

Manuscript version: Author's Accepted Manuscript

The version presented in WRAP is the author's accepted manuscript and may differ from the published version or Version of Record.

Persistent WRAP URL:

<http://wrap.warwick.ac.uk/131999>

How to cite:

Please refer to published version for the most recent bibliographic citation information. If a published version is known of, the repository item page linked to above, will contain details on accessing it.

Copyright and reuse:

The Warwick Research Archive Portal (WRAP) makes this work by researchers of the University of Warwick available open access under the following conditions.

© 2020 Elsevier. Licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International <http://creativecommons.org/licenses/by-nc-nd/4.0/>.



Publisher's statement:

Please refer to the repository item page, publisher's statement section, for further information.

For more information, please contact the WRAP Team at: wrap@warwick.ac.uk.

1 **Early versus delayed urinary catheter removal after hysterectomy: A systematic review**
2 **and meta-analysis**

3

4 Michael P Rimmer¹, Ian Henderson^{2,3}, Stephen D Keay³, Khalid S Khan⁴, Bassel H.Al
5 Wattar ^{2,3}

6

7 ¹MRC Centre for Reproductive Health, Queens Medical Research Institute, Edinburgh
8 BioQuarter, University of Edinburgh, UK.

9 ²Warwick Medical School, Warwick University, Coventry, UK.

10 ³University Hospital Coventry and Warwickshire, Clifford Bridge Road, Coventry, UK.

11 ⁴Department of Preventive Medicine and Public Health, University of Granada, 18071
12 Granada, Spain.

13

14 **Corresponding author:** Bassel H.Al Wattar - Warwick Medical School, Warwick
15 University, Coventry, UK – Email: dr.basselwa@gmail.com

16

17

18 **Short title:** Removal of urinary catheter after hysterectomy

19

20

21 **Abstract**

22 **Objectives:** In bladder drainage, an essential part of post-hysterectomy care, the optimal
23 timing for removing the urinary catheter is unclear. Our objective was to evaluate the risks
24 and benefits of early (<6 hours) vs delayed (>6 hours) catheter removal post-hysterectomy.

25 **Study design:** A systematic review searching MEDLINE, EMBASE and Cochrane
26 CENTRAL from inception till May 2019 for randomised trials of women undergoing
27 hysterectomy. We reported on urinary retention, positive urine culture, urinary tract infection
28 (UTI) (defined by symptoms and/or antibiotic use), post-operative pyrexia, time to
29 ambulation, and length of hospital stay. We assessed risk of bias in included trials and used a
30 random-effect model to generate risk ratios (RR) for dichotomous outcomes and weighted
31 mean differences (WMD) for continuous outcomes, with 95% confidence intervals (CI).

32 **Results:** Of 1020 potentially relevant citations, we included 10 randomised trials (1120
33 women). Four trials had low risk of bias for randomisation and allocation concealment while
34 five had low risk for outcome assessment and selective reporting. Compared to delayed
35 removal, women in the early catheter removal group had a higher risk of urinary retention
36 and needing re-catheterisation (10 RCTs, RR 3.61, 95%CI 1.21-9.21, $I^2=56\%$). There was
37 some reduction in the risk of post-operative UTI (6 RCTs, RR 0.42, 95%CI 0.18 to 0.96,
38 $I^2=0\%$), but we did not find a significant difference in post-operative pyrexia (6 RCTs, RR
39 0.73, 95%CI 0.43-1.24, $I^2=18\%$) or positive urine cultures (6 RCTs, RR of 0.56, 95%CI 0.27-
40 1.12, $I^2=55\%$). There was no significant difference in the average time to ambulation
41 (3RCTs, WMD -4.6, 95%CI -9.16 to -0.18, $I^2=98\%$) and length of hospital stay (3RCTs,
42 WMD -1.05, 95%CI -2.42 to 0.31, $I^2=98\%$). Our meta-regression on the provision of
43 prophylactic antibiotics did not show a significant effect on the reported outcomes. Our
44 analysis was limited by our inability to adjust for potential effect modifiers such as the
45 surgical route.

46 **Conclusions:** Early removal of the urinary catheter <6 hours post-hysterectomy seems to
47 increase the risk of urinary retention and needing re-catheterisation, but may reduce post-
48 operative UTI.

49
50 **Keywords:** Hysterectomy, catheter, urinary, postoperative retention, systematic review.

