Robotic Olympics: A novel robotic surgical training experience for residents in an obstetrics and gynecology residency program

Malte Renz MD PhD[1], Eric C. Liberman DO[1], Brian Daniels PhD[2], Sara Isani MD[1], Dennis Y. Kuo MD[1], Nicole S. Nevadunsky MD[1]*

[1] Montefiore Medical Center/ Albert Einstein College of Medicine, Department of Obstetrics & Gynecology and Women's Health, Bronx, NY

[2] Broad Institute, Boston, MA

*Corresponding Author:

Nicole Nevadunsky, MD

Division of Gynecologic Oncology

Montefiore Medical Center, Albert Einstein College of Medicine

Department of Obstetrics, Gynecology and Women's Health

1695 Eastchester Road

Bronx, New York 10461

Nnevadun@montefiore.org

Phone: 718-904-3316

Fax: 718-430-8676

A portion of this work was presented at the 2016 Society for Gynecologic Oncology

Disclosure statement: The authors declare that they have no conflicts of interest and nothing to disclose.

Word count, abstract: 249

Word count, main text: 1,987

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

Abstract

Background: Resident experience and opinions regarding robotic surgical training as part of the formal obstetrics and gynecology curriculum has not been reported.

Objective: To evaluate residents' experience with the newly introduced Robotic Olympics and a robotic surgical trainings curriculum in general, especially in correlation with future career goals.

Methods: All residents of the Obstetrics and Gynecology Residency Program at the Montefiore Medical Center, who participated in the Robotic Olympics 2014, a team-based simulation competition, completed a de-identified pre- and post-Olympics survey.

Results: For the participating 31 residents, the mean number of bedside-assistant robotic and console cases was 8 (0-50) and 4 (0-30), respectively. Both were positively associated with postgraduate level. The majority of residents (89%) reported that they were best trained in open surgery. Only 52% anticipated using robotic surgery in their future practice. Anticipated use of the robot and interest in robotic training were correlated with surgical subspecialty career goals. 100% of residents aspiring a career in gynecologic oncology and none interested in maternofetal medicine anticipated future use of robotic surgery. However, all residents desired the Robotic Olympics to be integral part of resident education.

Conclusions: The majority of residents welcomed the addition of the Robotic Olympics to the robotic-surgical curriculum. However, the residents' interest in robotic surgical training in general was disparate and correlated with the anticipated use of the robot in the residents' future career. This data suggests the need for directed robotic surgical training for residents interested in surgical sub-specialties to focus resources early on.

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

Highlights:

- Integration of Robotic Olympics into a robotic surgical trainings curriculum
- OB Gyn residents welcomed Robotic Olympics as motivational education event
- OB Gyn residents interest in robotic training in general correlated with sub-specialty career goals
- Disparate OB Gyn resident interest may favor early sub-specialty tracking

Keywords: robotic surgery educational curriculum; Robotic Olympics; Obstetrics and Gynecology Residency

Precis: Association of residents' preferences for robotic training with anticipated career goals

Introduction

In the past decade, over 1.5 million surgical cases were performed using computer-enhanced laparoscopic technology, i.e. robotic-assisted surgery [1,2]. These cases were identified nationally and internationally across all surgical disciplines, including gynecology, urology, general, head and neck, cardiac, and thoracic surgery [3]. The increasing interest in computer-enhanced laparoscopy is due to improved ergonomics, three-dimensional vision, instrument maneuverability and accuracy [4]. In the light of the ever-growing impact of robotic-assisted surgery, there is a well-articulated need for training and credentialing [5] in robotic-assisted surgery [6-9].

Reported data suggests that training in robotic-assisted surgery should start early in the surgical training [10-12] to maximize the surgical skill set of the developing physician. Thus, the implementation of a robotic-assisted surgery curriculum into a gynecologic residency appears important [13-15]. Across surgical disciplines different educational models have been explored, ranging from mentored training in the operating room to simulator-based training modules [16-18], or combinations of both; all these models share the same goal of developing a standardized curriculum for robotic surgery in resident education [19-22].

Residents at Montefiore Medical Center familiarize themselves with robotic-surgery over the course of the postgraduate years of training in a stepwise fashion starting with online courses and simulator modules provided by daVinci® Surgical System, dry runs organized by the gynecologic oncology division and bed-side assistance in OR cases. The completion of all simulator modules of the daVinci® Surgical System with a certain cut-off score is prerequisite for sitting at the robot console

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

during surgery and performing parts of the robotic-assisted surgery. The Robotic Olympics was initiated to foster resident education and interest in robotic-assisted surgery. Here, we present data on the Robotic Olympics performed at the Montefiore Medical Center in the Bronx. The goal of our study was to report our residents' experiences and expectations of the Robotic Olympics in particular and robotic surgical training in general and identify possible associations of interest in robotic-surgical training with future career goals.

