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Authors

Burton, Brittany N

Finneran, John J

Angerstein, Aaron

et al.

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Corresponding author:

Brittany N. Burton, M.D., M.H.S., M.A.S.
Department of Anesthesiology and
Perioperative Medicine, University of
California Los Angeles, 757 Westwood Plaza
Los Angeles, CA 90095, USA
Tel: +1-562-735-7013
Email: bnburton@ucla.edu
ORCID: <https://orcid.org/0000-0001-7078-2480>

Demographic and clinical factors associated with same-day discharge and unplanned readmission following shoulder arthroplasty: a retrospective cohort study

Brittany N. Burton¹, John J. Finneran², Aaron Angerstein³, Evelyn Ross⁴, Ana Mitchell⁵, Ruth S. Waterman², Ahmad Elsharydah⁶, Engy T. Said², Rodney A. Gabriel^{2,7}

¹Department of Anesthesiology and Perioperative Medicine, University of California Los Angeles, Los Angeles, CA, ²Department of Anesthesiology, University of California San Diego, La Jolla, CA, ³Department of Biological Sciences, University of California San Diego, La Jolla, CA, ⁴School of Medicine, University of California San Diego, La Jolla, CA, ⁵Department of Radiology, University of California Davis, Sacramento, CA, ⁶Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX, ⁷Department of Medicine, Division of Biomedical Informatics, University of California San Diego, La Jolla, CA, USA

Background: Same-day discharge, defined as discharge from the hospital within 24 h of surgery, has been shown to be safe for joint arthroplasty. We examined demographic and clinical factors associated with same-day discharge and unplanned readmission following shoulder arthroplasty in adult patients.

Methods: Utilizing data from the American College of Surgeons National Surgical Quality Improvement Program database, we extracted information of all patients that underwent shoulder arthroplasty. The primary and secondary outcome of interest was same-day discharge and 30-day unplanned readmission, respectively. We utilized multivariable logistic regression to identify covariates associated with these outcomes.

Results: There were 17,011 patients analyzed when identifying predictors for same-day discharge. There was an increase in same-day discharge from 2007 to 2016. The odds of same-day discharge were significantly better for males ($P < 0.001$). The odds of same-day discharge was significantly decreased for every 10-year increase in age and for patients with insulin dependent diabetes, poor functional status, chronic obstructive pulmonary disease, congestive heart failure (CHF), bleeding disorder, and comorbidity burden (all $P < 0.001$). There were 14,276 patients analyzed for hospital readmission. The odds of unplanned readmission were significantly higher for every 10-year increase in age and for patients with poor functional status, CHF, bleeding disorder, and higher comorbidity burden (all $P < 0.005$).

Conclusions: The results of this study show that preoperative comorbidities and advanced age reduce the odds of same-day discharge. Risk stratification, preoperative optimization, and coordinated care after surgery may be helpful to optimize patients for same-day discharge.

Keywords: Ambulatory; Discharge planning; Health care quality; Optimization; Outpatient; Rehabilitation.

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Introduction

Total shoulder arthroplasty (TSA) procedures have doubled in the United States over the past ten years [1]. With approximately 70,000 surgeries each year, TSA has become the fastest growing total joint replacement procedure in the United States [1,2]. The number of procedures is expected to further increase given the aging population and the notable success of TSA procedures in restoring function and reducing pain [3,4]. TSA procedures are used to treat various degenerative conditions of the shoulder common in older adult populations [4,5].

Facility utilization constitutes an additional modifiable aspect of overall cost for these procedures. Minimizing hospital length of stay has the potential to greatly reduce health care spending. Same-day discharge, defined as discharge from the hospital within 24 h of surgery, has been shown to be safe for joint arthroplasty. The objective of the present study was to evaluate demographic and clinical factors associated with same-day discharge among adult patients who underwent shoulder arthroplasty (total and hemiarthroplasty) using the American College of Surgeons National Quality Improvement Program (ACS NSQIP) database. A secondary objective was to identify risk factors for 30-day unplanned hospital readmission.

