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Current Practices in Microvascular Reconstruction in Otolaryngology-Head and Neck Surgery

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Abstract

Introduction—Despite major advances in the field of head and neck (H&N) microvascular free tissue transfer (MFTT) over the past several decades, there are not standardized perioperative regimens for the care of patients undergoing free flap reconstructive surgery, and continued variation in practice exists. This study aims to report current trends in the field of MFTT performed by otolaryngologists, including surgeon training, institutional operative practices, and perioperative management.

Methods—Survey of ACGME-accredited residency programs and AHNS fellowship sites.

Results—Seventy-one (62.8%) programs responded, with 67 (94.4%) routinely performing MFTT and 23 (32.4%) having a dedicated microvascular fellowship program. Of institutions performing MFTT, 66 (98.5%) reported the use of a two-surgeon team, most commonly both otolaryngologists (76.3%). Institutional MFTT volumes and donor site frequency are reported. Postoperative care includes routine admission to ICU (75.2%), step-down unit (15.0%), or general care floor (8.1%). Postoperative flap monitoring practices, including modalities, personnel, and timing/frequency show institutional variation. Despite differences in postoperative monitoring regimen and management (sedation, anticoagulation, antibiotic use), surgeon reported measures of flap success rate (95.7, SD 4.7%) and complication rate (6.8, SD 2.4%) show little difference across institutions.

Conclusion—Many elements of MFTT perioperative care show continued variation at an institutional level. There is a notable shift toward the two-team approach within otolaryngology. Self-reported flap complication and success rates showed no significant differences based on

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perioperative care and monitoring regimen. Further study of perioperative practices should focus on standardization of care to improve overall outcomes in this complex patient population.

Keywords

Microvascular; Free Tissue Transfer; Free Flap Reconstruction; Otolaryngology

INTRODUCTION

Defects following ablative surgery for head and neck (H&N) cancer are often substantial, and the field of microvascular free tissue transfer (MFTT) has developed considerably to allow a multitude of reconstructive options. Improved microsurgical techniques have led to a greater selection of donor sites, lower morbidity, and higher (>95%) success rates.¹ In 2007, Spiegel et al described national trends in incidence, postoperative care practices, and monitoring techniques in microvascular free flap reconstruction by otolaryngologists, and many subsequent studies have examined best practices.² Despite major advances in MFTT over the past several decades, there are not standardized perioperative protocols for patients undergoing free flap reconstruction of the H&N.³

Microvascular training in Otolaryngology-Head and Neck Surgery (ORL-HNS) has become common, with 40 advanced H&N oncology fellowships currently offered through the American Head and Neck Society (AHNS).⁴ With this increase in the frequency of training, the use of a two-team approach during MFTT cases has also become more common in the field of ORL-HNS. Benefits of a two-team approach include decreased operative time, dedicated ablative and reconstructive roles, and shared responsibilities throughout all phases of care.^{5,6} Still, many variations between single and two-team approaches exist, including whether both members of a two-team approach are otolaryngologists.

Additional variation in practices is prevalent in preoperative, intraoperative, and postoperative care of H&N MFTT patients.² In the preoperative and intraoperative period, surgeon roles and surgical planning including assessment of the anticipated anatomic and functional deficits are critical in choosing an optimal reconstructive option. In the intraoperative and postoperative setting, differences exist in responsibilities performed by various members of the care team.^{7,8} Many modalities of flap monitoring exist, as well as many institutional schema regarding the optimal timing and responsible providers for flap checks.^{2,8} Anesthetic/sedation plans, appropriate post-operative level of care, duration of postoperative antibiotics, and anticoagulation plans have all been studied, yet no consensus exists for many aspects of patient care following MFTT.^{1,9–12} Further, perioperative care regimens have not been reliably associated with measures of overall free flap success or complication rates.^{1,13–15} Thus, current research is being directed toward optimizing perioperative care protocols.

Perioperative care for MFTT patients is substantially complex. The aim of this study was to report current trends in the field of MFTT performed by otolaryngologists, including surgeon training, institutional operative practices, and perioperative management.

