



Objective Assessment of the Entrustable Professional Activity Handover in Undergraduate and Postgraduate Surgical Learners

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OBJECTIVE: This study used a virtual patient simulation (VPS) to quantifiably and objectively assess undergraduate (UG) to postgraduate (PG) medical learners' acquisition of the entrustable professional activity (EPA) "handover," focusing particularly on the transition to residency. This EPA is critical because it is part of a core competency for UG and PG training in both the United States and Canada, and is essential for patient safety and comprehensive professional communication.

DESIGN: Data were collected from 3 separate groups of participants: 2 UG cohorts from an earlier study, as well as a PG cohort at the beginning of residency. All participants completed the same trauma VPS, which required a free text summary statement that was used as a surrogate for an oral handover. These were collected and scored independently, using previously developed validated rubrics, one procedural and the second semantic.

SETTING: All study participants were from one site. The VPS case was completed online.

PARTICIPANTS: Two different UG groups, one designated *junior* ($N = 52$), was studied at the beginning of their clerkship year, a second group, designated *senior* ($N = 30$), was studied at the end of their clerkship year. These groups were compared to a third group of PG learners ($N = 31$) during the initial 2 weeks of their residency. Informed consent was obtained from all participants.

RESULTS: A procedural rubric assessed learners' cognitive knowledge of trauma care-management. A semantic rubric

assessed their use of the professional language necessary for a safe and succinct clinical handover communication. An Analysis of Variance comparing scores on the procedural rubric was highly significant with Tukey LSD tests indicating that all 3 groups were significantly different. Students increased their scores on the procedural rubric at each stage of their training. A parallel Analysis of Variance comparing students' scores on the semantic rubric revealed no significant increase in scores, indicating that students did not improve in their capacity to communicate professionally as they progressed through their training.

CONCLUSIONS: Taken together, these results demonstrate that training was successful in teaching cognitive-based procedures, but not effective in teaching professional communication, which is critical to the EPA handover. Greater emphasis needs to be placed on ensuring the acquisition of professional communication skills throughout the continuum of UG and PG clinical activities. Faculty development should serve as a support to assist medical educators to address this requirement. These results also demonstrate that VPS with associated objective and validated rubrics can be used as an assessment methodology to quantifiably measure learner performance with respect to the EPA handover. A similar strategy should be considered across the UG and PG continuum for other EPAs and could form the nexus for further research. (J Surg Ed 76:1258–1266. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Competency, EPAs, Milestones, Virtual Patient Simulations or Scenarios

COMPETENCIES: Medical Knowledge, Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

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INTRODUCTION

Medical education in Canada and the United States is transitioning from the Flexner model, introduced in 1910, to a competency-based medical education (CBME) construct with associated entrustable professional activities (EPAs).¹⁻⁵ In the undergraduate (UG) domain, the prespecified, structured 4-year curriculum is now being replaced by an organized representation of a set of inter-related knowledge and procedural competencies^{5,6} each aligned with EPAs that can objectively be measured.⁷ In postgraduate (PG) education, the framework of CBME and EPAs, is based on clearly defined standard expectations which (a) evolve from the UG curriculum, (b) effect a safer transition from medical school to residency, and then (c) continue to support further PG training,^{2,4,8,9} moderated by the unique demands of specific specialities and domains. PG CBME will “ensure that trainees are able to meet the health needs of the public and increase confidence among residents, patients and program directors from the first day of entry to residency.”²

Accreditation and regulatory bodies, including the Association of American Medical Colleges and the Association of Faculties of Medicine of Canada have specified core EPAs, their competencies and core procedures, expected of PG residents as of day one of their residencies.^{2,3,8-11} The Association of Faculties of Medicine of Canada has further mapped these to the CanMEDS roles of Medical Expert, Collaborator, Health Advocate, and Leader.^{9,12}

Both bodies agree in the alignment of UG and PG core competencies and associated EPAs, and specify that the EPAs should be objectively and quantifiably measurable,^{2,9,10,13} and evidenced at the beginning of residency.^{2,3,11,14} Thus UG curricula need to integrate knowledge and skills that can prepare PG entry

level residents⁹; PG curricula must reinforce these UG EPAs as well as support the attainment of further EPAs during residency training,⁴ and medical educators must create appropriate assessment methodologies for EPAs.