Materials and Methods

Data registry

Our study was exempt from Institutional Review Board (IRB) approval and the requirement for written informed consent was waived. In the retrospective study, patient data was de-identified and exempt from consent requirements by our IRB. The ACS NSQIP registry was used to extract all patient records [6]. Briefly, ACS NSQIP is a nationally validated surgical outcomes registry used extensively to improve health outcomes. Inter-Rater Reliability Audit of chosen participating sites and other training methods are in place to ensure high quality data abstraction. NSQIP undergoes a systemic sampling process called the 8-day cycle, developed to make certain cases have an equal chance of being selected from each day of the week thereby preventing bias in choosing cases for assessment. The manuscript adheres to Enhancing the Quality and Transparency of Research (EQUATOR) guidelines.

Data collection

Cases were defined with Current Procedural Terminology code for shoulder arthroplasty 23472 (total shoulder arthroplasty) and

23470 (hemiarthroplasty). We used the ACS NSQIP database from 2007 to 2016 to evaluate risk factors associated with the primary outcome — same-day hospital discharge. However, ACS NSQIP from 2012 to 2016 was used to evaluate factors associated with the secondary outcome — unplanned readmission — defined as any unplanned readmission (to the same or another hospital) for a postoperative occurrence likely related to the principal surgical procedure within 30 days of surgery. We evaluated the association of the following covariates with the outcomes of interest: sex, body mass index (BMI), age, smoking status, steroid use, dyspnea, functional status, diabetes mellitus, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), hypertension (HTN), bleeding disorder, anesthesia type, secondary anesthesia type (regional anesthesia versus none), and American Society of Anesthesiologists (ASA) classification score. BMI categories were $< 20 \text{ kg/m}^2$, $20\text{--}24.9 \text{ kg/m}^2$, $25\text{--}29.9 \text{ kg/m}^2$, $30\text{--}39.9 \text{ kg/m}^2$, $40\text{--}49.9 \text{ kg/m}^2$, $\geq 50 \text{ kg/m}^2$ (the reference group was those with BMI range $20\text{--}24.9 \text{ kg/m}^2$).

Statistical analysis

R (version 3.3.2) was the statistical computing software used to perform all statistical analysis discussed in our study. Mean differences between patients with same-day discharge versus those without (and with unplanned admission versus without) were compared with the Pearson chi-square and student t-test. A multivariable logistic regression was used to evaluate the association of same-day discharge and unplanned readmission. We first performed univariable logistic regression for each covariate and assessed its association with the outcomes. The primary and secondary outcomes are reported as odds ratios. During the initial model building of the multivariable logistic regression analysis, we only included those covariates with an association with the outcome with a P value < 0.2 from the univariable analysis. Subsequently, backward selection with a P value threshold of < 0.05 was performed to derive the final multivariable model. Covariates included in this final model were then presented as risk factors associated with the outcome. The odds ratio (OR) with associated 95% CI is reported for each covariate.

Results

Same-day discharge

We identified 17,021 patients who underwent shoulder arthroplasty from 2007 to 2016. After removing 10 observations with missing length of hospital stay, the final analysis included 17,011

Table 1. Study Characteristics

Patient factors	Same-day discharge		P value
	No (n = 9,367)	Yes (n = 7,644)	
Male	3367 (36.0)	4120 (53.9)	< 0.001
Age	70.24 ± 10.36	66.67 ± 10.49	< 0.001
18–29	13 (0.1)	35 (0.5)	
30–39	65 (0.7)	102 (1.3)	
40–49	238 (2.5)	293 (3.8)	
50–69	1031 (11.0)	1249 (16.3)	
60–69	2815 (30.1)	2781 (36.4)	
> 70	5205 (55.6)	3184 (41.7)	
BMI			< 0.001
< 20	229 (2.4)	106 (1.4)	
20–24.9	1486 (15.9)	1097 (14.4)	
25–29.9	2914 (31.1)	2561 (33.5)	
30–39.9	3580 (38.2)	3167 (41.4)	
40–49.9	905 (9.7)	601 (7.9)	
≥ 50	158 (1.7)	89 (1.2)	
Unknown	95 (1.0)	23 (0.3)	
DM			< 0.001
No	7545 (80.5)	6504 (85.1)	
Non-insulin dependent	1192 (12.7)	866 (11.3)	
Insulin dependent	630 (6.7)	274 (3.6)	
Smoker	985 (10.5)	927 (12.1)	0.001
Dyspnea			< 0.001
No	8570 (91.5)	7259 (95.0)	
Moderate exertion	751 (8.0)	371 (4.9)	
At rest	46 (0.5)	14 (0.2)	
Functional status			< 0.001
Independent	8878 (94.8)	7473 (97.8)	
Poor	430 (4.6)	121 (1.6)	
Unknown	59 (0.6)	50 (0.7)	
COPD	755 (8.1)	350 (4.6)	< 0.001
CHF	73 (0.8)	10 (0.1)	< 0.001
HTN	6497 (69.4)	4759 (62.3)	< 0.001
Bleeding disorder	326 (3.5)	142 (1.9)	< 0.001
Primary anesthesia			0.027
General	9008 (96.2)	7347 (96.1)	
Regional	343 (3.7)	268 (3.5)	
Unknown	16 (0.2)	29 (0.4)	
Additional anesthesia			< 0.001
Yes	2931 (31.3)	2905 (38.0)	
No	2437 (26.0)	2562 (33.5)	
Unknown	3994 (42.7)	2175 (28.5)	
ASA class			< 0.001
1 & 2 Mild disturbance	3616 (38.6)	4216 (55.2)	
3 Severe disturbance	5367 (57.3)	3301 (43.2)	
> 4 Life threatening disturbance	374 (4.0)	117 (1.5)	
Unknown	10 (0.1)	10 (0.1)	