51

52

53

54 **Introduction**

55 Hysterectomy is one of the commonest benign gynaecological procedures worldwide (1,2)
56 with more than 400,000 hysterectomies performed in the USA yearly (3). Maintaining an
57 empty bladder during surgery is common practice to reduce the risk of urological
58 complications and promote enhanced post-operative recovery. Still, the optimal timing for
59 post-operative catheter removal remains unclear (4). Delayed removal of urinary catheter
60 postoperatively has been linked to increasing the risk of urinary tract infection (UTI), use of
61 antibiotics, longer time to ambulation and hospital stay. In contrast, early removal (<6 hours
62 post operatively) could also increase the risk of post-operative urinary retention and re-
63 catheterisation (5,6).

64

65 A previous systematic review suggested that early catheter removal reduced the incidence of
66 postoperative UTI, positive urine culture, and the time to ambulation; however, it increased
67 the rate of re-catheterisation (7). This review, however, had several methodological
68 limitations; it included a non-randomised study in the meta-analysis and incorporated women
69 who had gynaecological surgery without a hysterectomy. Since its publication, two newer
70 trials were published (355 women) reporting contradictory results (8,9). To evaluate the
71 optimal time for removing the urinary catheter post-hysterectomy we conducted a systematic
72 review and meta-analysis of all randomised trials on the topic.

73

74 **Methods**

75 We undertook this systematic review using a prospectively registered protocol (CDR
76 42019132213) and reported in accordance with the PRISMA guidelines.

77

78 *Literature Search*

79 We searched major electronic databases (MEDLINE, EMBASE and Cochrane CENTRAL)
80 for all randomised trials evaluating the timing of catheter removal following hysterectomy
81 from inception until May 2019. We combined the following MeSH search terms using the
82 Boolean operators to screen for relevant studies (“hysterectomy”, “catheter”, “catheters,
83 indwelling”, “urine”, “urinary retention”) (Appendix 1). No search filters or language
84 restrictions were applied. We manually searched the bibliographies of relevant articles to
85 identify any additional studies not captured in the electronic search.

86

87 *Study Selection*

88 Two independent reviewers (MPR and IH) completed the study selection and inclusion
89 process in two stages. Any discrepancies were discussed and resolved in consensus with a
90 third reviewer (BHA). First, we screened titles and abstracts to identify potentially relevant
91 studies. Then, we reviewed the full texts of relevant articles against our inclusion criteria.

92 We included all primary randomised trials evaluating early versus delayed catheter removal
93 in women who underwent a hysterectomy via any modality (abdominal, laparoscopic or
94 vaginal). We excluded non randomised studies, animal studies, and review articles.

95

96 *Data Extraction*

97 Two reviewers (MPR and IH) extracted data in duplicate using a piloted electronic data
98 extraction tool. We collected data on study design, number of participants, inclusion and
99 exclusion criteria, length of catheterisation, clinical outcomes (symptoms of UTI, positive
100 urinalysis, positive urine culture, antibiotic administration for UTI, post-operative pyrexia,
101 re-catheterisation, time to ambulation (hours) and length of hospital stay (days)). Our primary
102 outcome was post-operative urinary retention following the removal of catheter. We also
103 reported on the following secondary outcomes which were planned *a priori*: post-operative

104 pyrexia and time to ambulation, length of hospital stay, positive urine culture, and UTI as a
105 composite outcome of urinary symptoms and/or use of antibiotics (10).

106

107 *Assessment of risk of bias*

108 The quality of published literature was assessed by two reviewers in duplicate (MPR and IH)
109 using the Cochrane Risk of Bias assessment tool. Studies were assessed in five domains:
110 randomisation and sequence generation, allocation concealment, outcome assessment,
111 completeness of outcome data, and selective outcome reporting. Due to the nature of the
112 intervention, we did not penalise unblinded trials, none of the trials blinded assessors.

113

114 *Data synthesis*

115 We reported on dichotomous outcomes using summary risk ratio (RR) with 95% confidence
116 intervals (CI) and on continuous outcomes using weighted mean difference (WMD). We
117 pooled data using a restricted maximum likelihood (REML) random-effect model (11). We
118 assessed the heterogeneity among included trials using the I^2 statistics. We planned a
119 sensitivity meta-regression analysis to investigate potential effect modifiers where relevant.
120 All statistical analyses were conducted in Stata V13 (StataCorp, TX) and Open Meta-analyst
121 software (Brown University; Providence, RI, USA).