METHODS

A survey of ACGME-accredited residency programs and AHNS fellowship sites (United States and Canada, 113 total) was distributed using Qualtrics survey software.¹⁶ A single representative surgeon from each unique program was surveyed, with answers reflecting institutional practices. To achieve a greater institutional response rate, a secondary contact was sought if the primary contact did not respond within 4 weeks, or at the primary contact's referral. First contacts included microvascular reconstructive fellowship directors where available, followed by fellowship trained microvascular surgeons and/or H&N oncology departmental chiefs where possible. The survey was composed of 41 elements, covering topics of departmental demographics, surgeon training, volume and variety of cases, and institutional practices during the perioperative period for MFTT cases. Descriptive and inferential statistics of self-reported data are reported.

RESULTS

Demographics

Seventy-one (62.8%) programs responded, with 67 (94.4%) of these routinely performing MFTT, and 23 (32.4%) having a dedicated microvascular fellowship program. Sixty-four (90.1%) of the responding surgeons completed a H&N fellowship with training in microvascular reconstruction, while the remaining 9.9% were ablative H&N surgeons without specific microvascular training. Respondents represented institutions from all geographic regions including Northeast (22.5%), South (31.0%), Midwest (25.4%), and West (21.1%). Responses represent 194 microvascular fellowship trained surgeons (mean 3.1 per department, median 3.0, range 0-9), with 156 (mean 2.5 per department, median 2, range 0-8) performing MFTT in current practice. This indicates that 80.4% of microvascular fellowship trained surgeons are actively performing MFTT (Table 1).

Institutional Operative Practices

Of responding institutions performing MFTT, programs reported an average of 83.0 free flaps performed per year (median 80.0, range 10-215). Mean flap volume at programs with a microvascular fellowship was 124 per year (median 120.0, range 45-215) compared to 59.0 per year (median 50.0, range 10-120) at programs without a fellowship (Table 2). Flap types performed at a majority of institutions include radial forearm (100% of programs), fibula (100%), anterolateral thigh (96.8%), latissimus (79.0%), scapular tip (71.0%), parascapular (62.9%), and osteocutaneous radial forearm (58.1%) (Figure 1). Less commonly performed flap types included rectus (40% of programs), ulnar forearm (24.2%), lateral arm (12.9%), lateral thigh (8.1%), gastro-omental (6.5%), serratus (6.5%), iliac crest (4.8%), and jejunum (4.8%).

Surgeon-reported flap success rate was 95.7% (std dev 4.7%, median 95.0, range 90-99%), and quoted complication rate requiring return to operating room (OR) was 6.8% (std dev 2.4%, median 5.0, range 1-25%) (Table 2). Flap volume was greater at programs offering microvascular fellowships than those that do not (123.5 vs. 51.9 flaps per year, $p < 0.001$). Reported complication rates (requiring return to OR) showed no significant difference

between these two groups (5.8% vs. 7.5%, $p=0.17$), though reported success rate was slightly higher at programs offering microvascular fellowships (97.0% vs. 94.9%, $p<0.001$) (Table 2).

All but one of the programs performing MFTT (98.5%) reported the use of a two-surgeon team (ablative and reconstructive) at least some of the time, and all but three (95.1%) reported use of a dual otolaryngologist team at least some of the time. Overall breakdown of reported practices most commonly involved a team of two otolaryngologists (76.3%), in distinction to a two-team collaboration with a non-otolaryngology department (eg, plastic surgery or oral surgery, 7.9%) or single surgeon performing both roles (15.8%) (Table 2). Only two programs reported *exclusive* use of a two-surgeon team collaborating with another (non-otolaryngology) department.

Care Teams and Free Flap Monitoring

Assuming uneventful postoperative course, patients are admitted to the intensive care unit (ICU, 75.2%, average duration 2.4 days), step-down unit (15.0%), or general care floor (8.1%). Reports of postoperative admission to general floor interestingly includes 6 programs, 5 of which send MFTT patients nearly exclusively to a general care unit. Average duration of ICU prior to step-down or floor was reported as 2.4 days (range 12 hours-7 days). There was a slight advantage in reported flap success rate for patients going to step-down or floor vs ICU (97.0% vs 95.3%, $p=0.02$); however, no corresponding difference in complication rate was observed. Eight programs (11.9%) report routine postoperative sedation of durations ranging 12-48 hours.