Finally, implementation of CBME requires an increased focus on theoretical and pedagogical frameworks.¹⁵ This translates into a robust, expansive, and more inclusive role for Faculty Development working within the clinical environment.^{2,4,9,12,14} This critical impact of Faculty Development should highlight (a) a systems level, (b) an institutional level to foster awareness, and active dissemination of new concepts and techniques and (c) outreach to individual teachers to ensure a critical understanding of its tenet.¹⁶ These challenges were emphasized by the McGill University Adair Chair for Surgical Education when he noted that “in the Department of Surgery there is a mismatch between the structure in which the clinical services are arranged and the ways in which education needs to be delivered. The hospitals are so dependent upon residents as staff and so overwhelmed by the need to provide patient care that their education mission is being neglected. The notion of going back to a pure apprenticeship (cognitive apprenticeship) model is under discussion.”¹⁷

Key Terms

Key terms utilized in this study include (a) competency, (b) EPAs, (c) milestones, and (d) virtual patient simulations or scenarios. A more extensive review of these terms can be found in [Table 1](#). For the purposes of this study, competency is defined as an observable ability of a health professional, integrating multiple components such as knowledge, skills, values, and attitudes,³ described by Englander et al., as “broad distinguishable areas of competence, that in aggregate, define the desired outcomes for a physician”⁵ (p. 2). EPAs are units

TABLE 1. Definitions and Examples

1. Competency: Competencies are “broad distinguishable areas of competence, that in aggregate, define the desired outcomes for a physician”⁵ (p. 2). An example of a UG competency is “Patient Engagement and Communication.” For PG this becomes “Interpersonal and Communication Skills.”¹⁸
2. Entrustable Professional Activity: EPAs are independently executable, observable and measurable in their process and outcome, and therefore suitable for entrustment decisions.²⁰ An example of 1 PG EPA that falls under the competency named above would be “Give or Receive a Patient Handover to Transition Care Responsibility.”⁷ In this case, a resident would be able to “organize and prioritize information for handover communications”⁴ (p. 53).
3. Milestones: Milestones are established for the pre-EPA and the EPA learner for each competency. An example of a milestone or pre-EPA would be “demonstrates minimal situational awareness of the teams’ work load or of the circumstances of the individual to whom one is transferring care; demonstrates minimal awareness of known threats to handover communication”³ (p. 94).
4. Virtual Patients Case Simulations or scenarios (VPS): VPS’s are based on decision-making and case-management and can result in diverse case outcomes.²¹ They include features that permit learners to input “summary statements” as free text, which can then serve as an equivalent to oral “handovers,” “hand-offs” or “sign-outs,” used within the health care setting to support professional communication skills.²²⁻²⁴ For the purposes of this article, the word handover encompasses these terms.

of professional practice, with each EPA linked to its critical competencies,^{2,18,19} independently executable, observable and measurable in process and outcome, and therefore suitable for entrustment decisions.²⁰ Milestones are behavior descriptors that determine a level of performance for a given competency and act as markers in the progression toward an EPA.⁵ VPS are interactive computer simulations of real-life clinical scenarios for the purpose of healthcare and medical education and/or assessment that are based on decision-making and case-management and can result in diverse case outcomes.²¹

The EPA Assessed: Handover

Handover is taught in UG and is required on day 1 of PG. It is described as an oral presentation of a clinical encounter used to transfer information about, and responsibility for a patient or patients between health care professionals and settings.^{7,13} It should include, among other things, a comprehensive review of the status of the patient at the time of transfer, the use of appropriate professional communication or semantics to clearly and explicitly state necessary information and, can improve patient safety, provider consistency and learner confidence.^{2,22,23} When incomplete, a handover can be a major cause of adverse medical events or errors.^{24,25} Inadequate handovers can threaten patient safety, the quality and continuity of care, cause miscommunications, inaccurate assessments and diagnoses, delayed and inappropriate treatment and medical mistakes, all of which are associated with increased morbidity and mortality, longer hospital stays and poor patient satisfaction.^{22,25} Nonetheless, “most programs do not assess whether residents possess the required knowledge base, communication and system skills to perform a ‘handoff’ in a clinical environment”⁷ (p.1336).

