**Objective**

This project aims to evaluate the impact of Deterra® drug disposal bag provision on the proper opioid disposal rate among families of children having outpatient surgery at Nationwide Children’s Hospital (NCH). Our ultimate goal is to reduce the presence of excess opioids in the home after a child has recovered from their surgery, in order to minimize accidental use and diversion of these medications.

**Background**

Opioids are an important component of post-operative pain management among children, but are often prescribed in excess and rarely disposed of appropriately. The lack of prompt and proper opioid disposal after recovery from surgery is contributing to the opioid crisis in Ohio by placing children at risk of accidental ingestion of opioids remaining in the home and allowing for unused opioids to be diverted for non-medical use.

Despite recent decreases in opioid prescribing, opioid-related overdose and death continue to rise among all age groups, with an increase of 165% in pediatric hospitalizations secondary to opioids from 1997 to 2012. Prescriptions from family or friends are the most common source of prescription opioids misused by adolescents, and leftover pills from adolescents’ own prescriptions are the second most common source. Young children with

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opioids in the home are at risk for opioid overdose through accidental ingestion\textsuperscript{8}. Opioids prescribed for postoperative pain management vary widely\textsuperscript{9}, are often in excess\textsuperscript{1}, and are rarely disposed of properly\textsuperscript{2}. Rates of proper disposal of unused opioids after surgery have been reported to be <10\% among both adults and children\textsuperscript{2,10,11}, suggesting that excess opioids remaining in the home after surgery are a widespread but targetable problem.

Several previous studies have targeted this problem by providing patients with educational materials describing methods for the proper disposal of their opioids. One such study, which randomized adult dental surgery patients to a behavioral intervention (informing them of local pharmacy-based opioid disposal sites) vs. routine postoperative instructions, found no increase in the proportion of patients who either disposed of or reported the intent to dispose of their unused opioids\textsuperscript{12}. Another prospective pre-post study evaluated the effect of an opioid education pamphlet on safe storage and disposal in adults having primary total hip or knee arthroplasty. This study found a significant increase, from 5\% to 27\%, in the proportion of patients who reported properly disposing of their opioids, among those who had discontinued opioids by 4 weeks after surgery. However, in this study, only about half of patients in both groups had discontinued their opioids by 4 weeks post-surgery.\textsuperscript{13} In the Michigan Opioid Engagement Network (M-OPEN) RCT of Deterra\textsuperscript{®} vs. educational materials vs. routine postoperative instructions among adult elective surgery patients, no effect of the educational materials on the disposal rate was detected. However, our collaborators from M-OPEN have tested Deterra\textsuperscript{®} bag provision in adult patients undergoing elective outpatient surgery and demonstrated that the opioid disposal rate was nearly double with Deterra\textsuperscript{®} provision than with usual care.

No published studies have evaluated the impact of educational interventions describing proper disposal of opioids on disposal rates among families of pediatric surgery patients. However, given the findings of these previous investigations in adult surgical patients, it is likely that educational materials alone may have a small effect or no effect on proper opioid disposal.

Data from the proposed study will provide evidence on the efficacy of Deterra\textsuperscript{®} bag provision to increase opioid disposal by caregivers of pediatric surgery patients. The results can subsequently be used to seek funding to implement and expand broad based drug disposal product distribution programs in Ohio. This study will also aim to reduce the presence of excess opioids in the home after a child has recovered from their surgery, in order to minimize accidental use and diversion of these medications.

Methods

This study is a randomized controlled trial. A randomized controlled trial design is being used because it will minimize bias in the identification of a causal relationship between the providing of Deterra\textsuperscript{®} bags and the proper disposal of excess opioids after pediatric surgery.

1. Eligibility criteria:

   • Inclusion criteria
     
     • English-speaking parent or legal guardian of a child having outpatient otolaryngologic or urologic surgery at Nationwide Children’s Hospital
     • Child’s age is between 1 and 17 years
     • Child is expected to receive a discharge opioid prescription

   • Exclusion criteria
     
     • Unable or unwilling to track pain medication use or complete a follow-up survey
2. Data collection:

Parents of children having outpatient surgery at NCH will be recruited for participation in the trial in the preoperative area. This setting was chosen based on family availability and to minimize disruption to the clinical workflow.