Material and Methods

After IRB approval, the Robotic Olympics were performed on four SI daVinci® simulator consoles at the Montefiore Medical Center in the Bronx in April 2014. The Olympics took place during protected educational time of Residency School. The month of April was chosen so that residents were able to gather experience in robotic-assisted surgery on their respective postgraduate level. The Olympics were announced 2 months prior to the event to allow for sufficient practice on the SI simulator consoles available in the ORs of the Jack D. Weiler and Moses Montefiore campuses. The modules and tasks of the Olympics were disclosed for efficient contest preparation.

On the day of the Robotic Olympics before its start, pre-Olympics Surveys were completed by the residents. Then, participants were divided into teams adjusted to postgraduate year and anticipated level of robotic-surgical skills. Skills were not only gauged by postgraduate year but also the time spent at the simulator and the scores achieved during simulator sessions. The four teams consisted of 9 participants each. During the Robotic Olympics, same level contestants of all four teams competed in timed tasks. Wide-screens displayed the contestants' view so that all participants were able to follow the performance of the contestants. Winner and runner-up were awarded points. The total number of points a team achieved determined the winner of the Robotic

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

Olympics. During the Olympics, each participant performed 5 tasks at the console, including 'pick and place', 'ring and rail' level1, 'peg board', 'energy dissection' and 'ring and rail' level 2. The latter was a team task with each of the three rings moved along a rail by different team members.

Six months after the Robotic Olympics, participants were asked to fill out a second survey, the post-Olympics Survey. Because of the low turnout, the time a resident spent to practice at the robot simulator was only analyzed before and after the *announcement* of the Robotic Olympics as assessed in the pre-Olympics Survey. For this relatively small study, statistical significance of the correlation between anticipated use of robotic surgery and sub-specialty career goal was calculated using Fisher's Exact test. Correlation between the interest in robotic surgical training and desired future sub-specialty was determined with the student t-test with a p-value of < 0.05 considered statistically significant.

Results

31 of 45 residents (67%) participated in the Robotic Olympics. The remaining 14 residents were not able to participate because of night shift or vacation. Participation was as follows: 9/13 PGY-1s (69%), 8/11 PGY-2s (72%), 6/11 PGY-3s (55%) and 8/10 PGY-4s (80%). 27 of 31 (87%) pre-Olympics Resident Surveys were completed, and only 12 of 31 (39%) post-Olympics Resident Surveys.

Resident survey – residents' experience

The reported resident experience with robotic-assisted surgery averaged 1 case for PGY1 or 2s, 10 cases for PGY3s and 25 cases for PGY4s (Figure 1a). The structure of our postgraduate training curriculum resulted in growing exposure to robotic cases

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

over the years starting as bedside-assistant (Figure 1a) to becoming primary surgeon at the robot console (Figure 1b).

Residents' perception of the importance of robotic surgery

The residents' career goals showed a balanced mixture of anticipated career pathways (Figure 2a). Four participants provided two possible future pathways and were counted for both named sub-specialties. Overall, 52% of the residents anticipated future use of robotic-assisted surgery (Figure 2b). There was a statistical significant correlation between anticipated future use of robotic-assisted surgery and intended sub-specialty career path ($p = 0.008$). Residents who were planning a nonsurgical career in maternofetal medicine anticipated no further use of robotic-assisted surgery or were unsure about it, while all gynecology oncology aspirants expected future use of robotic-assisted surgery. Overall, the majority of residents aspiring surgical sub-specialties anticipated future use of the robot or were not sure about it; only three residents who wanted to pursue a generalist career did not anticipate future robot use.

Residents' desire for training in robotic surgery

Intended future sub-specialty career was also correlated with the interest in robotic-surgical training. The level of interest appeared polarized between surgical and non-surgical disciplines. Student t-test revealed a statistical significant difference between the mean interest of residents aspiring a career in maternofetal medicine (mean ± STD: 6 ± 2.87) compared to the residents desiring a career in gynecologic oncology (mean ± STD: 9.67 ± 0.52) ($p = 0.0048$) (Figure 3a). Only very few residents interested in a career in maternofetal medicine expressed interest in broad education that includes robotic-surgical training, while all residents aspiring a future surgical career showed high interest in robotic surgical training. When asked to name obstacles of self-motivated training and use of the robotic simulator, most of the residents pointed to the lack of time during a busy residency in OBGYN (Figure 3b).

Educational and motivational impact of the Robotic Olympics

All residents, regardless of anticipated future sub-specialty, emphasized the usefulness of the event and felt that the Robotic Olympics motivated them to intensify their training in in robotic-assisted surgery (Figure 4a and b). Almost all residents expressed the wish to firmly integrate the Robotic Olympics into residency education (Figure 4 c); many residents even asked for biannual Olympics.

