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 replace 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 returned for a follow up visit and her problem resolved with the color of her urine in the urine bag returning back to normal.

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Clavulanic acid, Ceftriaxone, and Ciprofloxacin. Six weeks before presentation she had a urine culture that 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 μmol/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.
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.
| 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] | Brazil | 49 | F | Type 2 DM | Vesicovaginal fistula | 60 days | N | 9 | Morganella morgagni | Meropenem | N |
| Hokama et al., 2019 [22] | 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 | Y |
| Le Mouel et al., 2018 [23] | France | 86 | F | (–) | | (–) | Several weeks | Y | 10 | Klebsiella pneumoniae | Anti-biotherapy and laxatives | Y |
| Carmo et al., 2020 [24] | Brazil | 65 | M | (–) | Pelvic trauma and hip fracture | 60 days | N | 6.5 | Proteus mirabilis | Ciprofloxacin, Trimethoprim-sulfamethoxazole | Y |
| Wattanapisit et al., 2018 [25]* | Thailand | 89 | F | HTN, Stroke | (–) | 90 days | N | (–) | | Changed catheter and bag | Y |
| Rooney et al., 2018 [26]* | United Kingdom | 51 | M | MS | MS | Long Term | N | (–) | Enterococcus faecalis | Antibiotics, Endoscopic laser fragmentation, Changed catheter and bag | N |
| | | 83 | M | Type 2 DM, Lung Cancer | BPH | (–) | N | (–) | | | |
| Kumar et al., 2020 [27] | India | 60 | M | (–) | Paraplegia and urinary incontinence due to spinal cord injury | 2 Years | N | 7.6 | Escherichia coli | Ciprofloxacin, Changed catheter and bag | Y |
| Amoozgar et al., 2019 [28] | 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 | Y |
| Shin et al., 2018 [29]* | Korea | 81 | F | DM, HTN, PUD, HF | Uncontrolled leak of urine Severe skin impairment of the perineum and buttocks due to frequent leakage of urine | (–) | Y | 8 | (–) | | Y |
| | | 88 | F | HTN | | (–) | N | (–) | | | |
| Khalid et al., 2016 [30] | Pakistan | 60 | F | Type 2 DM, HTN, CKD | (–) | 90 days | N | 8 | | Meropenem, Vancomycin, calcium, vitamin D supplements | N |
| Barman et al., 2016 [31] | India | 65 | F | Type 2 DM, dementia | Fracture of left femur | 90 days | Y | (–) | Escherichia coli | Ceftriaxone | Y |
| Worku et al., 2018 [32] | United Kingdom | 94 | F | (–) | Post-void residual volume of 750mL | 14 days | Y | 7.2 | Escherichia coli | Laxatives | N |