In a separate section of the survey, programs were asked about providers involved with various phases of surgical care and postoperative monitoring. Residents and fellows assist in flap harvest at 80.3% and 42.6% of programs, respectively, with nearly identical trends seen for assistance with microvascular anastomosis (80.3% and 41.0%, respectively). Overall, a trainee of some level is involved in these practices at >95% of the responding programs. Other common institutional practices included team flap harvest and microvascular anastomosis with another microvascular trained surgeon (11.4%, 19.6%), or independent flap harvest (21.3%) and anastomosis (4.9%). Twenty-nine programs (43.3%) reported at least some access to H&N specialty trained anesthesiologists for MFTT cases, with 9 (13.4%) reporting access greater than half of the time and 3 (4.5%) reporting having a specialized H&N anesthesiologist for all cases.

Junior residents (88.5% of programs), senior residents (65.6%) and nursing staff (70.4%) were most commonly noted as “critical or primarily responsible” for performing flap checks. Postoperative flap checks are performed by a wide range of team members at variable frequencies: Table 3 shows the breakdown of flap monitoring responsibility and frequency on postoperative (POD) #1. Flap monitoring is discontinued on POD #7 or earlier at 90.9% of programs, with 21.8% stopping monitoring POD #4 or earlier (Figure 2). Routine (50% of the time) flap monitoring includes color (98.3% of programs), capillary refill (91.3%), doppler signal (86.9%), temperature (56.9%), pin prick/bleeding rate (54.1%), implanted doppler (40.0%), and infrared monitor (eg Viopix, 2 programs, 3.0%). Breakdown of flap check elements routinely included on POD #1 are shown in Figure 3.

Postoperative Care

Postoperative anticoagulation routinely (50% of the time) includes aspirin (83.6% of programs), subcutaneous heparin (37.5%), and lovenox (36.4%). When aspirin is used, dosing preferences were 325mg (53.6%) and 81mg (46.4%) (Figure 4). Restriction on circumferential neck dressings and/or head turning was reported routinely by 80.7% of programs. Starting statin medication postoperatively was rarely reported (5 programs, 7.5%).

Programs reported uniform use of antibiotics for surgical cases communicating with the aerodigestive tract, with duration spanning 24 hours (43.3%), 48 hours (8.3%), 72 hours (15.0%), or over 72 hours (30.0%, up to 1 week). Wider variability was seen in medication restriction, transfusion threshold, and frequency of labs. With regard to vasopressors, programs reported allowance as “always” (6.5%), “allow, but prefer not” (62.9%), and “never or only emergent use” (30.6%). Other substance restrictions included nicotine most commonly (33.9%), as well as restrictions on caffeine (9.7%) and anti-hypertensives, including alpha-blockers (8.1%). Regarding postoperative transfusion thresholds, about one third of respondents noted no specific threshold, making decisions on a case-dependent basis. In otherwise asymptomatic patients, transfusion thresholds were equally based on either hemoglobin (most commonly 8.0 g/dL) or hematocrit (most commonly 24-25%). Daily routine lab draws were reported by most programs (81.5%). Use of leeches for congested flaps was reported “rarely” (66.1%), “routinely” (14.5%), or “never” (19.4%).

Finally, participants were questioned about perceived importance of postoperative regimens. On a 5-point Likert scale, respondents reported varying perception of how critical postoperative regimen was to free flap survival, with average score of 3.2 and standard deviation of 1.1 (1=not critical, 5=very critical). With regard to opinions about institutional practices of postoperative care and flap monitoring, less variation was seen, as most responding surgeons felt their regimen was “about the same” relative to other programs (mean 2.9, std dev 0.7; 1=much simpler, 5=much more complex). Surgeons did not report significant differences in flap success rate or complication rate despite these differing perceptions of complexity and importance of institutional postoperative care regimen.