In fact, there was an increase in reported time dedicated to robotic simulator training *before* and *after* the announcement of the Robotic Olympics (Figure 5a and 5b). The mean time spent on the robotic simulator was 18 ± 45 min (0 – 200 min) before the Olympics announcement and 50 ± 95 min (0 - 360 min) after, i.e. over the 2-month period leading up to the Robotic Olympics. While this certainly indicates a trend towards self-motivated training triggered by the announcement of the Robotic Olympics, it did not reach statistical significance (p-value 0.128). The largest increase in training time was reported by individual residents of the junior post-graduate levels. While prior to the announcement, only one PGY-1 of all PGY-1 and PGY-2 residents reported only a few minutes of practice at the simulator, after the announcement 3/9 PGY-1s (33%) and 3/7 PGY-2s (43%) reported to have trained at the simulator for up to 300 min during the 2 months leading to the Robotic Olympics. This predominant increase in training time noted for junior residents is likely related to the fact that the Robotic Olympics was the first exposure for all of PGY-1s and PGY-2s maneuvering the robot console and that future career paths are not as well-determined in junior postgraduate years compared to senior years. Regular Robotic Olympics will certainly solidify and enhance this positive effect on training time.

Discussion

Here, we report residents' experience and opinion on robotic surgical training, in particular the Robotic Olympics that has recently been introduced at Montefiore Medical Center to complement and enhance existing robotic-surgical training. Residents' experience and opinions regarding robotic surgical training as part of the formal OBGYN curriculum have not been reported. The Robotic Olympics were unanimously perceived as educational and motivational. Almost all residents wished that an annual Robotic Olympics be integrated into the residency training curriculum. The announcement of the Robotic Olympics stimulated self-determined learning and increased self-dedicated training time. This increase was especially notable in junior resident years. For junior residents, curiosity and interest in the multifaceted aspects of an OBGYN residency are characteristic and sub-specialty goals not yet fully matured, which permits to motivate junior residents for a possible surgical career for example by the virtue of the Robotic Olympics. In general, self-determined learning is certainly the best driving force of any learning process. However, existing workload needs to be balanced to prevent physician burnout early in the career of the learning and developing physician. Of note in this context, lack of time was the most commonly identified obstacle to surgical training.

In contrast to the residents' opinion about the Robotic Olympics, the perceived relevance of robotic-surgical training in general was clearly correlated with future sub-specialty career goals and anticipated use of the robot in the future. This correlation may serve as additional argument for specialized career paths and initiation of sub-specialty tracking early-on in residency. Tracking into surgical and non-surgical pathways would permit a more in-depth training of those who want to pursue a surgical career, while

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

freeing up time and resources for those who will not pursue a surgical career. Early specialization and lack of general overview over the field of OBGYN, however, are drawbacks of early tracking and need to be weighed carefully in this context. Continued resident exposure to the full breadth of the field of OBGYN appears important; especially, since this study provided evidence that in fact junior residents can be motivated to dedicate more time for surgical training through events like the Robotic Olympics. Starting surgical and non-surgical tracking after junior resident years, i.e. after the completion of the second postgraduate year, may be a valid option to reconcile the need for obtaining an overview over the field of OBGYN on one hand and focusing resources and career paths on the other.

Because of the all throughout positive experience the residents reported about the Robotic Olympics, we are planning on making the Robotic Olympics integral part of resident education at the Montefiore Medical Center. The number of cases performed with robotic-enhanced laparoscopic surgery has been continuously increasing over the years; in parallel the need for adequate surgical training has become evident and various efforts to introduce a standardized surgical curriculum have been made. There is an obvious need to transfer the skills acquired in simulator-based training to the actual surgery [23] and robotic simulator cannot replace the actual mentored training in the operating room. Hence, the robotic surgical curriculum at the Montefiore Medical Center comprises a stepwise progression in surgical experience and responsibilities incorporating dry-runs, bed-side assistance, simulator training, Robotic Olympics and mentored training in the operating room seem to satisfied the broad scope of surgical education. Although this report is only a single-center experience, it may inspire the surgical curriculum of other residency programs. We will continue to evaluate the impact of integrating regular Robotic Olympics into the core robotic-surgical curriculum of our OBGYN Residency program.

Figures

Figure 1: Number of cases residents participated in and number of cases during which the residents fulfilled parts of the surgery as surgeon sitting at the surgeon's console.

Figure 1a: Number of cases residents participated in as reported in the resident survey with mean value indicated by horizontal bar. The residents took part in the robotic-assisted laparoscopic surgery as so called bedside assistants. They learn how to position the patient on the operating table for a safe procedure, how to enter the abdomen safely, how to place robotic ports and assist during the surgery through the assistant port, i.e. with suction irrigation, passing suture material, helping with exposure.

Figure 1b: Number of cases residents sat at the surgeon's console and performed parts of the surgery as primary surgeon as reported in the resident survey with mean value indicated by horizontal bar.

Figure 2: Residents' sub-specialty career goals and anticipated use of robotic-assisted surgery in these sub-specialties.