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| 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     | *Escherichia coli*                          | Ciprofloxacin, Changed catheter and urine bag | N         |
| de Menezes Neves PDM et al., 2020 | 2020                | Brazil    | 84  | M    | HTN, CKD, PD                                          | Prostate Cancer                              | (−)              | Y           | 9       | *Proteus penneri, Enterococcus faecalis*    | Ciprofloxacin, Laxatives                       | N         |
| Karray et al., 2018 [35]         | 2018                | Tunisia   | 78  | M    | DM, HTN                                                | Prostatic adenocarcinoma                     | (−)              | N           | (−)     | *Escherichia coli*                          | Ofloxacin, Gentamycin, Changed catheter and bag | Y         |
| Ficher et al., 2016 [37]         | 2016                | Brazil    | 83  | F    | HTN, CKD, HF, AF                                      | Intubation                                   | (−)              | N           | (−)     | *Streptoccocus agalactiae*                  | Piperacillin-tazobactam, Meropenem, Vancomycin | N         |
| Rodríguez et al., 2016 [38]      | 2016                | Spain     | 83  | M    | DM, HTN, COPD                                          | BPH                                          | Long Term        | N           | 9       | *Klebsiella pneumoniae*                     | Ciprofloxacin, Changed catheter and bag        | N         |
| Vallejo-Manzur et al., 2005 [39] | 2004                | USA       | 72  | M    | HTN, PD, Renal failure                                 | (−)                                         | (−)              | N           | 9       | *Escherichia coli*                          | Piperacillin/ Tazobactam, Levofloxacin, Ciprofloxacin | Y         |
| Traynor et al., 2017 [40]        | 2017                | Ireland   | 90  | F    | Vascular Dementia                                     | Acute urinary retention                      | (−)              | Y           | >9      | Mixed organisms                            | Nitrofurantoin, Changed catheter and bag       | N         |
| Wong et al., 2018 [41]           | 2018                | Malaysia  | 86  | F    | (−)                                                    | Acute urinary retention                      | (−)              | N           | 8       | Mixed organisms                            | Cefuroxime, Changed catheter and bag           | N         |
| Kumar et al., 2018 [42]          | 2018                | India     | 56  | F    | Breast Carcinoma                                       | Acute urinary retention                      | (−)              | (−)         | (−)     | (−)                                          | Nitrofurantoin                                | N         |
| Pillai et al., 2009 [43]         | 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 [44]   | 2015                | Turkey    | 79  | F    | (−)                                                    | (−)                                         | (−)              | N           | 8.5     | *Escherichia coli*                          | Ceftriazone, Gentamicin, Glycerol, Changed catheter and bag | Y         |
| Al Montasir et al., 2013 [45]    | 2013                | Bangladesh| 86  | M    | Osteoporosis                                           | Neurogenic bladder                          | 12 months        | Y           | Alkaline | *Escherichia coli*                          | Ceftriazone                                   | N         |
| Fari et al., 2016 [46]           | 2016                | India     | 76  | M    | (−)                                                    | (−)                                         | (−)              | N           | 7.6     | *Escherichia coli*                          | Ceftriazone                                   | N         |
| Lin et al., 2008 [47]            | 2008                | Taiwan    | 72  | M    | DM, BPH, ESRD, Alzheimer’s Dementia                    | (−)                                         | 26 months        | N           | (−)     | (−)                                          | (−)                                           | Y         |
|                                  | 72                  |           | M    |      | DM, BPH, ESRD, Alzheimer’s Dementia                    | (−)                                         | 24 months        | N           | (−)     | (−)                                          | (−)                                           | Y         |
| 83 M                            | DM, BPH, HTN, Alzheimer’s Dementia | 26 months | N | 8       | *Escherichia coli, Proteus mirabilis*                  | Ofloxacin, Gentamicin, Glycerol, Changed catheter and bag | Y         |
| 89 M                            | DM, BPH, HTN, Alzheimer’s Dementia | 33 months | N | 8.5     | *Escherichia coli, Proteus mirabilis*                  | Ofloxacin, Gentamicin, Glycerol, Changed catheter and bag | Y         |
| 80 M                            | HTN, BPH, Vascular Dementia | 12 months | Y | 9       | Providencia rettgeri                                    | Ofloxacin, Gentamicin, Glycerol, Changed catheter and bag | Y         |
