EDUCATION & TRAINING SECTION

Use of Immersive Learning and Simulation Techniques to Teach and Research Opioid Prescribing Practices

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Abstract

Introduction. Unsafe opioid prescribing practices to treat acute and chronic pain continue to contribute to the opioid overdose crisis in the United States, a growing public health emergency that harms patients and their communities. Poor opioid prescribing practices stem in part from a lack of education and skills training surrounding pain and opioid management. **Methods.** As part of the Clinical Pain Medicine Fellowship at Stanford University, physicians were given the opportunity to participate in a pilot program to practice opioid management in a live, simulated interaction. Twenty-seven physician trainees participated in the simulation with a live, standardized patient actor. Before beginning the simulation, participants were given a detailed patient history that included the patient's risk for opioid abuse. They were also provided with relevant risk evaluation and mitigation (REM) tools. All simulation interactions were video-recorded and coded by two independent reviewers. A detailed coding scheme was developed before video analysis, and an inter-rater reliability score showed substantial agreement between reviewers. **Results.** Contrary to expectations, many of the observed performances by trainees contained aspects of unsafe opioid prescribing, given the patient history. Many trainees did not discuss their patient's aberrant behaviors related to opioids or the patient's risk for opioid abuse. Marked disparities were also observed between the trainees' active patient interactions and their written progress notes. **Discussion.** This simulation addresses a pressing need to further educate, train, and provide point-of-care tools for providers prescribing opioids. We present our experience and preliminary findings.

Introduction

The United States is currently experiencing a public health epidemic of opioid overdose-related events and deaths. This epidemic accounted for 42,249 American deaths in 2016 alone [1]. According to data from the Centers for Disease Control and Prevention (CDC), an estimated one in five patients presenting with acute or chronic noncancer pain symptoms is prescribed opioids, amounting to 259 million opioid prescriptions in 2012 in the United States [2]. The use of opioid medications for

long-term pain management is associated with a number of risks, including tolerance, dependence, addiction, toxicity, and death [2].

Numerous studies investigating pain education for medical students and physicians have supported the notion that the consequences of poor opioid prescribing practices stem in part from a lack of skills training at the undergraduate, graduate, and continued medical education levels [3–4]. A study of pain education in North American medical schools [3] revealed that the topic is often

fragmented and incorporated as a few sessions within general required courses, rather than being taught as a course on its own. Only 16% of these schools offer pain as an optional elective course, and opioid management is even further under-represented in this coursework [3]. A recent study examining 2013 data from the Centers for Medicare and Medicaid Services showed that the medical specialties with the highest concentrations of opioid prescriptions were interventional and general pain medicine, anesthesiology, and physical medicine and rehabilitation [5]. Despite the fact that these specialties prescribed opioids more frequently, general practitioners still had the largest volume of opioid prescriptions [5]. These data support the argument that, because the number of adults reporting experiences of daily pain in the United States has risen to 11.2% [2], there is a tremendous need for comprehensive pain education across medical disciplines. The 2011 Institute of Medicine (IOM) Report, *Relieving Pain in America*, asserts that clinicians “need and deserve greater knowledge and skills so they can contribute to the necessary cultural transformation in the perception and treatment of people with pain” [6]. The IOM has called for improvements in educational programs and curricula to address these knowledge deficits.

Professional organizations, in response to the call for reform, have created a wealth of clinical guidelines for prescribing and managing opioids to treat pain [7–9]. Components of safe opioid management practices include the use of risk assessment and mitigation (REM) tools, cautious dosing thresholds and titration, treatment contracts, and urine drug screens at the point of care [1]. Because formal training in the use of these guidelines is limited, they have been incorporated into a continued medical education (CME) program within Stanford’s Division of Pain Medicine. The Accreditation Council for Graduate Medical Education (ACGME)–approved Clinical Pain Medicine Fellowship focuses on comprehensive, interdisciplinary, and collaborative training in pain medicine. One aspect of this educational experience involves participating in a simulated opioid management session.

Simulation and immersive learning have been identified as an effective educational tool within various pain medicine curricula [10,11]. This pilot program immersed learners in an interactive simulation experience, utilizing the educational guidelines outlined above to enhance trainee performance and patient safety. Here we present our initial experience and data on the development of a simulation-based module for safe opioid prescribing.