Figure 2a: The distribution of future career goals was maternal fetal medicine (26%), generalist (23%), urogynecology (20%), gynecologic oncology (17%), reproductive endocrinology (6%), and minimally invasive surgery (6%).

Figure 2b: Residents planning to specialize in non-surgical disciplines such as maternofetal medicine did not anticipate future use of robotic-assisted surgery. Generalists were split in their anticipation of future use of robotic surgery. Surgical subspecialties were foreseeing throughout use of robotic surgery in their respective sub-specialty. Fisher's Exact test showed statistical significance with a p-value of 0.008 between surgical and non-surgical subspecialties.

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

Figure 3: Residents' interest in training in robotic-assisted laparoscopic surgery and perceived obstacles to such training.

Figure 3a: Residents' interest in training in robotic-assisted laparoscopic surgery correlated with residents' future sub-specialty career goals. Box-whiskers plot provides the median value (red line) with quartiles and was combined with a dot plot showing the reported interest of each participant (filled circles). Outlier values are marked by open circles. The level of interest was polarized between anticipated entry into surgical and non-surgical sub-specialties and reached statistical significance for the mean interest in surgical training of the residents desiring a sub-specialization in maternofetal medicine (mean ± STD: 6 ± 2.87) versus gynecologic oncology (mean ± STD: 9.67 ± 0.52) as calculated with the Student t-test (p = 0.00485). Marked with asterisk.

Figure 3b: Perceived obstacles preventing more intense self-determined robotic-assisted surgery training. The most commonly answered barriers to robotic surgical training were lack of console time (62%), inaccessibility of the robotic simulator (19%), and not knowing how to use the simulator (19%).

Figure 4a-c: Residents' perception of the Robotic Olympics. Regardless of subspecialty career goals residents described their experience with the Robotic Olympics as useful, motivational and would like to see the Olympics as integral part of resident education.

Figure 5a+b: Change in self-determined simulator training before and after the announcement of the Robotic Olympics. There was an individual increase in the time spent at the robot simulator triggered by the announcement of the Robotics Olympics. Average time increased from 18 ± 45 min to 50 ± 95 min which did not reach statistical significance.

References

1. Nezhat, C. *et al.* Robotic-assisted laparoscopic myomectomy compared with standard laparoscopic myomectomy--a retrospective matched control study. *Fertil Steril* **91**, 556-559, doi:S0015-0282(07)04181-7 [pii] 16/j.fertnstert.2007.11.092 (2009).

2. Nezhat, C. & Lakhi, N. Learning Experiences in Robotic-Assisted Laparoscopic Surgery. *Best Pract Res Clin Obstet Gynaecol*, doi:S1521-6934(15)00221-7 [pii] 1016/j.bpobgyn.2015.11.009 (2015).

3. Cho, J. E., Shamshirsaz, A. H., Nezhat, C. & Nezhat, F. New technologies for reproductive medicine: laparoscopy, endoscopy, robotic surgery and gynecology. A review of the literature. *Minerva Ginecol* **62**, 137-167, doi:R09103096 [pii] (2010).

4. Schreuder, H. W. & Verheijen, R. H. Robotic surgery. *BJOG* **116**, 198-213, doi:BJO2038 [pii] 11/j.1471-0528.2008.02038.x (2009).

5. Peterson, S., Mayer, A., Nelson, B. & Roland, P. Robotic Surgery Training in an OB/GYN Residency Program: A Survey Investigating the Optimal Training and Credentialing of OB/GYN Residents. *Conn Med* **79**, 395-399 (2015).

6. Erickson, B. K., Gleason, J. L., Huh, W. K. & Richter, H. E. Survey of robotic surgery credentialing requirements for physicians completing OB/GYN residency. *J Minim Invasive Gynecol* **19**, 589-592, doi:S1553-4650(12)00220-8 [pii] 16/j.jmig.2012.05.003 (2012).

7. Fatehchehr, S., Rostaminia, G., Gardner, M. O., Ramunno, E. & Doyle, N. M. Robotic surgery training in gynecologic fellowship programs in the United States. *JSLS* **18**, doi:10.4293/JSLS.2014.00402-D-13-00402 [pii] (2014).

8. Geller, E. J., Schuler, K. M. & Boggess, J. F. Robotic surgical training program in gynecology: how to train residents and fellows. *J Minim Invasive Gynecol* **18**, 224-229, doi:S1553-4650(10)01269-0 [pii]16/j.jmig.2010.11.003 (2011).

9. Moles, J. J., Connelly, P. E., Sarti, E. E. & Baredes, S. Establishing a training program for residents in robotic surgery. *Laryngoscope* **119**, 1927-1931, doi:10.1002/lary.20508 (2009).

10. Brenot, K. & Goyert, G. L. Impact of robotic surgery on obstetric-gynecologic resident training. *J Reprod Med* **54**, 675-677 (2009).