| 80 F                            | (−)                 | (−)       | N | 9       | *Escherichia coli*                                     | Ofloxacin, Gentamicin, Glycerol, Changed catheter and bag | Y         |

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| Study ID            | Year of Publication | Country     | Age | Sex | Comorbidities                                                                 | Indication of Foley                  | Duration of Foley | Constipation | Urine PH | Type of Microorganism                  | Treatment                                      | Bedridden |
|---------------------|---------------------|-------------|-----|-----|--------------------------------------------------------------------------------|--------------------------------------|-------------------|--------------|----------|----------------------------------------|------------------------------------------------|-----------|
| Mondragon-Cardona et al., 2015 [46] | 2015 Colombia | 71 F |       |     | Alzheimer’s Dementia, Anemia, pulmonary fibrosis, hypercholesterolemia       | Urinary incontinence                         | 24 months         | N            | Y        | 8                       | Klebsiella pneumonia                                |           |
| Chang et al., 2007 [47] | Taiwan       | 61 F |       |     | Vascular dementia, Anemia, pulmonary fibrosis, hypercholesterolemia          | Intubation                                   | 71 months         | Y            | 8        | 7.5                      | Negative Culture                                   |           |
| Keenan et al., 2011 [4] | USA         | 97 M |       |     | Urinary retention from prostate hyperplasia                              |                                      |                 | Y            | 8        | (-)                      | Klebsiella pneumonia                                    |           |
| Su et al., 2009 [48] | Taiwan       | 81 F |       |     | DM, subclinical hypothyroid                                             | Bladder Cancer                              |                 | Y            | 8.5      | (-)                      | Escherichia coli, Proteus mirabilis, Enterococcus faecalis |           |
| Yau Ong et al., 2020 [49] | Singapore | 50 M |       |     | CKD, Dementia                                                            |                                      |                 | Y            | 8        | (-)                      | Klebsiella pneumonia                                |           |
| Wu et al., 2009 [50]   | Taiwan       | 95 F |       |     | Bladder Cancer                                                            |                                      |                 | Y            | 8        | (-)                      | Proteus mirabilis                                   |           |
| Iersel et al., 2009 [51] | Netherlands | 72 M |       |     | Metastasized bladder cancer                                               |                                      |                 | Y            | 8        | (-)                      | Escherichia coli                                    |           |
| Yaqub et al., 2013 [52] | Pakistan    | 83 F |       |     |                                      |                                      |                 | Y            | 8        | (-)                      | Proteus mirabilis                                   |           |
| Tan et al., 2008 [53]   | Taiwan       | 58 M |       |     | Advanced gastric cancer                                                  |                                      |                 | Y            | 7.8      | (-)                      | Proteus mirabilis                                   |           |
| Ihamma et al., 2011 [54] | Japan      | 93 F |       |     |                                      |                                      |                 | Y            | 9        | (-)                      | Providencia stuartii, Alcaligenes spp               |           |
| Karim et al., 2015 [55] | USA         | 83 M |       |     | Alzheimer’s Dementia, myelodysplastic syndrome, bladder cancer, COPD, hypothyroidism, GERD, hiatus hernia, osteoarthritis |                                      |                 | Y            | 7.5      | (-)                      | Pseudomonas aeruginosa, Staphylococcus epidermidis (left NT and UB) |           |
| Alex et al., 2015 [56]  | India        | 83 M |       |     | Bladder Cancer                                                            |                                      |                 | Y            | 7        | (-)                      | Klebsiella pneumonia, Morganellamorganii, Enterococcus, Citrobacter diversus, Pseudomonas aeruginosa |           |
| Delgado et al., 2014 [57] | Mexico      | 60 F |       |     | Type 2 DM, HTN, CKD, primary hypothyroidism                                | Fluid output monitoring                      | 24 hours          | N            | 8.5      | (-)                      | Antibiotic, catheter changed to silicone tubing     |           |
| Wang et al., 2005 [58]  | Taiwan       | 61 M |       |     | Type 2 DM, ESRD, retinopathy, neuropathy                                    |                                      |                 | Y            | 8        | (-)                      | Klebsiella pneumonia                                |           |