Values are presented as number of patients (%) or mean ± SD. BMI: body mass index, DM: diabetes mellitus, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, HTN: hypertension, ASA: American Society of Anesthesiologists.

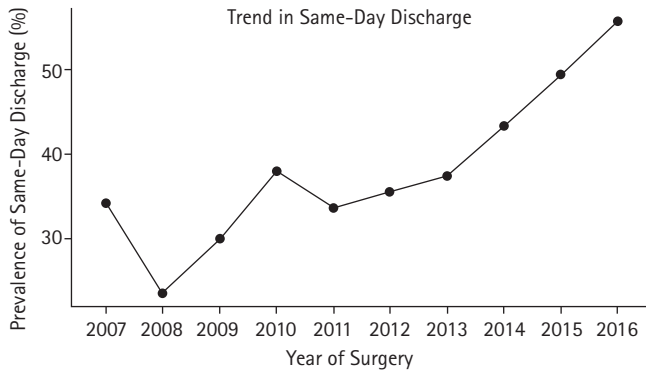


Fig. 1. Trends in same-day discharge.

patients. **Table 1** lists the study characteristics among the study population dividing the cohorts based on those with same-day discharge versus not. **Fig. 1** demonstrates an increase in the prevalence of same-day discharge per year. On an unadjusted analysis, compared to the rate of non-same-day discharge, the rate of same-day discharge was significantly higher for males (36% vs. 53.9%, $P < 0.001$), overweight (31.1% vs. 33.5%, $P < 0.001$) and obese (38.2% vs. 41.4%, $P < 0.001$) patients, and ASA class ≤ 2 (38.6% vs. 55.2%, $P < 0.001$). Compared to the rate of non-same-day discharge, the rate of same-day discharge was significantly lower for those with non-insulin dependent (12.7% vs. 11.3%, $P < 0.001$) and insulin dependent (6.7% vs. 3.6%, $P < 0.001$) diabetes mellitus, dyspnea with moderate exertion (8.0% vs. 4.9%, $P < 0.001$) and dyspnea at rest (0.5% vs. 0.2%, $P < 0.001$), poor functional status (4.6% vs. 1.6%, $P < 0.001$), COPD (8.1% vs. 4.6%, $P < 0.001$), CHF (0.8% vs. 0.1%, $P < 0.001$), hypertension (69.4% vs. 62.3%, $P < 0.001$), bleeding disorder (3.5% vs. 1.9%, $P < 0.001$), and regional anesthesia (3.7% vs. 3.5%, $P = 0.027$). **Fig. 1** shows the trends in same-day discharge.

30-day unplanned hospital readmission

To evaluate factors associated with unplanned readmission, we identified 14,276 patients who underwent shoulder arthroplasty from 2012 to 2016, who had available data regarding hospital readmission. **Table 2** illustrates the study characteristics among the study population dividing the cohorts based on those with unplanned readmission versus not.

Fig. 2 illustrates the results of the multivariable logistic regression analysis of factors associated with unplanned readmission. The odds of unplanned readmission were significantly higher for every 10-year increase in age and for patients with poor functional status, CHF, bleeding disorder, and ASA class 3 and 4 (all $P < 0.05$).