Methods

Simulation

Twenty-five pain medicine fellows and two anesthesia residents have participated in the opioid management simulation to date. The present study tracked four educational cohorts, each consisting of six to seven trainees.

All interactions took place at the Stanford University Center for Immersive and Simulation-based Learning (CISL). The simulation utilized standardized patient (SP) actors to replicate clinical interactions in a pain management setting.

Before starting the simulation, trainees were provided with the SP’s medical history, taken from a referring emergency department’s records (Table 1). They were also given onsite REM tools for opioid management. The participants were allocated 40 minutes to conduct a focused history and physical exam, utilize the available REM tools to determine a diagnosis, and formulate a treatment plan for the SP. The SP’s history was designed to designate the patient as being at high risk for opioid abuse and aberrant behavior, such as selling prescribed medications to coworkers and frequently visiting emergency rooms to obtain opioid refills. After the encounter, the learners completed a mock progress note for the referring physician and were debriefed as a group by a member of the Stanford Pain Medicine faculty.

Risk Evaluation and Mitigation Tools

Opioid Risk Tool

The Opioid Risk Tool (ORT) is a screening and diagnostic tool designed to help physicians identify individuals who may be at risk for opioid abuse. The ORT comprises five sections: family history of substance abuse, personal history of substance abuse, history of preadolescent sexual abuse, age, and psychological disease [12]. Patient scores are grouped into three risk categories: a score of 0–3 signifies low risk (unlikely to abuse), 4–7 signifies moderate risk (equally likely to abuse or not), and ≥ 8 signifies high risk (likely to abuse opioids). The data are typically collected via self-report, but for the purposes of the simulation, physicians were provided with the tool and instructed to use the patient history to calculate the risk score themselves.

Clinical Opiate Withdrawal Scale

The Clinical Opiate Withdrawal Scale (COWS) is a physician-administered tool that rates 11 common opioid withdrawal symptoms and assesses a patient’s level of physical dependence on opioids [13]. Physicians perform a detailed physical examination to gather information related to withdrawal symptoms, including resting heart rate, pupil size, gastrointestinal upset, restlessness, and sweating, among others. Each symptom is included in a detailed scoring sheet, and sum scores are calculated across the 11 symptoms. A score of 5–12 signifies mild opiate withdrawal, 13–24 signifies moderate withdrawal, 25–36 signifies moderately severe withdrawal, and >36 signifies severe withdrawal [13].

Pain Assessment and Documentation Tool

The Pain Assessment and Documentation Tool (PADT), commonly known as the “four As of analgesia,” is a

Table 1. Summary of standardized patient medical history**Background:**

- 39-year-old female referred to pain clinic from ER
- Suffers from chronic axial neck pain
- Frequent HM refill requests
- Patient takes large quantities of HM for pain and currently has 1 tablet left
- Patient states that HM is the only medication that works for pain
- Needs HM refill to prevent opioid withdrawal

History and physical:

- Negative for sinister pathology
- Examination reveals only cervical myofascial strain after MVA years prior
- Recent MRI of neck is negative

Medical history:

- Chronic neck pain s/p MVA 2 years prior
- Chronic opioid use
- Bipolar depression, stable with Trileptal 600 mg b.i.d.
- Allergies (NKDA)

Social history:

- Patient smokes tobacco 1 PPD, occasional alcohol use
- 3–4 drinks on weekends, “socially”
- No illicit drug use
- College graduate in fine arts
- Employed by local museum
- Patient revealed several conflicts with her boss due to being sedated while on the job
- Patient was caught selling HM once while at work

Family history:

- Alcoholism in patient’s father
- Patient deals with past trauma, molestation by father at age 12
- Medication abuse by mother, used thyroid medication for weight loss

Risk assessment:

- Assessment reveals concerning findings that patient is at high risk
- Patient is at high risk for aberrance and presence of an opioid misuse disorder according to DSM-V criteria

Objective:

Learner must appropriately gather data to decide if risk of opioid withdrawal and elevated pain outweighs the risk of aberrance

Abbreviations: DSM-V = Diagnostic and Statistical Manual of Mental Disorders, 5th Edition; ER = emergency room; HM = hydromorphone; MRI = magnetic resonance imaging; MVA = Motor Vehicle Accident; NKDA = No Known Drug Allergies; PPD = Packs Per Day.

clinical application of the specialized chart note. The PADT assesses four types of outcomes in long-term opioid therapy for chronic noncancer pain: pain relief (analgesia), function (activities of daily living), side effects (adverse events), and potential (aberrant) drug-related behaviors [14]. The assessment involves a clinical interview and medical chart review, after which the prescribing physician completes a detailed chart note template. Learners are encouraged to utilize the PADT to facilitate opioid-related discussions during the interaction phase of the simulation.