122

123 **Results**

124 *Characteristics of included studies*

125 Our electronic search identified 1020 potentially relevant citations, of which 15 articles were
126 deemed relevant and were assessed in full. We excluded five studies: three studies reported
127 incomplete data, one reported on women undergoing pelvic surgery (8) and one was a non-
128 randomised study (12). In total, we included ten trials reporting on 1120 women who

129 underwent a hysterectomy (9,13–21) (Figure 1). Three studies were conducted in the USA
130 and one study in each of the UK, Netherlands, Egypt, Italy, Hong Kong, India and Taiwan.
131 All studies randomised women to either early catheter removal (<6 hours post-operatively) or
132 delayed removal (>6 hours post-operatively), which ranged from 6 to 48 hours (Table 1).
133 The median sample size of the included trials was 124 (range 70-250). There were variations
134 in the surgical routes to perform hysterectomy with four trials reporting on abdominal
135 hysterectomy (4/10, 40%), two on laparoscopic or laparoscopy assisted hysterectomy (2/10,
136 20%), one on vaginal hysterectomy (1/10, 10%) and three on any surgical route (3/10, 30%).
137 Seven trials reported given prophylactic antibiotics pre-operatively (7/10, 70%) while three
138 did not report on it.

139

140 *Risk of Bias*

141 The overall quality of the included studies was moderate (Figure 2, Appendix 2). Four studies
142 had low risk of bias for randomisation and allocation concealment (4/10, 40%). Half of the
143 included trials had low risk of bias for both outcome assessment and selective reporting
144 (5/10, 50%), and majority had low risk of bias due to incomplete data (9/10, 90%) (Figure 2).

145

146 *Outcomes*

147 Compared to delayed removal, women in the early catheter removal group had a higher risk
148 of urinary retention and needing re-catheterisation (10 RCTs, RR 3.61, 95%CI 1.21-9.21,
149 $I^2=56\%$). There was some reduction in the risk of post-operative UTI (6 RCTs, RR 0.42,
150 95%CI 0.18 to 0.96, $I^2=0\%$), but we did not find a significant difference in post-operative
151 pyrexia (6 RCTs, RR 0.73, 95%CI 0.43-1.24, $I^2=18\%$) or positive urine cultures (6 RCTs, RR
152 of 0.56, 95%CI 0.27-1.12, $I^2=55\%$). There was no significant difference in the average time

153 to ambulation (3RCTs, WMD -4.6, 95%CI -9.16 to -0.18, $I^2=98%$) and length of hospital stay
154 (3RCTs, WMD -1.05, 95%CI -2.42 to 0.31, $I^2=98%$) in both groups.

155 We performed a meta-regression to evaluate the effect of prophylactic antibiotics on reported
156 outcomes. There was no significant effect on urinary retention ($p=0.54$), post-operative UTI
157 ($p=0.30$), positive urine cultures ($p=0.58$), or post-operative pyrexia ($p=0.34$). A meta-
158 regression was not possible for the two remaining outcomes due to the small sample size.

159

160 **Discussion**

161 *Summary of findings*

162 Our meta-analysis indicates that early removal of urinary catheter (<6 hours) post-
163 hysterectomy might reduce the risk of post-operative UTI, however, it appears to increase the
164 risk of urinary retention needing re-catheterisation. There were no obvious benefits in other
165 reported measures including reducing time to mobilisation and the length of hospital stay. In
166 view of the cumulative evidence on the potential adverse effects of early catheter removal,
167 we deduce that such practice should not be routinely offered to women pending future
168 research.

169

170 *Strengths and limitations*

171 We conducted this systematic review using a prospectively registered protocol and a
172 standardised methodology. We assessed the risk of bias in included studies and extracted data
173 in duplicate. We only included randomised trials and reported on clear time points (removal
174 of catheter before and after 6 hours) to reduce selection and performance bias.