Fig. 3 displays the results of the multivariable logistic regression

analysis of factors associated with same-day discharge. The odds of same-day discharge were better for males (OR: 1.91, 95% CI: 1.79, 2.04, $P < 0.001$). The odds of same-day discharge was significantly decreased for every 10-year increase in age and for patients with insulin dependent diabetes, poor functional status, COPD, CHF, bleeding disorder, and ASA class 3 and 4 (all $P < 0.001$).

Discussion

We conducted a retrospective cohort analysis of factors associated with same-day hospital discharge and 30-day hospital readmission after shoulder arthroplasty using patient data from a nationally validated surgical outcomes registry. The odds of same-day discharge was lower for every 10-year increase in age and for patients with a medical history of insulin dependent diabetes, poor functional status, COPD, CHF, bleeding disorder, or ASA class 3 or 4. However, in this study, the odds of same-day discharge was significantly increased for male patients. Patients with comorbidities were also more likely to experience unplanned hospital readmission. Although ambulatory surgery is well established and safe for knee and hip arthroplasty [7], further work is needed to define and understand the risk of adverse outcomes and benefits of ambulatory surgery for shoulder arthroplasty.

Although shoulder arthroplasty is less commonly performed than knee and hip arthroplasty, the demand is projected to increase [8]. The annual procedure volume growth rate of total shoulder arthroplasty and hemiarthroplasty was 9.4% and 5.4%, respectively [8]. From 1993 to 2007, there has been roughly a 2-fold reduction in postoperative hospital length of stay due to improvements in surgical technique and prosthetic design, preoperative patient education, use of intraoperative anesthetics allowing for rapid recovery, and postoperative multimodal analgesia. However, costs associated with shoulder arthroplasty have steadily increased [8–10]. Identifying factors and designing interventions mitigating barriers to cost control is therefore important.

In 2017, United States health care spending grew by 3.9% and comprises roughly 18% of annual spending [11]. Same-day discharge has been identified as a potential opportunity to lower costs while improving patient satisfaction and quality of care for joint arthroplasty [12]. The recent demand for ambulatory surgery may be due to escalating health care costs, and implementing same-day surgery discharged protocols with multidisciplinary care teams may be cost-effective. Same-day discharge is becoming common practice in many medical specialties across academic surgery centers and hospitals. Ambulatory TSA has increased in response to advances in multimodal pain management, patient

Table 2. Study Characteristics

Patient factors	Unplanned readmission		P value
	No (n = 13,860)	Yes (n = 416)	
Male	6124 (44.2)	181 (43.5)	0.823
Age	68.70 ± 10.24	71.09 ± 11.09	< 0.001
18–29	25 (0.2)	1 (0.2)	
30–39	117 (0.8)	3 (0.7)	
40–49	381 (2.7)	11 (2.6)	
50–69	1823 (13.2)	44 (10.6)	
60–69	4720 (34.1)	116 (27.9)	
> 70	6794 (49.0)	241 (57.9)	
BMI			0.571
< 20	262 (1.9)	9 (2.2)	
20–24.9	2041 (14.7)	68 (16.3)	
25–29.9	4434 (32.0)	127 (30.5)	
30–39.9	5571 (40.2)	156 (37.5)	
40–49.9	1258 (9.1)	45 (10.8)	
≥ 50	202 (1.5)	9 (2.2)	
Unknown	92 (0.7)	2 (0.5)	
DM			0.001
No	11433 (82.5)	317 (76.2)	
Non-insulin dependent	1699 (12.3)	61 (14.7)	
Insulin dependent	728 (5.3)	38 (9.1)	
Smoker	1569 (11.3)	54 (13.0)	0.331
Dyspnea			0.001
No	12988 (93.7)	372 (89.4)	
Moderate exertion	830 (6.0)	43 (10.3)	
At rest	42 (0.3)	1 (0.2)	
Functional status			< 0.001
Independent	13407 (96.7)	373 (89.7)	
Poor	358 (2.6)	39 (9.4)	
Unknown	95 (0.7)	4 (1.0)	
COPD	896 (6.5)	52 (12.5)	< 0.001
CHF	63 (0.5)	11 (2.6)	< 0.001
HTN	9130 (65.9)	308 (74.0)	0.001
Bleeding disorder	369 (2.7)	29 (7.0)	< 0.001
Primary anesthesia			0.895
General	13333 (96.2)	402 (96.6)	
Regional	485 (3.5)	13 (3.1)	
Unknown	42 (0.3)	1 (0.2)	
Additional anesthesia			0.774
Yes	5659 (40.9)	177 (42.5)	
No	4856 (35.1)	143 (34.4)	
Unknown	3338 (24.1)	96 (23.1)	
ASA class			< 0.001
1 & 2 Mild disturbance	6356 (45.9)	118 (28.4)	
3 Severe disturbance	7102 (51.2)	259 (62.3)	
> 4 Life threatening disturbance	386 (2.8)	39 (9.4)	
Unknown	16 (0.1)	0 (0.0)	
Reoperation	62 (0.4)	131 (31.5)	< 0.001