Parents of the children having outpatient surgery will not be consented; a waiver of consent is being requested because the study is extremely low risk and because discussing and providing the Deterra® Drug Disposal bag to the control group could potentially contaminate the study.

Study staff will review operating room schedules to identify surgeries in which an opioid is likely to be prescribed for home use (which may require confirmation with the operating surgeon). After confirming with the care team that an opioid is to be prescribed, a research team member will then approach the parent/guardian of the child in the preoperative area. The research team member will explain the study and answer any questions the parent or child may have. If the family is interested in participating in the trial, the research team member will randomize them. Randomization will be performed electronically using the Research Electronic Data Capture (REDCap) system.

Baseline data collection

In order to minimize disruption to the clinical workflow, minimal data will be collected at baseline directly from enrolled families. This will include the contact information required for follow-up, a limited set of research related questions, and a brief assessment of parent/guardian health literacy. Baseline demographic and clinical characteristics of the child, such as their primary payer, residential address, date of birth, age, and comorbidities at the time of surgery will be extracted from the electronic medical record (see baseline and electronic medical record data collection forms below).

Follow-up Survey

Parents/guardians will be contacted by their preferred method of email survey or phone call at 2 weeks postoperatively, at which time they will be surveyed on their child’s postoperative opioid and non-opioid medication use, opioid storage location, quantity of opioid remaining, disposal method, and any barriers to disposal. If the child continues to require opioids, they will be contacted again at 4 weeks postoperatively. If the parent believes that their older child or adolescent can assist in answering the survey questions, they will be encouraged to complete the survey together (see follow-up survey below).

3. Interventions

All families will receive a 1-page pain journal to record the child’s opioid and non-opioid adjunct pain medication administration. In addition to the instructions provided by the care team as described above, families randomized to the intervention arm will additionally receive a Deterra® bag and instructions on its use by a research team member. The control group will receive the routine, standardized education about opioid use, storage, and disposal that is provided by the care team. In addition, parents/guardians of children having otolaryngologic procedures are required to sign an opioid consent form.

4. Outcome variables

The primary outcome of this trial is the proper disposal of unused opioids. Secondary outcomes include the quantities of opioid used and leftover after surgery, opioid storage location, opioid disposal by any method, and barriers to disposal. As these outcomes are being self-reported, it is possible that there may be reporting bias, with some families falsely reporting proper opioid disposal. To account for this, we have based our sample size on the effect size detected in the adult RCT performed by our collaborators at the University of Michigan, which also relied on self-reporting. We believe that reporting bias is likely to be non-differential. In addition, research staff, both at enrollment and follow-up, will stress the importance of answering all survey questions completely and truthfully. Importantly, written information consent (e.g. a detail consent explaining the Deterra® bag and the purpose of the
follow-up survey) will not be performed, as this might unduly influence disposal practices in both groups. Instead, consent will be implied upon completion of the baseline survey.

5. Exposure variables

Chronic pain or pain medication use by anyone in the child’s household prior to the child’s surgery

Patient preoperative demographic (e.g. age, race/ethnicity, gender, primary payer, household income, parent/guardian educational level) and clinical (type of surgical procedure(s)) characteristics

Healthy literacy of the parent/guardian

6. Analytic plan including power/sample size calculation if appropriate

Primary and Secondary Endpoints

The primary outcome is the proper disposal of unused opioids, defined as the disposal of unused opioids by an FDA-recommended method or by using the drug disposal bag. Secondary outcomes include the quantities of opioid used and leftover after surgery, opioid storage location, disposal by any method, and barriers to disposal.

Statistical Methods

Throughout enrollment and data collection, data quality checks will regularly be performed. Descriptive analyses will be undertaken to examine the presence and causes of missing or unusual data. Upon completion of data collection, statistical analyses will be performed. The means/medians and standard deviations/interquartile ranges of baseline characteristics will be evaluated in the total study sample and compared between groups using t-tests or Mann Whitney U tests for continuous variables and Pearson chi-square tests for categorical variables. For the primary outcome of proper disposal of unused opioids, we will calculate this proportion in both treatment groups, and we will compare this proportion between groups using a Pearson chi-square test. Analogous analyses will be performed for secondary outcomes. Additive and multiplicative treatment effect heterogeneity by parent/guardian health literacy level will be explored by evaluating linear and log binomial regression models to include treatment, health literacy score, and an interaction between the two factors. Health literacy scores will be categorized as low/marginal and adequate. Identification of effect modification will be made through the test of interaction in this model. Analogous analyses will be performed to evaluate for treatment effect heterogeneity by receipt of an opioid consent form. SAS Enterprise Guide version 7.15 (SAS Institute Inc., Cary, NC) will be used for the statistical analyses.