11. De Ugarte, D. A., Etzioni, D. A., Gracia, C. & Atkinson, J. B. Robotic surgery and resident training. *Surg Endosc* **17**, 960-963, doi:10.1007/s00464-002-8745-6 (2003).

12. Broholm, M. & Rosenberg, J. Surgical Residents are Excluded From Robot-assisted Surgery. *Surg Laparosc Endosc Percutan Tech* **25**, 449-450, doi:10.1097/SLE.0000000000000001909689-201510000-00016 [pii] (2015).

13. Moola, D., Westermann, L. B., Pauls, R., Eschenbacher, M. & Crisp, C. The Impact of Robotic-Assisted Surgery on Training Gynecology Residents. *Female Pelvic Med Reconstr Surg* **22**, 11-15, doi:10.1097/SPV.0000000000002276319-201601000-00004 [pii] (2016).

14. Jeppson, P. C. *et al.* Impact of robotic technology on hysterectomy route and associated implications for resident education. *Am J Obstet Gynecol* **212**, 196 e191-196, doi:S0002-9378(14)00786-8 [pii] 016/j.ajog.2014.07.037 (2015).

15. Finnerty, B. M., Afaneh, C., Aronova, A., Fahey, T. J., 3rd & Zarnegar, R. General surgery training and robotics: Are residents improving their skills? *Surg Endosc* **30**, 567-573, doi:10.1007/s00464-015-4240-8007/s00464-015-4240-8 [pii] (2016).

16. Gomez, P. P., Willis, R. E. & Van Sickle, K. R. Development of a virtual reality robotic surgical curriculum using the da Vinci Si surgical system. *Surg Endosc*, doi:10.1007/s00464-014-3914-y (2014).

17. Ruparel, R. K. *et al.* Assessment of virtual reality robotic simulation performance by urology resident trainees. *J Surg Educ* **71**, 302-308, doi:S1931-7204(13)00227-4 [pii] 1016/j.jsurg.2013.09.009 (2014).

18. Thiel, D. D., Patel, V. R., Larson, T., Lannen, A. & Leveillee, R. J. Assessment of robotic simulation by trainees in residency programs of the Southeastern Section of the American Urologic Association. *J Surg Educ* **70**, 571-577, doi:S1931-7204(13)00138-4 [pii] 16/j.jsurg.2013.04.014 (2013).

19. Ahmed, K. *et al.* Development Of A Standardised Training Curriculum For Robotic Surgery: A Consensus Statement From An International Multidisciplinary Group Of Experts. *BJU Int*, doi:10.1111/bju.12974 (2014).

20. Rashid, H. H. *et al.* Robotic surgical education: a systematic approach to training urology residents to perform robotic-assisted laparoscopic radical prostatectomy. *Urology* **68**, 75-79, doi:S0090-4295(06)00127-0 [pii] 16/j.urology.2006.01.057 (2006).

21. Volpe, A. *et al.* Pilot Validation Study of the European Association of Urology Robotic Training Curriculum. *Eur Urol*, doi:S0302-2838(14)01039-2 [pii] 16/j.eururo.2014.10.025 (2014).

22. Sperry, S. M., O'Malley, B. W., Jr. & Weinstein, G. S. The University of Pennsylvania curriculum for training otorhinolaryngology residents in transoral robotic surgery. *ORL J Otorhinolaryngol Relat Spec* **76**, 342-352, doi:000369624 [pii] 159/000369624 (2014).

23. Moglia, A. *et al.* A Systematic Review of Virtual Reality Simulators for Robot-assisted Surgery. *Eur Urol*, doi:S0302-2838(15)00929-X [pii] 016/j.eururo.2015.09.021 (2015).

