

APPENDIX

Supplementary Table 1. Search strategy		
1	exp Surgical Procedures, Operative/	(7220088)
2	exp Specialties, Surgical/	(4422497)
3	exp surgery/	(4265000)
4	(surg\$ or microsurg\$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy]	(5734468)
5	or/1-4	(9210386)
6	ed.fs.	(262111)
7	education, graduate/ or education, medical, graduate/ or education, medical/ or education, medical, continuing/	(338400)
8	medical education/	(260274)
9	educat\$ or train\$ or learn\$ or teach\$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy]	(3561617)
10	or/6-9	(3633187)
11	5 and 10	(422781)
12	Surgical training/	(17128)
13	11 or 12	(422781)
14	wet lab\$.mp.	(1777)
15	in-vivo or ex-vivo or fresh frozen or porcine or animal model\$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy]	(3181469)
16	Cadaver/	(84352)
17	cadaver\$.mp.	(155311)
18	(porcine or pig\$1).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy]	(666576)
19	or/14-18	(3751832)
20	13 and 19	(17427)
21	exp *Surgical Procedures, Operative/ or exp *Specialties, Surgical/ or exp *surgery/	(4099004)
22	(surg\$ or microsurg\$).tw.	(3963558)
23	or/21-22	(6537482)
24	20 and 23	(13476)
25	exp *Surgical Procedures, Operative/ed or exp *Specialties, Surgical/ed or exp *surgery/ed	(25046)
26	*education, graduate/ or *education, medical, graduate/ or *education, medical/ or *education, medical, continuing/ or *medical education/	(185764)
27	*Surgical training/	(8131)
28	educat\$ or train\$ or learn\$ or teach\$).tw.	(2708345)
29	or/25-28	(2777956)
30	24 and 29	(12524)
31	*Cadaver/	(7623)

*Al-Jabir A, et al. Current status of wet lab and cadaveric simulation in urological training:
A systematic review*

32	(wet lab\$ or (in-vivo or ex-vivo or fresh frozen or porcine or animal model\$) or cadaver\$ or (porcine or pig\$1)).tw.	(2827026)
33	or/31-32	(2830433)
34	30 and 33	(10216)
35	(educat\$ or train\$ or learn\$ or teach\$).ti.	(848296)
36	27 or 35	(851281)
37	34 and 36	(3662)
38	(surg\$ or microsurg\$).ti.	(1275498)
39	transplant\$.ti.	(551385)
40	operative.ti.	(77743)
41	or/38-40	(1882968)
42	37 and 41	(1555)
43	35 and 42	(1474)
44	(wet lab\$ or (in-vivo or ex-vivo or fresh frozen or porcine or animal model\$) or cadaver\$ or (porcine or pig\$1)).ti.	(747603)
45	43 and 44	(439)
46	remove duplicates from 45	(254)

Supplementary Table 2. Types of validity as per McDougall¹, Van Nortwick et al,¹⁴ and Tay et al¹⁵

Type of validity	Definition
Face	Opinions, including of nonexperts, regarding the realism of the simulator – does the simulator represent what it is supposed to represent?
Content	Opinions of experts about the simulator and its appropriateness for training – does the simulator teach what it is supposed to teach?
Construct A	Within one group — ability of the simulator to assess and differentiate between the level of experience of an individual or group measured over time
Construct B	Between groups — ability of the simulator to distinguish between different levels of experience
Concurrent	Comparison of the new model against the older and gold standard, usually by Objective Structured Assessment of Technical Skills (OSATSs)
Transfer	A measure of whether the simulator has the effect that it proposes to have – does the simulator produce a learning effect and improve performance with continued use?
Predictive	Correlation of performance with operating room performance, usually measured by OSATS