Sample Size and Power

Based on the results of the M-OPEN trial, we expect the disposal rate to increase by 20% in the Deterra® group in this RCT. To achieve 80% power to detect a 20% effect size with an assumed baseline disposal rate of 23%, and accounting for a combined 15% rate of non-receipt of opioid prescriptions and loss to follow-up, we need to enroll 202 patients in our RCT. This should be easily achievable as more than 1500 outpatient otolaryngology and urologic surgery procedures are performed annually at the surgery centers at NCH, and approximately 60% of these patients receive an opioid prescription at discharge.

7. List of references

16. Fowler W. Deterra® System Deactivation of Unused Drugs: Comparison between Deterra Ingredients and Others Recommended in Federal and SmartRx Disposal Guidelines.
**Protocol Appendix**

**Enrollment Script/Process**

“Hello Mr./Mrs./Ms. __, my name is __. We are doing a study to better understand children's pain management needs after surgery. The study involves a 5 minute survey now and a 10 minute survey either online or by phone in 2 weeks. Are you interested in participating in this study?”

If no, thank the family for their time.

If yes:

“Great. Today, we will collect your contact information, some demographic information, some information regarding whether anyone in the child’s home currently lives with chronic pain or uses pain medications, and some information about how you process and understand health information. Other information such as your child’s age, the type of surgery they had, and any health conditions they currently have will be taken from their medical record for the purposes of this research study. You will also receive a 1-page pain journal to record opioid and non-opioid pain medication that your child takes after they leave the hospital. Going home with you today will be a ClinCard registered in your child’s name. This ClinCard will be used to reimburse you for your time at the 2-week follow-up time point.

In two weeks, a research team member from Nationwide Children’s Hospital will call or email you. At this time, you will be asked several questions regarding your child’s pain and pain medication use. None of the information we collect will be made known to your surgeon or the team of people caring for your child. It will be used for research purposes only. After you have completed the follow-up survey in two weeks, $20 will be loaded on to your ClinCard.

Do you have any questions at this time about this research study?

Answer any questions the family has, then ask the parent/guardian to complete the baseline survey in REDCap on the iPad. In the meantime, randomize the family in REDCap to receive or not receive a Deterra bag. If the family is randomized to receive the bag, provide the bag to the parent/guardian and briefly review the instructions on the bag, then thank them for completing the baseline survey and remind them that we will contact them by their preferred method of contact in two weeks. If the family is not randomized to receive the bag, simply thank them for completing the baseline survey and remind them that we will contact them by their preferred method of contact in two weeks.
Baseline Data Collection Form

1. What is your name:  First___________ Last___________

2. Name of other caregiver (if present and willing to be involved in study): First_______ Last_________

3. What is the best way to contact you for the follow-up survey?
   □ Phone
   □ Email (with a link to online survey)

4. What is the best phone number to reach you? (if phone number was checked) ____________________

5. Is there an alternate phone number we might use? (if phone number was checked) ____________________

6. What is the best time to call? (if phone number was checked) ____________________

7. What is your email address? (if email was checked) ____________________

8. What is the highest level of education completed by any parent/guardian with whom the child primarily lives (check one)
   □ Elementary    □ High School/GED
   □ Some College  □ 2-Year College (Associate’s)
   □ 4-Year College (BS/BA) □ Master’s Degree (MS/MA/MPH)
   □ Doctorate (PhD/ScD) □ Professional (MD/DO/JD)

9. Total household income where the child primarily lives (check one)
   □ $25,000 or less □ Over $50,000- $100,000
   □ Over $25,000- $50,000 □ Over $100,000

10. Does anyone in the child’s household live with chronic pain?
    □ Yes
    □ No
    □ I don’t know

11. Does anyone in the child’s household use prescribed opioid pain medications?
    □ Yes
    □ No
    □ I don’t know

12. To your knowledge, does anyone in the child’s household use illegal drugs?
    □ Yes
    □ No
    □ I don’t know
BRIEF Health Literacy Screening Tool

