, Hyperlipidemia	(-)	Long Term	N	(-)	<i>Proteus mirabilis</i>	Ceftriaxone, Ciprofloxacin, Changed catheter and bag	Y
Ribeiro et al., 2004 [74]	2004	Portugal	56	F	ALS	Mechanically ventilated	6 years	N	alkaline	<i>Morganella morganii</i> , <i>Pseudomonas aeruginosa</i> , <i>Proteus mirabilis</i>	(-)	Y
Canavese et al., 2013 [75]*	2013	Italy	60	F	(-)	Cerebral infarction	Long Term	N	(-)	(-)	Changed catheter and bag	Y
			78	M	HTN, Hypercholesterolemia	Fluid output monitoring	Long Term	N	(-)	(-)	Antibiotic, Changed catheter and bag	N
			89	M	BPH, CKD	(-)	Long Term	N	(-)	<i>Providencia rettgeri</i>	(-)	N
			99	F	(-)	(-)	Long Term	N	9	<i>Providencia stuartii</i> , <i>Enterococcus faecalis</i> , <i>Proteus mirabilis</i> .	(-)	N
Pillai et al., 2007 [76]	2007	UK	76	F	DM, PD, Asthma, Depression	Urinary incontinence	(-)	Y	(-)	Mixed organisms	Changed catheter and bag	Y

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Table 1 (continued)

Study ID	Year of Publication	Country	Age	Sex	Comorbidities	Indication of Foley	Duration of Foley	Constipation	Urine PH	Type of Microorganism	Treatment	Bedridden
Ferrara et al., 2010 [77]	2010	Italy	81	F	COPD	Bilateral nephrostomy	6 years	N	9 (left NT)	<i>Escherichia coli</i> (left NT)	Ciprofloxacin	N
Siu et al., 2010 [78]	2010	USA	48	M	Type 2 DM	Ischemic encephalopathy and chronic urinary tract infections	(–)	N	8	<i>Escherichia coli</i>	Changed catheter and bag	N
Bar-Or et al., 2007 [79]	2007	USA	68	M	DM, HF, COPD	(–)	(–)	N	6–6.5	<i>Klebsiella oxytoca</i> , <i>Enterococcus</i> species	Linezolid, Levofloxacin Changed catheter and bag	N
Al-Sardar et al., 2009 [80]	2009	UK	82	M	HTN, Depression	(–)	(–)	Y	8	Mixed organisms	(–)	N
Achtergael et al., 2006 [81]	2006	Belgium	77	M	(–)	Bladder neck stenosis and an acute urinary retention	1 year	N	(–)	Mixed organisms	Changed catheter and bag	N
Hoekstra et al., 2016 [82]	2016	USA	80	M	(–)	Bladder cancer	3 days	N	7.6	<i>Providencia stuartii</i>	(–)	N
Jubouri et al. [83]	(–)	UK	85	F	(–)	(–)	Long term	N	8.5	<i>Providencia rettgeri</i>	(–)	N
Ollapallil et al., 2002 [84]*	2002	Australia	61	F	ESRD, diabetic neuropathy	(–)	5 months	Y	9	Mixed organisms	(–)	Y
			49	F	chronic paranoid schizophrenia	Fluid output monitoring	2 days	Y	5	Negative Culture	(–)	N
Current Case:	2021	Jordan	80	F	Type2 DM, HTN, CDK, history of a stroke	Urinary incontinence	1 month	Y	8	<i>Proteus mirabilis</i>	Ciprofloxacin, Changed catheter and bag	N

(*): Case Series, F: Female, M: Male, Y: Yes, N: No, (–): Not mentioned, DM: Diabetes Mellitus, HTN: Hypertension, MS: Multiple Sclerosis, PUD: Peptic Ulcer Disease, HF: Heart Failure, CKD: Chronic Kidney Disease, AF: Atrial Fibrillation, COPD: Chronic Obstructive Pulmonary Disease, BPH: Benign Prostatic Hyperplasia, NHL: Non-Hodgkin's Lymphoma, ESRD: End-Stage Renal Disease, GERD: Gastroesophageal Reflux Disease, BPPV: Benign Paroxysmal Positional Vertigo, ALS: Amyotrophic Lateral Sclerosis.
NT: Nephrostomy Tube, TURP: Transurethral resection of the prostate, TMP/SMX: trimethoprim-sulfamethoxazole.

Table 2

Microorganisms causing PUBS in reviewed cases.

Microorganism	Number of cases
<i>Escherichia coli</i>	31
Mixed organism	22
<i>Klebsiella pneumoniae</i>	13
<i>Proteus mirabilis</i>	13
<i>Pseudomonas aeruginosa</i>	7
Enterococcus	6
<i>Providencia stuartii</i>	4
<i>Providencia rettgeri</i>	4
<i>Morganella morganii</i>	3
<i>Proteus vulgaris</i>	2
<i>Proteus penneri</i>	1
<i>Streptococcus agalactiae</i>	1
<i>Acinetobacter baumannii</i>	1
<i>Enterobacter cloacae</i>	1
<i>Klebsiella oxytoca</i>	1
<i>Staphylococcus epidermidis</i>	1
<i>Citrobacter diversus</i>	1
Gram-negative coliforms	1

Declaration of competing interest

The authors report no conflict of interest.

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