Prescription Drug Monitoring Program

This state-level intervention program, referred to as the Controlled Substance Utilization Review and Evaluation System (CURES), in California [15] is committed to reducing prescription drug abuse by partnering licensed

prescribers and pharmacists via an online government database. Physicians can access Schedule II–V drug dispensing data, reported electronically to the state’s Department of Justice by pharmacists, to prevent overlapping prescriptions from multiple clinicians to the same patient.

Urine Drug Screen

Learners can order a point-of-care urine drug screen (UDS) during the simulated visit to screen for drug toxicity [16]. In this patient case, an appropriate drug screen result would return positive for hydromorphone (Dilaudid) and no others. Urine drug screens are used by prescribing physicians to verify patient reports of drug and medication usage in order to mitigate any unsafe combinations.

ACGME Metrics

In an effort to situate the pilot program within an educational context, the simulation learning goals and objectives were aligned to the current ACGME [17] core competencies (Table 2). The educational categories include patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. These learning objectives were utilized as criteria for analyzing the recorded simulation interactions.

Data Collection

All interactions were video-recorded and archived for retrospective analysis. A detailed coding scheme, based on ACGME assessment criteria, was created for both the interaction and note-writing components of the simulation before data collection. Each interaction was divided into three sections: information gathering (Table 3), assessment of opioid-related risk (Table 3), and treatment planning (Table 4). In addition to reviewing outside medical records during the information gathering section, learners obtained a detailed history of integrated pain management, including physical therapy, pain psychology, and acupuncture. Risks were measured by determining the number of REM tools effectively utilized by each trainee, as well as the discussions of opioid use. Finally, the treatment planning section categorized the learners’ final prescription decisions. To compare observations from the recorded interactions and the information written in the final progress note, the raters compared the same data points across both components of the simulation (Simulated Visit and Documentation).

Analysis

Two reviewers assessed each recorded interaction (MH, LS) independently to reduce the risk of bias. A detailed coding scheme (Supplementary Appendix 1) was developed before the data were collected, and an associated Cohen’s kappa statistic was calculated for each video to determine inter-rater reliability. The kappa statistic for 26 videos (one excluded for coding training and fidelity

Table 2. Simulation project goals aligned to ACGME core competencies

ACGME Core Competencies	Project Goals
PC SBP MK	1. Reduce harm to patients and general public from unsafe opioid prescribing
MK PBL PC SBP	2. Recognize the broad differential diagnosis that exists in chronic pain patients utilizing opioids in an inappropriate fashion
MK PBL PC SBP	3. Understand risk factors for opioid addiction disorder
PC SBP	4. Be aware of diagnostic and management options for chronic pain patients utilizing opioid medications in inappropriate fashions
Project Objectives	
PC MK ICS P	1. Gather basic information from the patient regarding their opioid use to yield a broad differential diagnosis
PC PBL SBP ICS PC P ICS	2. Consider other informational resources to help formulate a diagnosis: call referring physician, PDMP report, urine or serum drug levels for specific opioid agents
PC P ICS	3. Communicate assessment and comprehensive plan to patient. Manage opioid request in a nonjudgmental, professional fashion, with patient and public safety in mind
PC MK P ICS PC MK ICS	4. Offer medications for withdrawal and other services to patient given their present situation
PC MK ICS	5. Produce clear written assessment plan, which includes broad differential diagnoses

Abbreviations: ACGME = Accreditation Council for Graduate Medical Education; ICS = interpersonal and communication skills; MK = medical knowledge; P = professionalism; PBL = practice-based learning and improvement; PC = patient care; PDMP = Prescription Drug Monitoring Program; SBP = systems-based practice.

check) ranged from 0.44 to 0.93. The average across all scores showed substantial agreement according to magnitude guidelines ($\kappa = 0.69$) [18]. The most notable discrepancies in inter-rater agreement were observed for utilization of two of the five REM tools during the simulated visit (see the asterisks in Table 3).