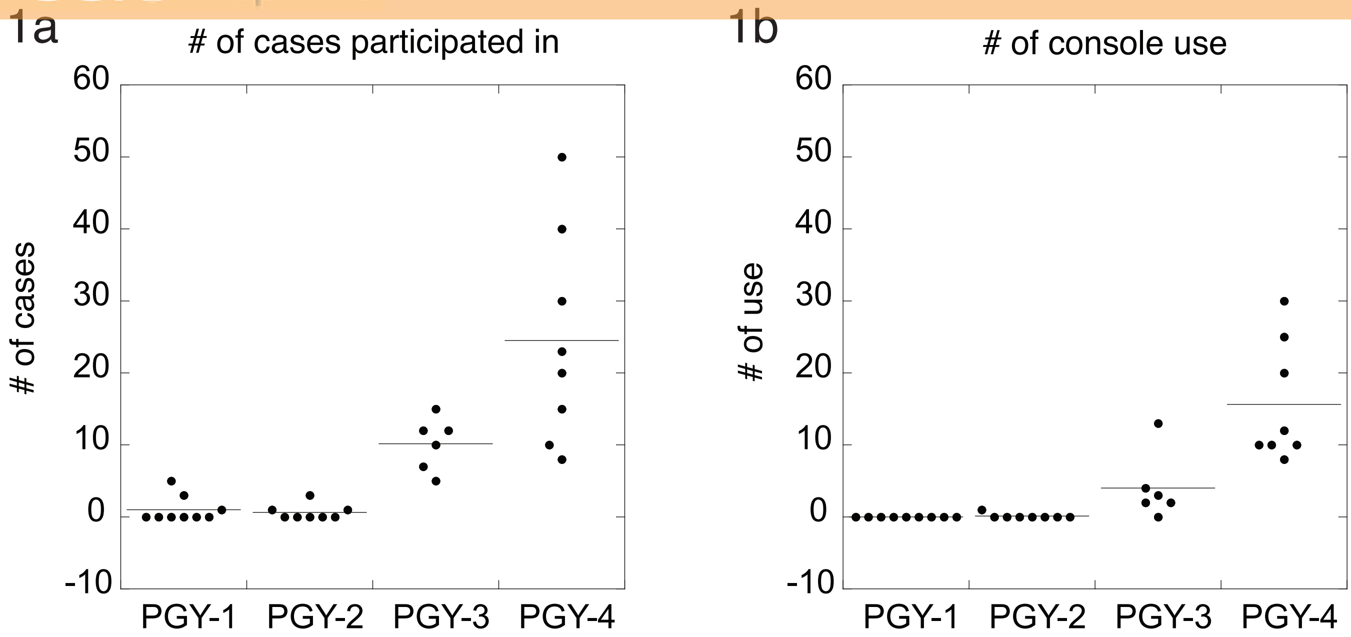

Figure 1: Number of robot cases participated in and number of console use during robotic-assisted surgery.

Renz et al. 2018

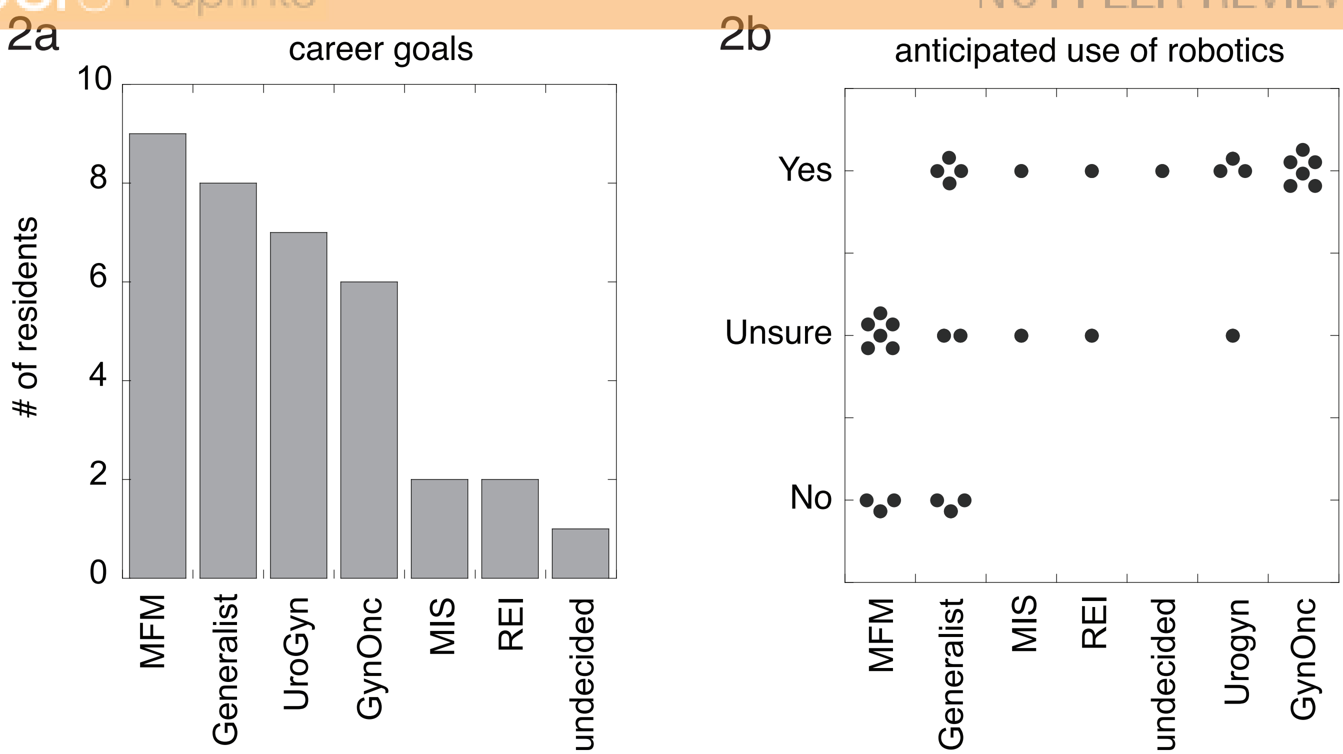

Figure 2: Career goals and anticipated use of robotic-assisted surgery.