Values are presented as number of patients (%) or mean ± SD. BMI: body mass index, DM: diabetes mellitus, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, HTN: hypertension, ASA: American Society of Anesthesiologists.

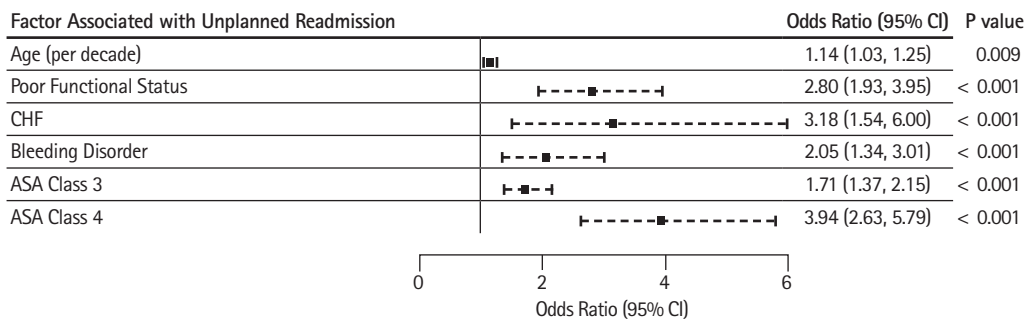


Fig. 2. Multivariable analysis of factors associated with unplanned readmission. CHF: congestive heart failure, ASA: American Society of Anesthesiologists.

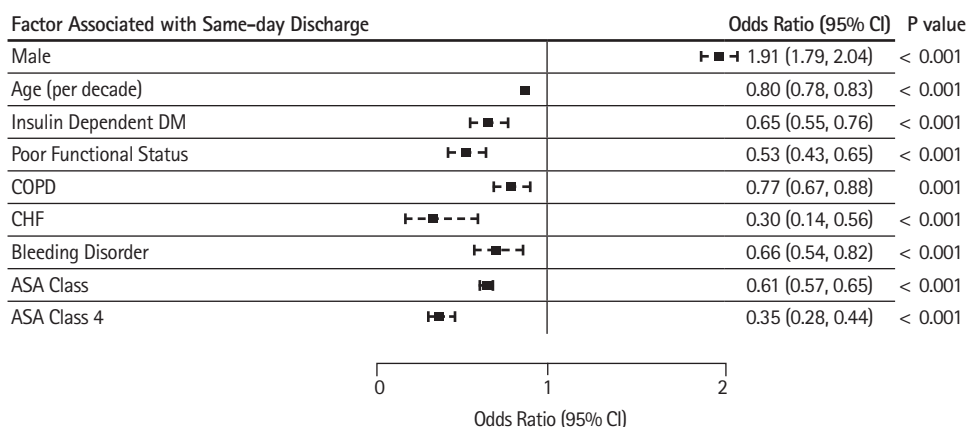


Fig. 3. Multivariable analysis of factors associated with same-day discharge. COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, ASA: American Society of Anesthesiologists.

screening parameters, and efforts to reduce costs due to inpatient admission. Cost benefit analyses estimate that outpatient procedures can lead to savings of thousands of dollars per patient and millions of dollars over the next ten years [13,14]. Previous studies of ACS NSQIP and single institution data have retrospectively examined predictors of morbidity with same day TSA procedures [13,15,16]. These factors, such as CHF, hematocrit < 38%, BMI, and depression, allow physicians to screen for suitable candidates, further decreasing morbidity post-operatively. Current studies have found no significant differences in the complication rates between same day discharge and inpatient procedures in appropriately screened patients [14].