175

176 Our findings are not without limitations. Women included had different background
177 morbidity and underwent different operative route for hysterectomy. The increased pain

178 associated with open abdominal surgery might lead to a higher risk of urinary retention in
179 contrast to laparoscopic hysterectomy. Several trials provided intravenous or intramuscular
180 antibiotics at the start of the surgery which could also reduce the risk of developing a UTI
181 postoperatively and the sensitivity of urine cultures.(Table 1) This varied across included
182 studies (using 1g ceftriaxone , 1.2g augmentin , 500mg cefazolin , 2g cefazolin or
183 doxycycline), still, our meta-regression did not show a significant effect of antibiotics on the
184 reported outcomes. The definition of UTI adopted by most authors was pragmatic including
185 symptoms and use of antibiotics. While this is consistent with established guidelines (10),
186 adopting a more stringent definition might reduce the event rate in both comparison groups.

187

188 The size of the urinary catheter used and the insertion technique were poorly reported which
189 could impact our estimates. Other factors such as the duration of the anaesthesia, the
190 operating time, and the post-operative pain relief could also impact the women's ability to
191 pass urine after removing the catheter. The threshold of 6 hours used by most authors is
192 somewhat arbitrary and the duration for delayed removal and the time of re-catheterisation
193 varied across included trials. Our inferences are subject to the inherent, unavoidable
194 heterogeneity in our meta-analyses. We believe our findings present the best available
195 pragmatic evidence to advise clinical practice pending future studies.

196

197 *Implications for future practice*

198 With the increasing numbers of minimally invasive interventions in gynaecology, adopting
199 the principles of enhanced recovery and early mobilisation is key to improve operative
200 outcomes and meet the patients' expectation for a speedy recovery (4). Early removal of the
201 urinary catheter is becoming routine practice especially since the introduction of same-day
202 discharge following laparoscopic hysterectomy (22). However, our findings suggest that

203 removing the catheter before 6 hours might increase post-operative complications. Therefore,
204 careful mitigation of peri-operative factors (planned time of discharge, length of the
205 procedure, patient co-morbidity, etc.) remains essential to formulate a safe and optimal post-
206 operative care plan (23,24).

207 Traditionally, prolonged and repeated catheterisation was deemed to be a contributing factor
208 for post-operative UTIs. Still, the overall estimate in our meta-analysis shows minimal
209 benefit of early vs delayed removal of catheter. Arguably, using an aseptic catheterisation
210 technique with prophylactic IV antibiotic cover after anaesthetic induction and removal of the
211 catheter less than 12 hours post-op might offer the optimal practice to reduce the risk of UTIs
212 and post-operative pyrexia (25,26).

213

214 Future large trials are needed to evaluate the role of catheter removal in women planned for
215 same-day discharge following total laparoscopic and laparoscopy assisted hysterectomy
216 given their increased frequency and the potential for higher complications with early
217 discharge. Future studies should take into account the various effect-modifiers identified in
218 this systematic review to aid translation into clinical practice.

219

220 **Conclusions**

221 Early removal of the urinary catheter (<6 hours) post-hysterectomy seems to increase the risk
222 of urinary retention needing re-catheterisation with some reduction in the risk of UTI.

223

224 **Acknowledgements:** None

225 **Disclosure of Interests:** None

226 **Funding:**

227 Bassel H. Al Wattar holds a personal Lecturership from the UK National Health Institute of
228 Research.
229 Khalid S. Khan is a Distinguished Investigator at the University of Granada with a grant
230 awarded by the Beatriz Galindo Program (senior modality) of the Spanish Ministry of
231 Science, Innovation and Universities.
232