DISCUSSION

The field of H&N microvascular reconstruction has undergone major advances in the last decade. The AHNS currently offers 40 advanced H&N oncology fellowships, the majority of which offer training in microvascular reconstruction.⁴ This study observed an average of 3.1 (median 3.0) microvascular surgeons per department, whereas Spiegel *et al* found the average number of microvascular surgeons per department to be 1.62 one decade ago, owing to an overall increase the number of microvascular fellowship trained Otolaryngologists.² This increase may be attributable to a greater number of training opportunities within otolaryngology, overall advancement of the field, and trend toward two-team surgery.^{4,5} Despite this increase, an attrition rate in microvascular practice persists, with roughly 20% of microvascular-trained otolaryngologists no longer performing reconstructive MFTT cases in current practice. While there is likely great variability in personal and professional choices, factors such as aging/fatigue, career stressors, burnout (emotional exhaustion/

diminished satisfaction), pursuit of research or other academic endeavors, and rapid evolution of the field may contribute to this phenomenon.^{17–20}

Our data show a clear trend toward implementation of the two-team approach within academic ORL-HNS programs, most commonly with H&N fellowship trained otolaryngologists performing both ablative and reconstructive roles (95.1% of programs, weighted 75.1% of practice). The two-team approach to H&N reconstruction far predates the routine use of H&N MFTT.⁶ As the field of MFTT advances, the paradigm in microvascular reconstruction has shifted toward a two-team approach with separate ablative and reconstructive teams. Several advantages to this approach are recognized, including clear focus on either clearing margins (ablative team) or reconstructing anatomic and functional defects (reconstructive team), decreased operative time, facilitated communication between surgical teams, and sharing of perioperative responsibilities in a complex and time-intensive hospitalization.⁵ The benefits of decreased operative and anesthetic time include lower risk of flap failure and other postoperative complications, including transfusion requirement, prolonged hospitalization or need for reoperation.^{9,21–23} Taken together, the strong trend toward two-team ORL-HNS approach likely reflects recognition of its clinical benefits alongside advancement of techniques and more microvascular training opportunities within ORL-HNS.

A wide variety of MFTT donor sites were reported (Figure 1). As expected with variation in surgeon training and preference, there is institutional variation in the breadth and choice of donor sites used. The radial forearm free flap, anterolateral thigh free flap and fibular free flap were the most commonly utilized donor sites. This is unsurprising given the versatility, ease of concurrent two-team surgery, and reliability of these sites. This survey polled data regarding the type of flaps commonly used, however did not specify overall frequency of each flap type.

Resident and fellow involvement in MFTT cases and postoperative care is critical to overall patient care at academic institutions. This survey found that trainees were routinely involved in free flap harvest and microvascular anastomosis at >95% of programs, with residents involved at 80% of programs and fellows always involved where applicable. Trainees also have prominent roles and responsibilities to perform flap checks, as described in Table 3. Studies have shown that trainee involvement in MFTT cases does not impact complication rates.⁷ Further, reduction in frequency of trainee free flap monitoring and increased monitoring by trained nursing staff have been described in the era of work hour restrictions.^{8,24} A variety of flap monitoring techniques have been described.²⁵ Our study found that multiple, concurrent modalities of monitoring are used for MFTT patients, most commonly color, capillary refill, and doppler signal (Figure 3).

The majority of programs quote high success rates (>95%) and consistently low complication rates (5–10%) to patients. Similar trends of high success, precise complication rate, and low institutional variability have previously been reported to corroborate these findings.^{1,2} In our survey, success rates were defined as maintenance of viable free tissue transfer, and complications rates were defined as any complication requiring return to OR, commonly hematoma or revision of anastomosis. Notably, the survey return to OR rate of

6.8% is lower than the National Surgical Quality Improvement Program reported reoperation rates of 10.8% for flap reoperation urgently or delayed wound closure and 20.2% overall (reoperation in first 30 days) for MFTT cases. This discrepancy may be attributable to self-reporting inaccuracy.²³ Responding programs that offer microvascular fellowship reported higher overall success rates and lower complications rates, though the magnitude of these differences was small. The final questions of this survey assessed surgeon perception of the importance and complexity of postoperative monitoring practices. Interestingly, reported scores on 5-point Likert scale for both “importance of regimen to flap success” and “complexity of regimen compared to other programs” were not appreciably skewed, and did not show significant association with reported success and complication metrics. The correlation between postoperative regimen and MFTT outcomes remains uncertain, indicating need for further study and standardization of MFTT perioperative practices.³