Level	Criteria
1a	Systematic reviews (meta-analysis) containing at least some trials of level 1b evidence, in which results of separate, independently conducted trials are consistent
1b	Randomized controlled trial of good quality and of adequate sample size (power calculation)
2a	Randomized trials of reasonable quality and/or of inadequate sample size
2b	Non-randomized trials, comparative research (parallel cohort)
2c	Non-randomized trials, comparative research (historical cohort, literature controls)
3	Non-randomized, non-comparative trials, descriptive research
4	Expert opinions, including the opinion of work group members

Level	Criteria
1	Based on one systematic review (1a) or at least two independently conducted research projects classified as 1b
2	Based on at least independently conducted research projects classified as level 2a or 2b, within concordance
3	Based on one independently conducted research project level 2b, or at least two trials of level 3, within concordance
4	Based on one trial at level 3 or multiple expert opinions, including the opinion of work group members (e.g., level 4)

Supplementary Table 4. Laparoscopic urological surgery models								
Reference	Type of simulation			Procedure	Subjects	Validation type	LoE	LoR
Molinas 2004 ⁴⁴	Animal	Rabbit	In-vivo	Laparoscopic nephrectomy	20	Face; content; construct	2b	3
Cruz 2012 ²⁶	Animal	Porcine	In-vivo	Laparoscopic radical nephrectomy	6	Face; content; transfer	2b	3
De Win 2013 ⁵⁶	Animal	Porcine	Ex-vivo	Laparoscopic radical nephrectomy	22	Content, construct	2b	3
Marchini 2016 ⁴³	Animal	Porcine	In-vivo	Total nephrectomy (SILS)	15	Face; content	2b	3
Ramachandran 2008 ⁵⁹	Animal	Chicken	Ex-vivo	Laparoscopic pyeloplasty	3	Construct	3	4
Jiang 2013 ¹⁷	Animal	Chicken	Ex-vivo	Laparoscopic pyeloplasty	15	Construct	2b	3
Teber 2010 ²⁴	Animal	Porcine	Ex-vivo	Laparoscopic pyeloplasty	5	Construct	2b	3
Yang 2006 ¹⁸	Animal	Chicken	Ex-vivo	Laparoscopic urethrovesical anastomosis	8	Content; construct	2b	3
Laguna 2006 ¹⁹	Animal	Chicken	In-vivo	Laparoscopic urethrovesical anastomosis	5	construct	2b	3
Boon 2008 ²⁷	Animal	Porcine	Ex-vivo	Laparoscopic urethrovesical anastomosis	12	Face; content; construct	2b	3
Sabbagh 2012 ²⁸	Animal	Porcine	In-vivo	Laparoscopic urethrovesical anastomosis	28	Face	2a	2

LoE: level of evidence; LoR: level of recommendation.

Supplementary Table 5. Endourology models								
Reference	Type of simulation			Procedure	Subjects	Validation type	LoE	LoR
Grimsby 2011 ³⁸	Animal	Porcine	Ex-vivo	Rigid cystoscopy; bladder biopsy	2	Construct; transfer	2b	3
Soria 2014 ⁴²	Animal	Porcine	Ex-vivo	Urethrocystoscopy	40	Face; content; construct	2b	3
Bowling 2010 ⁵⁵	Cadaver			Urethrocystoscopy	29	Construct	1b	2
Hu 2015 ²³	Animal	Porcine	In-vivo	Flexible ureteroscopy	20	Face; construct	2b	3
Chou 2006 ⁵⁷	Animal	Porcine		Ureterorenoscopy	16	Concurrent	2a	
Ogan 2004 ⁵⁸	Cadaveric			Diagnostic ureteroscopy	32	Construct, predictive	2b	
Mains 2017 ⁵¹	Cadaveric			Semi-rigid and flexible ureterorenoscopy	8	Face; content	3	4
Rai 2004 ⁵²	Cadaveric			Ureterorenoscopy; transurethral resection of prostate	11	Face	2b	3
Soria 2015 ²²	Animal	Porcine	In-vivo	Endoscopic retrograde intrarenal surgery	60	Face; content; construct	2b	3
Huri 2016 ⁴⁸	Cadaveric			Retrograde intrarenal surgery	12	Face; content; construct	2b	3
Mishra 2010 ³⁶	Animal	Porcine	Ex-vivo	Percutaneous renal puncture	24	Construct	2b	3
Earp 2003 ³⁰	Animal	Porcine	Ex-vivo	Percutaenous lithotripsy and endopielotomy		Face	3	4