233 **References**

- 234 1. Wu JM, Wechter ME, Geller EJ, Nguyen T V, Visco AG. Hysterectomy rates in the
 235 United States, 2003. *Obstet Gynecol.* 2007;110(5):1091–5.
- 236 2. Stewart EA, Shuster LT, Rocca WA. Reassessing hysterectomy. *Minn Med.*
 237 2012;95(3):36.
- 238 3. Wright JD, Herzog TJ, Tsui J, Ananth C V, Lewin SN, Lu Y-S, et al. Nationwide
 239 trends in the performance of inpatient hysterectomy in the United States. *Obstet*
 240 *Gynecol* [Internet]. 2013 Aug;122(2 Pt 1):233–41. Available from:
 241 <https://www.ncbi.nlm.nih.gov/pubmed/23969789>
- 242 4. Wijk L, Franzen K, Ljungqvist O, Nilsson K. Implementing a structured Enhanced
 243 Recovery After Surgery (ERAS) protocol reduces length of stay after abdominal
 244 hysterectomy. *Acta Obstet Gynecol Scand.* 2014;93(8):749–56.
- 245 5. Schumm K, Lam TBL. Types of urethral catheters for management of short-term
 246 voiding problems in hospitalized adults: A short version Cochrane review. *Neurourol*
 247 *Urodynamics Off J Int Cont Soc.* 2008;27(8):738–46.
- 248 6. Ghezzi F, Cromi A, Uccella S, Colombo G, Salvatore S, Tomera S, et al. Immediate
 249 Foley removal after laparoscopic and vaginal hysterectomy: determinants of
 250 postoperative urinary retention. *J Minim Invasive Gynecol.* 2007;14(6):706–11.
- 251 7. Zhang P, Hu W-L, Cheng B, Cheng L, Xiong X-K, Zeng Y-J. A systematic review and
 252 meta-analysis comparing immediate and delayed catheter removal following
 253 uncomplicated hysterectomy. *Int Urogynecol J.* 2015;26(5):665–74.
- 254 8. Rajan P, Raghavan SS, Sharma D. Study comparing 3 hour and 24 hour post-operative
 255 removal of bladder catheter and vaginal pack following vaginal surgery: a randomised
 256 controlled trial. *BMC Womens Health.* 2017;17(1):78.
- 257 9. Sandberg EM, Twijnstra ARH, van Meir CA, Kok HS, van Geloven N, Gludovacz K,
 258 et al. Immediate versus delayed removal of urinary catheter after laparoscopic
 259 hysterectomy: a randomised controlled trial. *BJOG An Int J Obstet Gynaecol.*
 260 2019;126(6):804–13.
- 261 10. Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al.
 262 Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in
 263 adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases
 264 Society of America. *Clin Infect Dis.* 2010 Mar;50(5):625–63.
- 265 11. Lin B, Pang Z, Jiang J. Fixed and random effects selection by REML and pathwise
 266 coordinate optimization. *J Comput Graph Stat.* 2013;22(2):341–55.
- 267 12. Roy S, Sau M, Watson AJ. Bladder care after abdominal hysterectomy: a comparison
 268 of in-and-out versus continuous drainage. *J Obstet Gynaecol J Inst Obstet Gynaecol.*
 269 2001;21(6):630.
- 270 13. Lang P, Quezada Y, Whiteside JL. 20: A randomized trial comparing conventional and
 271 “fast track” indwelling urinary catheter management among women undergoing
 272 benign gynecologic surgery. *Am J Obstet Gynecol.* 2018;218(2):S905.
- 273 14. Joshi B, Aggarwal N, Chopra S, Taneja N. A prospective randomized controlled
 274 comparison of immediate versus late removal of urinary catheter after abdominal
 275 hysterectomy. *J Midlife Health.* 2014;5(2):68.
- 276 15. Dunn TS, Shlay J, Forshner D. Are in-dwelling catheters necessary for 24 hours after
 277 hysterectomy? *Am J Obstet Gynecol.* 2003;189(2):435–7.
- 278 16. Dobbs SP, Jackson SR, Wilson AM, Maplethorpe RP, Hammond RH. A prospective,
 279 randomized trial comparing continuous bladder drainage with catheterization at
 280 abdominal hysterectomy. *Br J Urol.* 1997;80(4):554–6.
- 281 17. Chai J, PUN T. A prospective randomized trial to compare immediate and 24-hour