Handover is a core competency in both the United States and Canada. In the United States, handover falls under the PG core competency “Interprofessional and Communication Skills,” a competency that includes PG EPA 8, (give or receive a patient handover to transition care responsibility) which, in turn, is mapped to competencies within each domain critical to entrustment activities “Interprofessional and Communication Skills” (ICS 2, ICS 3) and “Physician Competencies by Domain”

TABLE 2. Entrustment Activities

ICS 2: Communicate effectively with colleagues within ones profession or speciality, or health professionals and health-related agencies
ICS 3: Work effectively with others as a member or leader of a health care team or other professional group
PC 8: Provide appropriate referral of patients including ensuring continuity of care throughout transitions between providers or settings and following up on patient progress and outcomes

(PC 8)³ (p. 50) or see [Table 2](#). It evolves from a UG curricular competency “Patient Engagement and Communication Skills,” EPA 8. In Canada this UG core competency is Standard 7.8 “Communication Skills”²⁴ and the PG EPA is 7.⁸ A recent Canadian review of PG EPAs highlighted major gaps in both teaching and assessment of patient handovers.⁹

This EPA is particularly relevant as residents work shorter and more restricted hours,²⁵ increasing the number of handovers.²² Krisberg reported this number has now risen to approximately 4,000 a day per teaching hospital, many for complex patients, further emphasizing the need for clear, comprehensive professional communication.²⁵

Purpose of the Study

Using a VPS and associated rubrics this study objectively assessed learners’ acquisition and application of the EPA handover. This study is an extension of previous research²⁶ that compared 2 different UG cohorts to now include PG R1 learners at the beginning of their residency training.

To assess learner progression from UG to PG for this EPA using VPS we asked the following research questions:

1. Is there objective evidence of a progression in procedural knowledge from the 2 UG cohorts to the PG R1 cohort for this particular EPA?
2. Is there objective evidence of a progression in semantic knowledge from the 2 UG cohorts to the PG R1 cohort for this particular EPA?

METHODS AND MATERIALS

Participants

The study population consisted of 36 first-year surgical residents (PGs) at McGill University during the first 2 weeks of their residency. All but 2 residents gave their informed consent. Thirty-one of the remaining 34 study participants completed the VPS case between July 1, 2017 and July 14, 2017. All participants managed the same VPS and were scored using the same assessment rubrics described in Fleiszer et al.²⁶ In the current study 31 PG students’ results were compared to those of the *junior* (N = 52) and *senior* (N = 30) UG cohorts from our previous study.

Study Instruments

VPS Case

The VPS case was based on the management of a patient in the context of the “Advanced Trauma Life Support”

TABLE 3. VPS Expert Summary

Trauma Case: Mr. Johnny Delray: Expert Trauma Surgeon Response

This is (name of the student) calling. I am a third-year medical students. We have a young adult male, Mr. Johnny Delray, in the trauma bay who was the driver involved in a T-bone car crash. There was substantial intrusion where he was sitting. There were no airbags. He smells of alcohol and he was staggering around the accident site when the ambulance arrived, however, subsequently, he became unresponsive. At 3:15, on arrival in the trauma bay, he was somnolent and in severe respiratory distress. He has been intubated. He has a hemothorax and has had a left chest tube inserted. Approximately 600 cc of blood was drained. There are multiple rib fractures and subcutaneous crepitus but he is oxygenating well at this point with a Sat of 90%. He arrived with a pressure of 90, a pulse of 130 and a respiratory rate of 30 and shallow. After the chest tube insertion, we started 2 IVs and after approximately 1 L of Ringers Lactate his pressure is now 100 and his pulse 120. He has been cross-matched for 6 units and we will give him blood as soon as it arrives. He has a closed head injury that has progressed since the accident. His GCS at 4:13 was 4t (E1 M3). Neurosurgery has been called. On exposing and logrolling the patient there is no obvious abdominal injury, however, his left leg is shortened and internally rotated, suggesting a left hip fracture. We are about to start the secondary survey and assuming he continues to stabilize we will take him to CT for a total body scan. Is there anything else you would like us to do?