Al-Jabir A, et al. Current status of wet lab and cadaveric simulation in urological training: A systematic review

Hammond 2008 ³²	Animal	Porcine	Ex-vivo	Percutaneous nephrolithotomy		Face	3	4
Zhang 2008 ³⁵	Animal	Porcine	Ex-vivo	Percutaneous renal manipulations	42	Face	2b	3
Hacker 2007 ³¹	Animal	Porcine	Ex-vivo	Percutaneous nephrolithotomy		Face	3	4
Strohmaier 2009 ³³	Animal	Porcine	Ex-vivo	Percutaneous nephrolithotomy		Face	3	4
Strohmaier 2005 ³⁴	Animal	Porcine	Ex-vivo	Percutaneous nephrolithotomy		Face	3	4
Jagtap 2010 ³⁷	Animal	Porcine	In-vivo	Percutaneous renal puncture	24	Face; content	2b	3
Jutzi 2013 ²⁵	Animal	Porcine	Ex-vivo	Minimally invasive percutaneous nephrolithotomy	7	Face	3	4
Jutzi 2014 ²⁹	Animal	Porcine	Ex-vivo	Minimally invasive percutaneous nephrolithotomy	11	Face	3	4
Page 2015 ⁴⁶	Cadaveric			Holmium laser enucleation of prostate; Thulium prostate resection; high-power KTP laser vaporization		Face; content	3	4

LoE: level of evidence; LoR: level of recommendation.

Supplementary Table 6. Robotic urological surgery models								
Reference	Type of simulation			Procedure	Subjects	Validation type	LoE	LoR
Hung 2012 ²⁰	Animal	Porcine	Ex-vivo	Robot-assisted partial nephrectomy	46	Face; content; construct	2b	3
Hung 2012 ²¹	Animal	Porcine	Ex-vivo	Robotic bowel resection; robotic cystotomy and repair; robotic partial nephrectomy	24	Concurrent; predictive	2a	2
Khanna 2011 ³⁹	Animal	Porcine	Ex-vivo	Robot-assisted ex-vivo kidney transplantation		Face	2b	3
Tiong 2017 ⁴¹	Animal	Porcine	In vivo	Robot-assisted kidney transplantation		Face; content	3	4
Alemozaffar 2014 ⁴⁰	Animal	Porcine	Ex-vivo	Robot-assisted radical prostatectomy	20	Face; content; construct	2b	2
Blaschko 2007 ⁴⁹	Cadaveric			Robot-assisted laparoscopic prostatectomy; cardiac surgery	22	Face	3	4
Raison 2014 ⁵⁰	Cadaveric			Robotic radical cystectomy; robotic radical prostatectomy; robotic extended lymph node dissection; robotic radical nephrectomy	16	Face; content; construct	2b	3

LoE: level of evidence; LoR: level of recommendation.

Reference	Type of simulation			Procedure	Subjects	Validation type	LoE	LoR
Ozcan 2015 ⁵³	Cadaveric			Urological anatomy dissection	50	Face; transfer	3	4
Huri 2010 ⁴⁵	Cadaveric			Radical prostatectomy; inguinal orchiectomy; retroperitoneal lymph node and pelvic lymph node dissection; nephrectomy; adrenalectomy; radical cystectomy; extended lymph node dissection	25	Face; content	2b	3
Cabello 2014 ⁴⁷	Cadaveric			Renal transplantation	28	Face	2b	3
Ahmed 2015 ⁵⁴	Cadaveric			Various urological procedures	102	Face; content	2b	3

LoE: level of evidence; LoR: level of recommendation.