In the immediate postoperative period, the majority (75.2%, avg duration 2.4 days) of institutions report admitting patients to the ICU, with step-down units (15.0%) or general care floors (8.1%) used much less frequently. By comparison, Spiegel *et al* found the rate of ICU care to be 88.9% for an average duration of 2.4 days in 2007.² Variables contributing to differences in patient disposition may include specific hospital policies regarding frequency of monitoring, number of free tissue transfers performed at each hospital per year, and nursing comfort or familiarity with MFTT patients. A cost analysis of postoperative care for free flap patients by Panwar *et al* found an increased cost of 38% over the course of hospitalization attributable to short-term immediate post-operative ICU care.²⁶ With this in mind, efforts at improving nursing comfort and tailoring policies that support immediate bypass of, or early transfer from, the ICU could help decrease the overall significant financial costs of free tissue transfer. The utilization of specialized “head and neck surgery” units with deliberate training and expertise in H&N free tissue transfer patients, including free flap monitoring and tracheostomy care, have successfully allowed immediate post-operative recovery on the general care floor. This transition away from ICU recovery has been studied, with decreased hospital stay lengths, decreased cost, and no changes in flap survival or inpatient morbidity.^{1,10,26–28} Our study found a slight advantage in reported MFTT success for patients going to floor or step-down unit (97.0%, vs 95.3% for ICU-level care), and no differences in reported complication rates were observed. Taken together, existing literature and the current study suggest that specialized general care units and step-down are feasible, cost-effective, and noninferior alternatives to ICU-level care.

Access to specialized H&N anesthesia was reported by nearly half of respondents, and three programs reported having H&N trained anesthesiologists available for all cases. Greater understanding of fluid management from a specialty trained anesthesiologist may also constitute optimal care. Postoperative sedation was infrequently reported, yet importantly necessitates ICU-level care.

As corroborated by survey responses, postoperative anticoagulation is a common practice following H&N MFTT; however, protocols for agent, dose, and duration have not been established.^{12,29} Anticoagulation is primarily aimed at preventing venous thrombosis at or near the microvascular anastomosis, as compromised venous outflow is a common contributor to free flap failure and may require return to OR for anastomotic revision. Many

surgeons choose an anticoagulation regimen based on anecdotal evidence and personal experience, and studies have found comparable free flap outcomes in a wide variety of regimens.¹² Our study shows variable use of heparin and lovenox, though there is relatively widespread adoption of postoperative aspirin (40.3% 81mg, 48.4% 325mg) and abandonment of dextran (Figure 4).

All respondents in this study reported use of prophylactic antibiotics with surgeries communicating with the autodigestive tract, as is standard of care. Complex H&N cancer resections are typically clean-contaminated cases, for which surgical wound infection rates of 8.1 to 41% have been reported.³⁰ Further, surgical site infection is a significant risk factor for readmission and free flap failure. Recent studies have shown evidence to support recommendations including use of prophylactic antibiotics for at least the first twenty four hours of hospitalization, cautious use of clindamycin, and no benefit to duration greater than 1 week for free flap patients.^{11,30,31} There is currently no consensus on antibiotic regimen or duration otherwise. Here, a variable duration of postoperative antibiotic from 24 hours to 1 week was observed.

Other practices including statin initiation, substance and activity restrictions, use of leeches, and transfusion thresholds have not been studied sufficiently to generate consensus practice.^{32,33} Not surprisingly, these practices showed great variation in this study.

Limitations

Response rate is a common limitation of survey studies, though this study reached a response rate of 62.8%. Further, a vast majority (90.1%) of responding surgeons were fellowship trained in microvascular reconstruction. As the aim of this study was to capture current practices across academic centers, we queried only one surgeon from each department and requested that responses reflect institutional, rather than personal, practices. Capturing variation in practices *within* an institution is challenging, and our survey was designed to allow accurate reflection of either multiple concurrent practices or “most common” practice. We have no a priori reason to suspect that surgeons who report the practice trends identified would be more likely to respond to the survey request to constitute a response bias.

Use of self-reported outcomes is a notable limitation, particularly as it pertains to estimates of free flap success rates and complication rates, which has low variance in this study. Surgeon-reported data for outcomes including free flap success rate and complication rate was reported as an estimate or “what is quoted to patients” may differ from objective outcomes based on patient data. Further studies may benefit from use of clinical data to report institutional outcome measures.^{13,34} Other factors contributing to free flap outcomes, including preoperative risk stratification and co-morbidities are beyond the scope of this study.