(ATLS) primary trauma survey.^{27,28} The patient was an intoxicated young man involved in a T-bone motor vehicle accident at 3 AM. The VPS showed that the patient was initially noted to be confused but conscious, however he became increasingly tachycardic and somnolent during transport to the trauma centre. The case was temporal in design, with multiple branching options, some of which led to potential care-management errors. Study participants were asked to virtually actively manage the case, make clinical and treatment decisions based on the primary trauma survey, and then, briefly but comprehensively summarize the case for the attending staff person. This summary was in free text written in narrative form and was used as a substitute or surrogate for the participant's oral handover. It was completed by each individual student at the end of the case. Subsequent to its submission, the participants were shown a model summary written by 2 expert trauma surgeons (Table 3) to support comparison and remediation.

Assessment Rubrics

To objectively assess student handovers, 2 rubrics, the first *procedural* and the second *semantic*, created for the previous study were used.²⁶ The procedural rubric included 19 patient care-management items that demonstrated key ATLS trauma patient criteria, in the

TABLE 4. Procedural Rubric

Procedural Summary Statement Indicators	Included in Summary Yes/No	Score
1. Student identifies himself/herself		
2. Student identifies the patient		
3. Student identifies the context of the trauma (T-bone care crash) and the cause of the injury		
4. Student refers to 'C-spine precautions		
5. Student refers to Airway		
6. Student refers to Intubation		
7. Student refers to Breathing		
8. Student refers to needle thoracostomy and subsequent chest tube insertion		
9. Student notes the amount of drainage		
10. Student refers to Circulation		
11. Student notes the number of IVs		
12. Student notes the IV solution and the rate of infusion		
13. Student refers to Disability		
14. Student refers to the Glasgow Coma Scale		
15. Student refers to Expose		
16. Student summarizes the severity of the injury at this time		
17. Student includes a timeline		
18. Student refers to the Secondary Survey		
19. The word count is between 150 and 300		
Score		

TABLE 5. Semantic Rubric

Use of Sematic Qualifiers Terms that should be Included	Included in Summary Yes/No	Score
1. T-bone		
2. Substantial intrusion		
3. Severe respiratory distress		
4. Hemopneumothorax on pneumothorax		
5. Multiple rib fractures		
6. Subcutaneous crepitus or bony crepitus		
7. Oxygenating and O ₂ saturation		
8. Somnolent		
9. Inclusion of blood pressure and vital signs × 1		
10. Inclusion of blood pressure and vital signs × 2		
11. Inclusion of time of arrival		
12. Inclusion of time when GCS was done		
13. Crossmatch with number of units		
14. Hemodynamically unstable		
15. Closed head injury that has progressed		
16. Unresponsive with time		
17. Reports GCS as 5t and/or E1 V1 M3		
18. Internal rotation and shortening of the leg		
19. States that neurosurgery has been called, refers to specialized care		
20. States that the secondary survey will now be started		
21. States that the patient will be sent to CT for a total body scan		
22. Requests feedback from attending staff		
Score		

appropriate temporal sequence (Table 4). The second rubric assessed 22 semantic qualifiers²⁹ (Table 5) required to provide a handover comprised of concise, clear, and comprehensive professional clinical language. These rubrics were scored independently by 2 raters without trauma experience. In the previous study both the procedural and semantic rubrics demonstrated high inter-rater reliability (Chronbach's alphas of 0.94 and 0.97, respectively), extremely high content validity, as well as a relatively high concurrent validity ($r = 0.78$ and 0.66 , respectively).²⁶

Design and Description of the Methodology

The use of a trauma VPS, utilizing the relatively succinct ATLS algorithm (airway maintenance with cervical spine protection, breathing and ventilation with life-threatening chest injury management, circulation with hemorrhage control, disability or neurologic status with intracranial mass lesion recognition, and exposure/environment with maintenance of normal body temperature)^{27,28} simplified the analysis of the "summary statement" as compared to the more extensive handover required for a case based on the medical model⁷ (p. 1336).

All participants' summary statements were collected and scored individually, using these rubrics. The PG scores collected were then compared to previously collected scores from 2 UG cohorts, junior, and senior.²⁶

The current study extended this evaluation and compared first year surgical residents (PGs) during their bootcamp, which took place in the first 2 weeks of their residency training, to these initial 2 cohorts of UG students. Each first-year resident (R1) was required to complete the case and the summary statement. The free-text summary statement was used as a surrogate version for the oral handover. Scores on both the procedural and semantic rubrics were compared across the 3 groups of students, the PG group to the UG "senior" group, and to the UG "junior" group.