Results

A retrospective video review was used to determine trainee performance results. Given the relative strength of agreement between the two reviewers, the following results are reported for Rater 1 only. A full data set comparing results from both Rater 1 and Rater 2 can be found in Tables 3–5.

Focused History/REM Tools Utilization

At the beginning of each simulated visit, the learners discussed the SP's personal and medical history based on the

outside medical records that were provided. The Stanford Division of Pain Medicine employs a multidisciplinary model for pain management, stressing the importance of complementary and integrative therapies for optimal patient care. As part of their discussions with the SP, 25 learners (92.6%) explored prior physical therapy treatment, 22 (81.5%) discussed pain psychology, and 18 (66.7%) discussed acupuncture.

The learners were also scored on successful utilization of the REM tools during the information gathering section: 16 learners (59.3%) successfully used the ORT, 13 (48.1%) used COWS, 17 (63.0%) used the PADT, 17 (63.0%) used the Prescription Drug Monitoring Program (PDMP), and 13 (48.1%) ordered a UDS. Differences were observed between the information gathered during the simulation and the information that was documented in the after-visit progress note (Figure 1). Of the 27 learners, only four (14.8%) utilized all five REM tools available. Five learners (18.5%) used four of the REM tools, seven (25.9%) used three tools, six (22.2%) used two tools, three (11.1%) used one tool, and two (7.4%) used none. No significant associations were found between the number of REM tools used and discussion of opioid use diagnosis ($X^2(20, N = 27) = 25.23, P = 0.19$) or the number of REM tools used and hydromorphone prescription ($X^2(5, N = 27) = 4.44, P = 0.49$).

Opioid Use—Diagnosis Discussion

Discussion surrounding an opioid use diagnosis was coded into four main categories, based on the 2006 World Health Organization Lexicon of Alcohol and Drug terms [19]. Although many of the trainees counseled the SP on opioid-related side effects and concerns, only two (less than 10%) confronted the SP regarding opioid-aberrant or abusive behavior. Contrary to expectations, in 40.7% of cases, the learners did not have any discussion of the opioid-related diagnosis with the SP. This was the most commonly observed incidence and was coded as “No Discussion.” The next most commonly observed diagnoses were, in descending order, dependence (25.9%), tolerance (22.2%), and addiction (11.1%).

Documentation of Opioid Use

To compare observations from the learner–SP interactions and the after-visit progress notes, four analogous categories of opioid use were identified from the progress notes: chronic use, indicating no change from the referred medical records (40.7%); tolerance (3.7%); dependence (33.3%); and addiction, including opioid abuse/misuse/use disorder (22.2%). Discrepancies were observed between the simulated visit and documentation regarding opioid use; clinicians were more likely to discuss opioid tolerance with the SP during the visit and to document addiction/opioid abuse in the after-visit progress note.

Table 3. Data gathering techniques

Technique observed	Simulated Visit Learners Who Performed Method (%)		Documentation Learners Who Indicated Method in Progress Note (%)	
	Rater 1	Rater 2	Rater 1	Rater 2
Focused history				
Physical therapy	25 (92.6)	25 (92.6)	21 (77.8)	21 (77.8)
Pain psychology	22 (81.5)	21 (77.8)	20 (74.1)	20 (74.1)
Acupuncture	18 (66.7)	14 (51.9)	8 (29.6)	9 (33.3)
REM tool utilization by type				
Opioid Risk Tool	16 (59.3)	9 (33.3)	26 (96.3)	26 (96.3)
Clinical Opioid Withdrawal Scale	13 (48.1)*	1 (3.7)*	6 (22.2)	5 (18.5)
Pain Assessment and Documentation Tool	17 (63.0)*	0 (0.0)*	24 (88.9)	25 (92.6)
Prescription Drug Monitoring Program	17 (63.0)	13 (48.1)	16 (59.3)	19 (70.4)
Urine drug screen	13 (48.1)	13 (48.1)	11 (40.7)	13 (48.1)
Opioid use diagnosis				
No discussion/chronic use	10 (37.0)	11 (40.7)	11 (40.7)	11 (40.7)
Tolerance	7 (25.9)	6 (22.2)	1 (3.8)	1 (3.8)
Dependence	8 (29.6)	7 (25.9)	8 (29.6)	9 (33.3)
Addiction/abuse/misuse/use disorder	2 (7.5)	3 (11.2)	7 (25.9)	6 (22.2)

Abbreviation: REM = risk evaluation and mitigation.