Renz et al. 2018

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

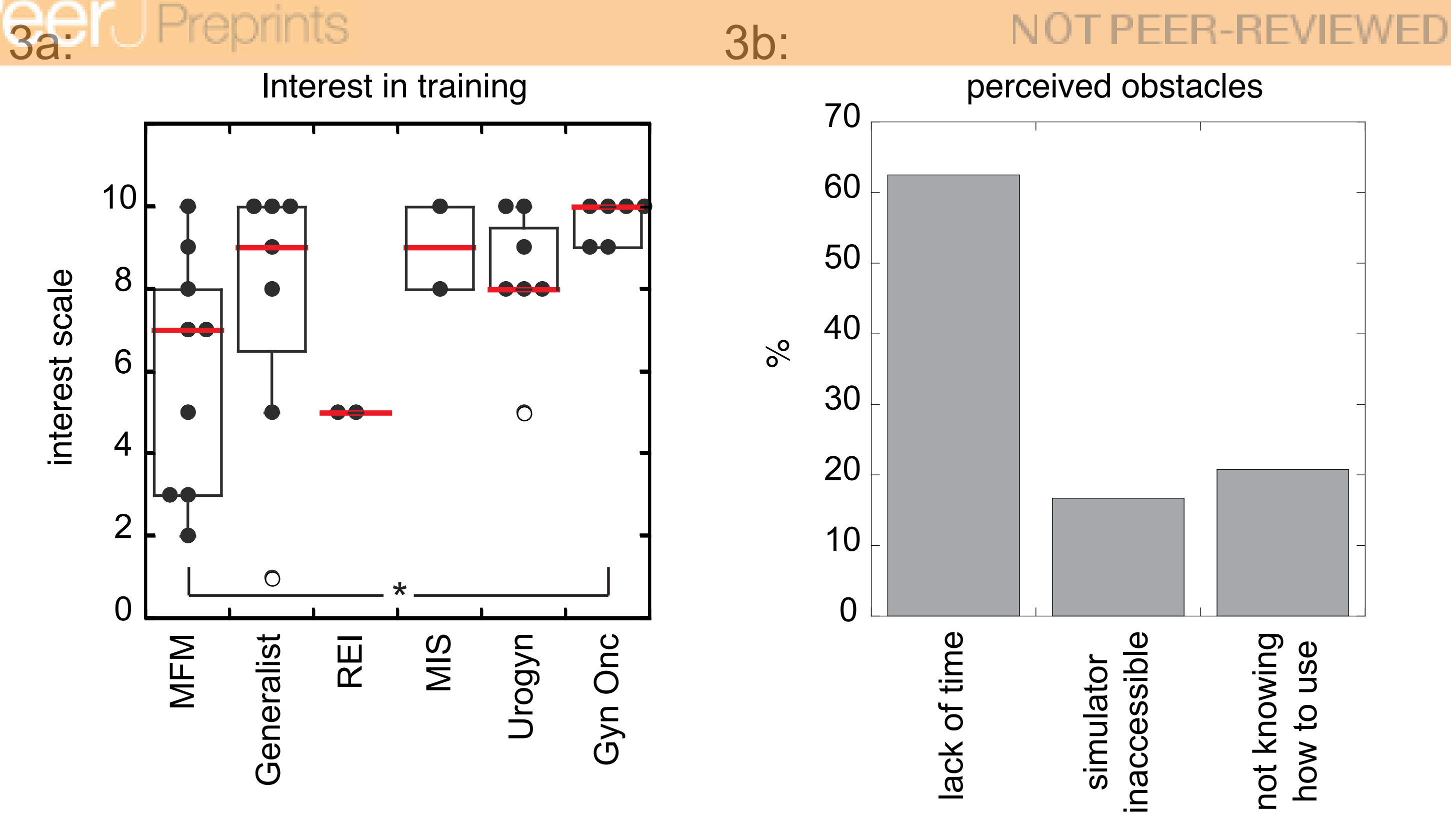

Figure 3: Interest in training and perceived obstacles for robotic-assisted surgery.