Data Analysis

Statements were collected from the VPS database, anonymized and analyzed and compared to the data from the junior and senior UGs reported in the previous study.²⁶

To address the research questions, 2 parallel Analyses of Variance were conducted, one for scores on the procedural rubric, the other for scores on the semantics rubric, for the 3 groups of students, with post hoc Tukey tests of significance to compare group differences when the Analysis of Variance (ANOVA) found significant differences.

Recruitment Procedures

Each participant encountered an online consent (Table 6) at the beginning of the VPS. Only those

TABLE 6. Online Consent

Research on this Case

Responses to the case, titled Mr. Johnny Delray, may be used for future research. While the completion of this and the other virtual patient trauma cases is obligatory, your participation in this research is voluntary.

1. If you chose not to consent there will be no effect on your professional standing, confidentiality, or feedback from Bootcamp.
2. Should you consent to take part in this research, your feedback will be used in a research publication to support medical educators as they develop virtual patients for undergraduate and postgraduate learning technologies.
3. You may withdraw at any time without explanation.
4. Your confidentiality will be ensured as all information gathered will be coded and anonymized. Your name will not appear in any published documentation.

Please input either (1) I consent, or (2) I do not consent.

- I consent
- I do not consent

participants who agreed were included in the data analysis. Two participants who clicked on “I do not consent” were excluded.

Details on Confidentiality

All data were anonymized and there was no link between the data and the participant during the scoring.

Statement on Ethical Considerations

This study was conducted according to ethical principles stated in the Declaration of Helsinki (2013) and the requirements of McGill University. Ethics approval was obtained from the Research Ethics Office Institutional Review Board of McGill University before initiating this study.

RESULTS

Results (Fig. 1) demonstrated a significant progression from junior to senior clerkship and then to PG in the procedural rubric, but no significant differences as measured in the semantic rubric. A power analysis was performed to determine whether the sample sizes available were sufficient to capture the learners’ progress over time for both of the ANOVAs. Since it was expected that learners would improve over time on this EPA, a moderate effect size of 0.30 was assumed. The resultant power of 0.80 was deemed sufficient. The ANOVA comparing scores on the procedural rubric was highly significant ($F_{(2,108)} = 15.402$, $p < 0.001$, Cohen’s $d = 1.12$), indicating that the 3 groups were not the same. Tukey LSD tests indicated that all 3 groups were significantly different from the others for procedural performance (junior vs senior, $p = 0.02$, senior vs PG, $p = 0.04$, junior vs PG,

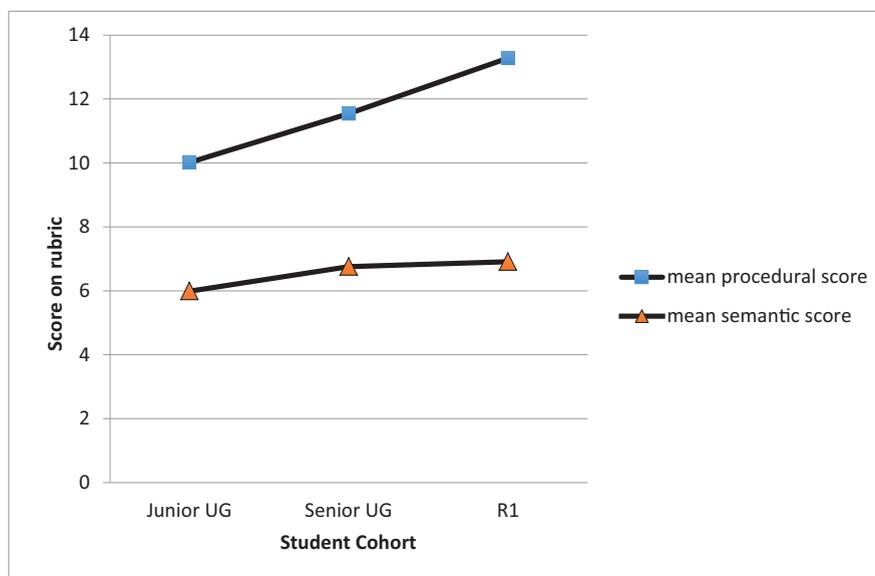


FIGURE 1. Increase in Student Performance over Time.