*Most notable discrepancies between raters.

Table 4. Total REM tool usage

Decision	Learners Who Performed Method (%)	
	Rater 1	Rater 2
No tools	2 (7.4)*	9 (33.3)*
1 tool	3 (11.1)	4 (14.8)
2 tools	6 (22.2)*	12 (44.4)*
3 tools	7 (25.9)	2 (7.4)
4 tools	5 (18.5)	0 (0.0)
5 tools	4 (14.8)	0 (0.0)

Abbreviation: REM = risk evaluation and mitigation.

*Most notable discrepancies between raters.

Table 5. Prescribing decision

Decision	Learners Who Performed Method (%)	
	Rater 1	Rater 2
Hydromorphone (Dilaudid)	18 (66.7)	21 (77.8)
Opioid rotation (Suboxone, OxyContin, etc.)	2 (7.4)	3 (11.1)
Opioid wean	12 (44.4)	14 (51.9)
Limited supply	7 (25.9)	4 (14.8)
Opioid contract	11 (40.7)	13 (48.1)
Addiction consult	2 (7.4)	3 (11.1)

Prescribing Decision

Of the 27 trainees who completed the opioid prescribing simulation, 18 (69.2%) prescribed hydromorphone (HM) as requested by the SP. Of these, 12 (66.7%) planned for a weaning dose, seven (38.9%) provided a limited supply of HM, 11 (61.1%) required the patient to sign an opioid use contract, and one (5.6%) ordered an addiction medicine consult. Of the nine physicians who did not prescribe HM to the SP, two (22.2%)

initiated an opioid rotation and one (11.1%) ordered an addiction medicine consult.

Cohort Effects

Repeated chi-square tests of independence were performed to examine differences between educational cohorts on the variables of interest. No significant relationships were found between opioid prescribing decisions and the cohort ($X^2(3, N=27) = 0.43, P=0.93$), opioid diagnosis discussion and cohort ($X^2(12, N=27) = 15.09, P=0.24$), or opioid use documentation and cohort ($X^2(9, N=27) = 7.46, P=0.59$).

Discussion

This study demonstrates successful utilization of the ACGME core competencies as a framework for assessing opioid prescribing practices in a group of pain medicine trainees. Our observations support the opioid prescribing simulation as an effective educational tool and measure of performance across cohorts in the fellowship program. The recent surge in opioid abuse and subsequent overdose deaths underscores the urgent need for medical education reform, with a stronger emphasis on pain management.

Although primary care and surgical subspecialties are the most frequent prescribers [5], practitioners in pain medicine and anesthesiology are among the most educated in the medical field with regards to opioids. Despite being pain-educated prescribers, few learners in this simulated environment explicitly discussed drug-aberrant behavior during the SP encounter, many did not use the REM tools suggested for optimal care, and most interactions lacked consistency between patient interaction and documentation.

Figure 1. Detailed history and risk evaluation and mitigation tools utilization: simulation vs progress note. Abbreviations: COWS = Clinical Opiate Withdrawal Scale; ORT = Opioid Risk Tool; PADT = Pain Assessment and Documentation Tool; PDMP = Prescription Drug Monitoring Program; UDS = urine drug screen.

For some REM measures, such as the ORT and PADT, more frequent observations were made in documentation than in the patient interaction. This disparity indicates, alarmingly, that important information was included in the after-visit progress note but was not discussed with the SP during the visit. These observations demonstrate the need to teach adequate opioid management and health communication skills in the medical field, which is supported in the literature [20–22].