- 282 delayed catheter removal following total abdominal hysterectomy. *Acta Obstet*
283 *Gynecol Scand.* 2011;90(5):478–82.
- 284 18. Alessandri F, Mistrangelo E, Lijoi D, Ferrero S, Ragni N. A prospective, randomized
285 trial comparing immediate versus delayed catheter removal following hysterectomy.
286 *Acta Obstet Gynecol Scand.* 2006;85(6):716–20.
- 287 19. Ahmed MR, Ahmed WAS, Atwa KA, Metwally L. Timing of urinary catheter removal
288 after uncomplicated total abdominal hysterectomy: a prospective randomized trial. *Eur*
289 *J Obstet Gynecol Reprod Biol.* 2014;176:60–3.
- 290 20. Summitt Jr RL, Stovall TG, Bran DF. Prospective comparison of indwelling bladder
291 catheter drainage versus no catheter after vaginal hysterectomy. *Am J Obstet Gynecol.*
292 1994;170(5):1815–21.
- 293 21. Liang C-C, Lee C-L, Chang T-C, Chang Y-L, Wang C-J, Soong Y-K. Postoperative
294 urinary outcomes in catheterized and non-catheterized patients undergoing
295 laparoscopic-assisted vaginal hysterectomy—a randomized controlled trial. *Int*
296 *Urogynecol J.* 2009;20(3):295–300.
- 297 22. Perron-Burdick M, Yamamoto M, Zaritsky E. Same-day discharge after laparoscopic
298 hysterectomy. *Obstet Gynecol.* 2011;117(5):1136–41.
- 299 23. Erekson EA, Yip SO, Ciarleglio MM, Fried TR. Postoperative complications after
300 gynecologic surgery. *Obstet Gynecol.* 2011;118(4):785.
- 301 24. Cheng H, Chen BP-H, Soleas IM, Ferko NC, Cameron CG, Hinoul P. Prolonged
302 operative duration increases risk of surgical site infections: a systematic review. *Surg*
303 *Infect (Larchmt).* 2017;18(6):722–35.
- 304 25. Assadi F. Strategies for preventing catheter-associated urinary tract infections. *Int J*
305 *Prev Med.* 2018;9.
- 306 26. Marschall J, Carpenter CR, Fowler S, Trautner BW. Antibiotic prophylaxis for urinary
307 tract infections after removal of urinary catheter: meta-analysis. *Bmj.* 2013;346:f3147.
308

309
310
311
312
313

Table 1: Characteristics of included trials comparing early vs delayed removal of urinary catheter post hysterectomy

Study	Country	Numbers randomised	Inclusion Criteria	Exclusion Criteria	Use of prophylactic Antibiotic
Sandberg 2018	Netherlands	155	> 18 years old undergoing laparoscopic hysterectomy	Additional procedures to hysterectomy Incontinence	Not reported
Ahmed 2014	Egypt	221	Undergoing total abdominal hysterectomy	Neurological disorders, Pre-operative UTI, surgeons decision for catheter to remain longer than cohort assignment, urge incontinence	1g Intramuscular ceftriaxone
Dunn 2003	USA	250	Undergoing a hysterectomy	Anticipated complicated procedure Additional bladder procedure during hysterectomy	Single dose of unspecified antibiotics prophylaxis before the operation
Alessandri 2006	Italy	96	Undergoing a hysterectomy	Anticipated complicated procedure, Recurrent UTI Urinary incontinence, Neurological disorders	Single dose of unspecified antibiotics prophylaxis before the operation
Chai 2011	Hong Kong	70	Undergoing total abdominal hysterectomy	Recurrent UTI, urinary incontinence, neurological disorders, surgeons decision for catheter to remain, spinal anaesthesia and patient controlled analgesia	Not given
Lang 2018	USA	200	Undergoing hysterectomy via any surgical route and expected to be hospitalized for at least one day	None reported	Not reported
Dobbs 1997	UK	95	Undergoing total abdominal hysterectomy for non-malignant reasons	None reported	1.2 g IV augmentin or alternative regime if allergic to penicillin
Liang 2009	Taiwan	150	Laparoscopic assisted vaginal hysterectomy	Pelvic reconstructive surgery, stress incontinence, Urinary symptoms	500mg iv cefazolin
Summitt 1994	USA	99	Undergoing a vaginal hysterectomy	Procidentia, Stress incontinence, positive urine culture	2g Iv cefazolin or 200 mg IV doxycycline if penicillin allergic
Joshi 2014	India	70	Undergoing abdominal hysterectomy	Anticipated complicated procedure, bladder suspension/Colporrhaphy surgery, positive urine culture, co-morbidities requiring fluid balance	at the time of surgery and continued postoperatively as per department protocol.

314
315

316 **Figure legends:**

317 **Figure (1):** Selection and inclusion process for trials in the systematic review comparing
318 early vs delayed removal of urinary catheter post hysterectomy

319 **Figure 2:** Risk of bias in included randomised trials comparing early vs delayed removal of
320 urinary catheter post hysterectomy

321 **Figure (3):** Forest plots of random effect meta-analyses for reported outcomes in trials
322 comparing early to delayed removal of the urinary catheter post hysterectomy

323

324

325