$p < 0.001$.) As can be seen in Figure 1, there was an increase in scores from junior ($M = 10.02$, $SD = 2.51$), to senior ($M = 11.54$, $SD = 2.70$), to R1 ($M = 13.28$, $SD = 2.67$). These results indicated that students increased their scores on the procedural rubric at each stage of their training.

A parallel ANOVA comparing students' scores on the semantic rubric was run for the same 3 groups of students. As can be seen in Figure 1, although there was a slight increase in mean scores in the predicted direction (junior, $M = 5.99$, $SD = 3.26$, to senior $M = 6.76$, $SD = 3.35$, to R1 $M = 6.91$, $SD = 2.59$), the ANOVA indicated that there were no significant differences among the 3 groups ($F_{(2,108)} = 1.037$, $p = 0.36$), therefore no post hoc tests were performed. This indicated that students did not improve in their capacity to communicate professionally as they progressed through their training.

LIMITATIONS

Limitations of this study include the focus on one EPA, "handover" within the context of a trauma case and the associated relatively succinct ATLS algorithm.²⁶ Using a medical VPS would require a more expansive medical model handover summary and generalizability of this approach is a direction for future study. Written text was used as a surrogate for oral communication due to the nature of the VPS and the features of the application, which permitted standardization and provided the authors the ability to more objectively assess these handovers through the rubrics. We are not certain that this is a drawback, but recognize that the written communication did not permit an assessment of more subjective impressions, such as body language, learner facial expression, and requests from the receiving physician for clarification as well as the ability to for immediate comment. In the case of the VPS, this feedback was available in the expert's response which each student received subsequent to submitting the handover.

The study was confined to 1 geographic site, used only 1 VPS and a relatively small cohort of PG participants. Subjective assessment modalities were not included in this analysis but could play an important role in a comprehensive assessment.

DISCUSSION

This study used a VPS to quantifiably and objectively assess the EPA handover which is, the "oral presentation of a clinical encounter, used to transfer information about, and responsibility for, a patient or patients between health care

professionals and settings."^{7,13} This EPA was chosen because it is a core competency for UG and PG training in both the United States and Canada, and is particularly critical during the transition from UG to PG. It is essential for patient safety and comprehensive professional communication with clinical colleagues² and major gaps have been found in the assessment of this EPA.⁹

VPS were chosen as an instrument since they are relatively easy and inexpensive to create, include the appropriate feature sets to support objective assessment of learner progression, and can be standardized. For these reasons, and since this EPA has wide applicability throughout medical training, we have explored an innovative methodology and determined that student performance for this EPA can be quantifiably and objectively measured.

The VPS case required clinical decision-making, treatment prioritization, the potential to make care-management errors, and the use of medical judgement based on cognitive knowledge. Students completed the VPS case with a summary statement, using free text input as a surrogate for an oral handover. The study used 2 previously published rubrics (procedural and semantic)²⁶ to assess this EPA. Study results indicated that as students progressed through their training, they acquired the expected procedural knowledge, but failed to improve in their semantic or professional communication skills.

These results indicate that clinical instructors need to place a stronger emphasis on semantics, which may, in turn, require a more robust role for Faculty Development, including the direct involvement of their resources within clinical areas. This out-reach would help to support clinical teachers charged with implementation of CBME and the associated assessment of EPAs. It would also help to facilitate the early recognition and timely remediation of student progress.^{2,4,13,16,22}

CONCLUSION

CBME requires expansive quantitative and objective measures of EPAs to ensure that necessary competencies are attained. This study described how VPS with associated validated rubrics can be used as an assessment methodology to quantifiably measure learner performance for the EPA "handover." These results demonstrate that learners from this school are progressing as required for procedural knowledge, but this progression is not seen in their professional communication skills. Student remediation and support for clinical teachers from Faculty Development to resolve this discrepancy should be considered. A similar assessment strategy could be explored for other UG and PG EPAs as a nexus for future research.

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