The patient history in this simulated encounter was specifically designed to indicate high risk for aberrant opioid-related behavior and would have met criteria for moderate opioid use disorder (OUD) according to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V) [23]. Learners in this program were particularly hesitant to mention addiction or opioid misuse during the simulated visit, which should have been a critical component of the prescribing discussion for a high-risk patient. However, due in part to inconsistent usage of REM tools, many trainees failed to gather the necessary information for safe opioid prescribing. Another equally important concern is that many trainees did not adequately discuss issues related to aberrant behavior and the patient's risk for opioid abuse.

Limitations

The authors recognize several limitations of the pilot program presented here. First, given the small size of each cohort in Stanford's Clinical Pain Medicine Fellowship program, the sample size for any statistical analyses remains relatively small. Second, the use of actors as simulated patients could potentially affect the results and may not correlate with clinically based observations. Although SPs are professionally trained actors, subtle

inconsistencies in performance could have altered trainees' experiences and subsequent prescribing decisions. Third, although a comprehensive coding scheme was created before the analyses were performed, noteworthy differences were observed between the two raters on successful utilization of two of the five REM tools. Despite these differences, inter-rater reliability between coders remained substantial.

Additionally, the learners rated their satisfaction and likelihood of applying lessons from the simulation in clinical practice, but the current program lacked a means of measuring pre- and post-simulation comparisons of such skills. Last, these results are indicative of the cumulative experiences of physician learners over the course of a four-year span. As such, any changes in the structure, staffing, or content of the educational program could have confounded the outcomes of interest.

Future Directions

Although our findings suggest that inconsistent use of REM tools played a large part in the prescribing practices observed in this study, the mechanisms underlying these practices still remain unclear. Another unanticipated, but equally important, observation from video analysis was the lack of discussion surrounding an opioid use-related diagnosis. Additional research on complex patient-clinician interactions such as these [24,25] is needed to improve educational programs addressing these skills.

Future additions to this program may include the learners' assessments of clinical skills acquisition pre- and post-simulation. The development and implementation of a pre-post simulation measure for learners would serve as a useful tool to better understand pain and opioid management practices. Self-reported survey measures

would capture integral aspects of the learning experience, such as mentorship exposure and opioid prescribing history. Such changes would liken this program to others in the area [26] that utilize the objective structured clinical exams (OSCE) format while maintaining its novelty as a learner-centered experience for opioid prescribing in graduate medical education.

Although this study lacked data on learner satisfaction, the debrief session acted as an opportunity for learners to provide feedback on their simulation experience. Many learners voiced praise for the module's realism, application to clinical settings, and desire for more sessions to practice these skills. The results of this study inspire further development of related clinical education tools, such as a cognitive aid to encourage safe and consistent opioid prescribing. The simulation module could be used to test and validate such a tool before implementation in clinical settings.

An additional measure to consider for the simulated patient profile is the "Expectancy of Treatment Scale," [27] from the Stanford Division of Pain Medicine's Collaborative Health Outcomes Information Registry (CHOIR; <http://choir.stanford.edu>). This measure gauges the degree to which patients believe a medical treatment is suitable for their condition and assesses their emotional response to said treatment. Orienting prescribers to this scale and using the content to further teach treatment management and communication skills would also be strong additions to the program.

Conclusions

As the United States grapples with the epidemic of opioid overdoses, medicine and medical education have been tasked with redirecting scientific and educational efforts to achieve a response that is both healing and proactive. Although federal regulations have focused on supply-related solutions, medical education's focus must be patient-centered. In order to prevent further harm to patients seeking pain relief, physicians must be well armed with an educational experience that can combat the complexity inherent in these cases.

The key aspects of safe opioid prescribing include adequate assessment of risk, active communication of drug use diagnoses, and compassionate treatment options. Although this novel experience was initially created for pain medicine trainees, the simulation could easily be modified and integrated into other medical education curricula.

The opioid overdose epidemic has cast a light not only on prescribing practices but on medical education for pain management as a whole. Although many clinicians prescribe opioids responsibly, some lack the proper education to do so. The initial results of this pilot simulation-based learning program, implemented by the Stanford Clinical Pain Medicine Fellowship, proved to be an effective means for observing opioid-related skills and

practicing new approaches in the treatment of high-risk patients. Further research investigating the mechanisms of unsafe prescribing practices and patient-clinician interactions will be crucial for developing better means of diagnosing and treating patients on opioid medications.

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