We identified several comorbidities that were associated with a decrease in same-day discharge. Not surprisingly, patients with insulin-dependent diabetes mellitus, poor functional status, COPD, CHF, bleeding disorders, or higher ASA class were less likely to be discharged on the same day as the surgery. Sher and colleagues show a higher prevalence of impaired functional status, history of pulmonary and cardiac disease, stroke, and ASA class ≥ 3 among patients who were not eligible for same-day discharge

following total knee or hip arthroplasty [12]. Similarly, Basques and colleagues report that diabetes mellitus and older age were shown to be associated with higher rates of 30-day readmission following same-day discharger for joint arthroplasty [17]. While many of these conditions are chronic, patients may benefit from preoperative optimization and postoperative multidisciplinary coordinated care pathways.

If patients are candidates for same-day discharge, early physical therapy has been shown to reduce readmission rates among patients undergoing total joint arthroplasty [18], and may be beneficial in this surgical population. Gogineni et al. [19] report no differences in complications rates among patients who underwent outpatient versus inpatient surgery after implementing structured care pathways involving surgeons, anesthesiologists, case management, rehabilitation services, home care companies, hospital administrators, and nursing leaders. Life expectancy has increased in the United States and consequently chronic diseases have become more prevalent. We must counteract the deleterious impact of these chronic conditions by standardizing preoperative care and mobilizing multidisciplinary health teams.

Joint arthroplasty is more common among women, who also experience worse health outcomes compared to men [20]. In this study, the odds of same-day discharge was 86% higher for men compared to women. While the causes of this disparity are currently undefined, possible explanations include higher comorbidity burden in women, worse functional status, or other sociodemographic features that worsen outcomes. Further work is needed to substantiate our findings and provide insight into other contributing factors, with the ultimate aim to identify modifiable factors that may improve health outcomes and reduce health care spending.

ACS NSQIP is an excellent database source for evaluating outcomes in ambulatory surgery. However, ACS NSQIP does not include important perioperative variables that would allow for a more detailed and informative study such as cost associated with same-day versus non-same day discharge, severity of preoperative comorbidities, prosthesis used, surgeon's experience, hospital volume, intraoperative anesthetic agents delivered, intraoperative variables (i.e., case duration and estimated blood loss), and pain management strategies. This retrospective study has limitations that are inherent to retrospective studies that include but are not limited to misclassification bias and confounding. Fortunately, since ACS NSQIP prospectively collects data, the temporal relationship between preoperative and postoperative variables is not ambiguous. Additionally, ACS NSQIP has program demands that may limit the participation of smaller community hospitals.

In conclusion, this is the first study to evaluate factors associated with same-day discharge and unplanned readmission following shoulder arthroplasty. The results of this study show that preoperative comorbidities and advanced age reduce the odds of same-day discharge and increase the odds of unplanned readmission. Risk stratification, preoperative optimization, and coordinated care after surgery may help to safely implement standardized protocols for same-day discharge. Enhanced care pathways may be helpful for patients who are candidates for same-day discharge.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Author Contributions

Brittany Burton (Conceptualization; Data curation; Methodology; Writing – original draft; Writing – review & editing)
John J. Finneran (Writing – review & editing)
Aaron Angerstein (Writing – review & editing)

Evelyn Ross (Writing – review & editing)
Ana Mitchell (Writing – review & editing)
Ruth S. Waterman (Writing – review & editing)
Ahmad Elsharydah (Writing – review & editing)
Engy T. Said (Writing – review & editing)
Rodney A. Gabriel (Conceptualization; Data curation; Formal analysis; Writing – original draft; Writing – review & editing)

ORCID

Brittany N. Burton, <https://orcid.org/0000-0001-7078-2480>
John J. Finneran, <https://orcid.org/0000-0002-0955-155X>
Aaron Angerstein, <https://orcid.org/0000-0001-9945-4085>
Ahmad Elsharydah, <https://orcid.org/0000-0002-6243-0618>
Engy T. Said, <https://orcid.org/0000-0002-7897-1670>
Rodney A. Gabriel, <https://orcid.org/0000-0003-4443-0021>

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