CONCLUSION

While some perioperative practices for MFTT are performed nearly uniformly, many elements continue to show variation at an institutional level. There is a notable shift toward a

two-surgeon approach with defined ablative and reconstructive roles, often both fellowship trained otolaryngologists. Self-reported flap complication and success rates showed no significant differences on the basis of perioperative care and monitoring regimen. Further study of postoperative practices should focus on evidence-based standardization of perioperative care protocols to optimize patient care, utilization of resources, and overall outcomes and in this complex patient population.

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Abbreviations

AHNS	American Head and Neck Society
H&N	Head and Neck
ICU	Intensive Care Unit
MFTT	Microvascular Free Tissue Transfer
OR	Operating Room
POD	Postoperative Day

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Figure 1. Free Flap Types Performed by Institution

Percentage of programs performing each flap type, with positive responses representing performance of each type at least once per year.

Figure 2. Postoperative Duration until Cessation of Flap Checks

Time to discontinuation of flap checks, reported as standard practice or “pathway” and assuming uncomplicated postoperative course.

Figure 3. Flap Monitoring Modalities

Percentage of programs including each modality routinely (when applicable) on POD #1, assuming an uncomplicated postoperative course.

Figure 4. Postoperative Anticoagulation

Reported frequency of use for postoperative anticoagulation regimen following MFTT cases. Inset depicts preferred dose of aspirin, if used.

Table 1
Surgeon Demographics by Department

Descriptive statistics of total, microvascular-trained, and actively practicing MFTT surgeon numbers are reported.

	Mean (N)	Median (Range)
Number surgeons per department	16.3	15.0 (0-40)
Number microvascular trained surgeon	3.1 (N=194)	3.0 (0-9)
% of departmental faculty with microvascular fellowship training	19.0%	–
Number microvascular surgeons performing MFTT actively	2.5 (N=156)	2.0 (0-8)
% microvascular surgeons performing MFTT actively	80.4%	–

Table 2
MFTT Volume, Reported Outcomes, and Team Dynamics

Statistics for case volume, reported outcomes, and surgical practices are reported overall programs, and stratified by programs with and without microvascular fellowship. Weighted practices are reported as single versus team approach and by specialties involved.

	Overall	Fellowship [‡]	No Fellowship
# Responding Programs	71 (100.0%)	23 (32.4%)	48 (67.6%)
MFTT Volume, Mean ± Std Dev	83.0 ± 50.9	123.5 ± 47.9	59.1 ± 35.3
MFTT Volume Median (Range)	80.0 (10-215)	120.0 (45-215)	50.0 (10-120)
Reported Success Rate (%)			
Median ± Std Dev	95.7 ± 4.7	97.0 ± 1.5	94.9 ± 2.6
Median ± Range	95.0 (90-99)	97.0 (95-99)	95.0 (90-98)
Reported Complication Rate (%)			
Median ± Std Dev	6.8 ± 2.4	5.8 ± 3.3	7.5 ± 5.3
Median ± Range	5.0 (1-25)	5.0 (1-15)	5.0 (1-25)
Weighted Team Practices[‡]	Two-Team, both Otolaryngology	76.3%	80.1%
	Two-Team, Non-Otolaryngology Reconstruction	7.9%	2.7%
	Single Surgeon	15.8%	17.2%

[‡]For weighted practices, three cells in each column equal 100%.

[‡]Percentage of responding programs with microvascular fellowship (32.4%) is comparable to the overall proportion of programs offering fellowships in the US and Canada (35.4%).

Table 3
Post-Operative Day 1 Flap Check Personnel and Timing

Percentage of programs identifying each team member as responsible for flap checks.

Team Member	Responsible for POD #1 flap checks (% of programs) [†]	Most commonly reported frequencies [‡]
Attending (Ablative)	45.5%	Does not perform (54.6%) Once daily (36.3%)
Attending (Reconstructive)	91.7%	Once daily (73.3%)
Fellow	71.1%	Twice daily (39.5%) Once daily (26.3%)
Senior resident	98.3%	Twice Daily (69.5%)
Junior resident	98.3%	Every 4 hours (25.4%) Every 6 hours (22.0%) Twice daily (22.0%)
Nurse	94.7%	Every hour (77.2%)
Student	5.6%	Does not perform (94.4%)

[†] Answers are non-exclusive.

[‡] Only most common practices listed (% of programs identifying this frequency), do not total to 100%.