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| 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 | (–) | Escherichia coli, Klebsiella pneumonia, Morganella morganii. | Antibiotics, Changed catheter and bag | N |
| Harun et al., 2007 [60]* | 2007 Brunei | 45 | F | Cervical carcinoma | Cervical carcinoma invading bladder | (–) | N | (–) | Negative Culture | Coadoxycilav | N |
| Bocrie et al., 2012 [61] | 2012 France | 87 | F | Acute urinary retention | Acute urinary retention | 6 days | N | (–) | Escherichia coli | Antibiotics, Changed catheter and bag | N |
| Sulaiman et al., 2016 [62] | 2016 Malaysia | 65 | F | Stroke | Stroke | long term | N | 7.5 | Klebsiella pneumonia | (–) | N |
| Chung et al., 2008 [63] | 2008 Taiwan | 85 | M | HTN, CKD | Long term | N 7.5 | Proteus mirabilis, Enterobacter cloacae | Ciprofloxacin | N |
| Richardson-May et al., 2016 [64] | 2016 UK | 94 | F | stroke, sinustitis, hemorrhoids, age-related macular degeneration, BPPV, polypoidal ileocecal valve tumor | Urinary retention | 21 days | Y | 8 | | Antibiotic, Changed catheter and bag | N |
| Lin et al., 2009 [65]* | 2009 Taiwan | 50 | (–) | DM, HF, Respiratory failure | (–) | 90 days | N | 8.5 | Escherichia coli and Acinetobacter baumannii. | (–) | N |
| Gautam et al., 2007 [66] | 2007 India | 78 | M | DM, COPD | Cerebrovascular accident | Acute urinary retention | 60 days | N | 7.5 | Proteus mirabilis | (–) | N |
| Kenzaka et al., 2015 [67] | 2015 Japan | 72 | F | Bladder cancer | Bladder cancer | (–) | N | (–) | Escherichia coli | Cefaclor | N |
| Ting et al., 2007 [68] | 2007 Taiwan | 72 | F | DM, ESRD | Residual urine drainage | BPH | 6 months | Y | 8 | Escherichia coli | Ciprofloxacin | Y |
| Pandey et al., 2018 [69] | 2018 India | 70 | M | (–) | (–) | (–) | N | (–) | (–) | | Antibiotics, Changed catheter and bag | N |
| Tuli Llh et al., 2016 [70] | 2016 USA | 58 | M | Spastic partial quadriplegia | Neurogenic bladder | 5 years | Y | 8.5 | Proteus vulgaris | Ceftriaxone, TMP/SMX | N |
| Duff et al., 2012 [71] | 2012 USA | 57 | F | Transverse myelitis | Transverse myelitis | 21 days | N | 7.5 | Klebsiella pneumonia | Ciprofloxacin, Changed catheter and bag | N |
| Redwood et al., 2015 [72] | 2015 USA | 90 | M | (–) | BPH | (–) | N | (–) | Escherichia coli | (–) | N |
| Mohamad et al., 2013 [73] | 2013 Brunei | 78 | F | HTN, Dementia, Hyperlipidemia | (–) | Long Term | N | (–) | Proteus mirabilis | Ceftriaxone, Ciprofloxacin, Changed catheter and bag | Y |
| Ribeiro et al., 2004 [74] | 2004 Portugal | 56 | F | ALS | Mechanically ventilated | 6 years | N | alkaline | Morganella morganii, Pseudomonas aeruginosa, Proteus mirabilis | (–) | Y |
| Canavese et al., 2013 [75]* | 2013 Italy | 60 | F | (–) | Cerebral infarction | Long Term | N | (–) | | Changed catheter and bag | Y |
| | 2013 Italy | 78 | M | HTN, Hypercholesterolemia | Fluid output monitoring | Long Term | N | (–) | | Antibiotic, Changed catheter and bag | N |
| | 2013 Italy | 89 | M | BPH, CKD | (–) | Long Term | N | (–) | Providencia rettgeri | (–) | N |
| | 2013 Italy | 99 | F | (–) | (–) | Long Term | N | 9 | Providencia stuartii, Enterococcus faecalis, Proteus mirabilis. | Mixed organisms | (–) | N |
| Pillai et al., 2007 [76] | 2007 UK | 76 | F | DM, PD, Asthma, Depression | Urinary incontinence | (–) | Y | (–) | | 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   | 2010               | Italy   | 81  | F   | COPD                                       | Bilateral nephrostomy and chronic urinary tract infections | 6 years            | N           | 9 (left NT) | *Escherichia coli* (left NT)                         | Ciprofloxacin                                  | N         |
| Siu et al., 2010       | 2010               | USA     | 48  | M   | Type 2 DM                                  | Ischemic encephalopathy and chronic urinary tract infections | (−)                | N           | 8          | *Escherichia coli*                                     | Changed catheter and bag                      | N         |
| Bar-Or et al., 2007    | 2007               | USA     | 68  | M   | DM, HF, COPD                               | Bladder neck stenosis and acute urinary retention            | 1 year             | N           | (−)        | Mixed organisms                                       | Linezolid, Levofloxacin Changed catheter and bag | N         |
| Al-Sardar et al., 2009 | 2009               | UK      | 82  | M   | HTN, Depression                            | Bladder cancer                                                | 3 days             | N           | 7.6        | *Providencia stuartii*                                  | (−)                                           | N         |
| Achtergaal et al., 2006| 2006               | Belgium | 77  | M   | (−)                                       | Bladder cancer                                                | 1 year             | N           | (−)        | Mixed organisms                                       | Changed catheter and bag                      | N         |
| Hoekstra et al., 2016  | 2016               | USA     | 80  | M   | (−)                                       | Bladder cancer                                                | 3 days             | N           | 7.6        | *Providencia stuartii*                                  | (−)                                           | N         |
| Jubouri et al.         | 2009               | UK      | 85  | F   | (−)                                       | Long term                                                    | 8.5                | N           | 8.5        | *Providencia rettgeri*                                 | (−)                                           | N         |
| Ollapallil et al., 2002| 2002               | Australia | 61  | F   | ESRD, diabetic neuropathy                  | Fluid output monitoring                                       | 5 months           | Y           | 9          | Mixed organisms                                       | (−)                                           | Y         |
|                        |                    |         | 49  | F   | chronic paranoid schizophrinia             |                                                                  | 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          | *Proteus mirabilis*                                    | 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 PUS in reviewed cases.

| Microorganism                          | Count |
|----------------------------------------|-------|
| Escherichia coli                       | 31    |
| Mixed organism                         | 22    |
| Klebsiella pneumoniae                  | 13    |
| Proteus mirabilis                      | 13    |
| Pseudomonas aeruginosa                 | 7     |
| Enterococcus                          | 6     |
| Providencia stuartii                   | 4     |
| Providencia rettgeri                   | 4     |
| Morganella morgani                     | 3     |
| Proteus vulgaris                       | 2     |
| Proteus peregrinus                     | 1     |
| Streptococcus agalactiae               | 1     |
| Acinetobacter baumannii                | 1     |
| Enterobacter cloacae                   | 1     |
| Klebsiella oxytoca                     | 1     |
| Staphylococcus epidermidis             | 1     |
| Citrobacter diversus                   | 1     |
| Gram-negative-cofactors                | 1     |

Declaration of competing interest

The authors report no conflict of interest.

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