Renz et al. 2018

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

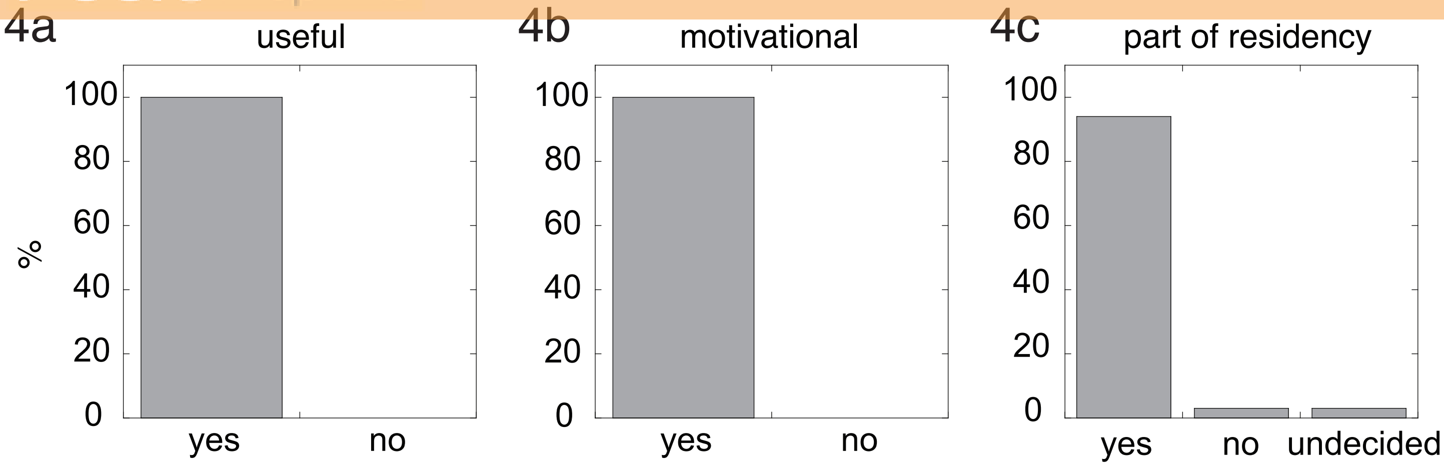

Figure 4: Residents' view on the Robotic Olympics.

PeerJ Preprints | https://doi.org/10.7287/peerj.preprints.3510v2 | CC BY 4.0 Open Access | rec: 7 Jan 2018, publ: 7 Jan 2018

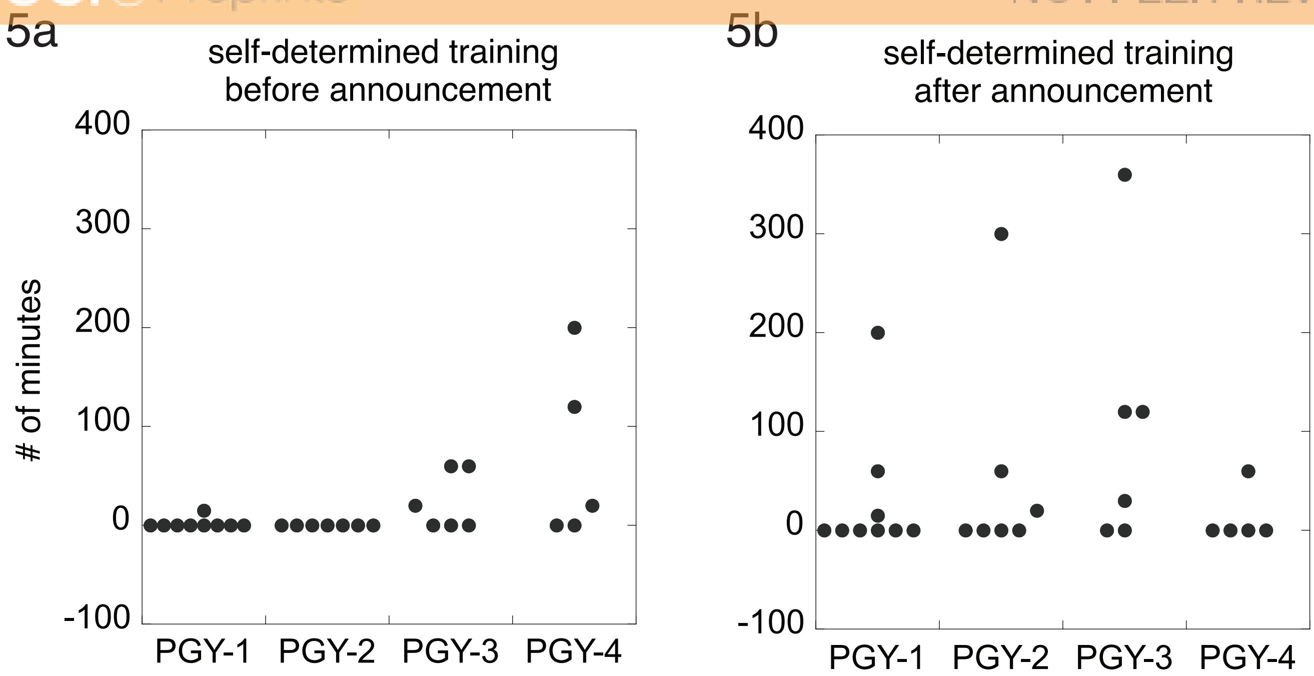

Figure 5: Increase in self-determined learning before and after the announcement of the Robotic Olympics.

Renz et al. 2018