1. How often do you have someone help you read hospital materials?
   □ Always
   □ Often
   □ Sometimes
   □ Occasionally
   □ Never

2. How confident are you filling out medical forms by yourself?
   □ Not at all
   □ A little bit
   □ Somewhat
   □ Quite a bit
   □ Extremely

3. How often do you have problems learning about your child’s medical condition because of difficulty understanding written information?
   □ Always
   □ Often
   □ Sometimes
   □ Occasionally
   □ Never

4. How often do you have a problem understanding what is told to you about your child’s medical condition?
   □ Always
   □ Often
   □ Sometimes
   □ Occasionally
   □ Never
Electronic Medical Record Data Collection Form

1. Child’s name: ________________________
2. Address: ______________________________________________________
3. Age in years: __________
4. Gender: M/F
5. Race/ethnicity:
   a. White
   b. Black or African American
   c. Asian
   d. Hispanic (of any race)
   e. Biracial/multiracial
   f. Unknown
   g. Other_________________
6. Primary Insurance:
   a. Medicaid
   b. Private
   c. Other________________
   d. Unknown
7. Surgical procedures (check all that apply):
   a. Tonsillectomy without adenoidectomy
   b. Adenotonsillectomy
   c. Septoplasty
   d. Tympanoplasty
   e. Mastoidectomy
   f. Umbilical hernia repair
   g. Epigastric hernia repair
   h. Inguinal hernia repair
   i. Circumcision
   j. Circumcision revision
   k. Orchiopexy
   l. Hydrocele repair
   m. Hypospadias repair
   n. Cystoplasty
   o. Other______________
13. Opioid prescribed at discharge
   a. Hydrocodone
   b. Oxycodone
   c. Codeine
   d. Tramadol
   e. Meperidine
   f. Morphine
   g. Hydromorphone
   h. Other________________
14. Opioid Formulation
   a. Pills
   b. Solution
15. Strength of each tablet or capsule (in mg) (if pills were prescribed)__________
16. Total quantity of tablets/capsules prescribed (if pills were prescribed)__________
17. Strength of solution (in mg/mL) (*if a solution was prescribed*)
18. Total quantity of solution prescribed (*if a solution was prescribed*)
19. How is the medication to be taken (Sig)?
Follow-up Survey

1. Study ID: ______________________

2. How would you rate your child’s overall pain control after surgery?
   a. Poor
   b. Adequate
   c. Good

3. Would you describe your child’s pain control since surgery as:
   a. Worse than you expected?
   b. About what you expected?
   c. Better than you expected?

4. When you left the hospital, you were given a prescription for an opioid pain medication. Did you fill the prescription?
   a. Yes
   b. No (skip to #15)

5. How many doses of the prescription opioid pain medication you received after surgery has your child taken? If you know the exact number of doses (times your child took the medicine), please provide that number: ___________
   If you are unable to remember the exact number, please choose from the following:
   i. None
   ii. Less than half the pills/bottle (if liquid formulation)
   iii. About half of the pills/bottle
   iv. Nearly all (less than half pills/bottle remaining)
   v. All of the pills/The full bottle
   vi. More than the entire initially prescribed amount (we got a refill)

6. For how many days (including the day of their surgery) did your child take their prescription opioid pain medication?
   If you know the exact number of days, please provide that number: ___________
   If you are unable to remember the exact number, please choose from the following:
   i. 0 days (not used)
   ii. 1-3 days
   iii. 4-7 days
   iv. More than 1 week

7. Where did you store the opioid pain medication in your home?
   a. On a counter
   b. In an unlocked closet, cabinet, or drawer
   c. In a purse, backpack, or other carrier
   d. In a locked box, closet, cabinet, or drawer
   e. Other (please describe): __________________

8. Did you have any medication leftover from your child’s prescription after they stopped taking it?
   a. Yes
   b. No (skip to #15)

9. Did you get rid of the leftover opioid pain medication? (answered only if #8 was answered “Yes”)
   a. Yes (skip to #11)
   b. No
10. Please get the opioid medication bottle to look at it. If it is a liquid, hold it up to the light and estimate how much is left. If tablets, dump them onto a flat surface and count how many are left. (answered only if #8 was answered “Yes” and #9 was answered “No”. Then after this question skip to #12)
   i. None
   ii. Less than half the pills/bottle (if liquid formulation)
   iii. About half of the pills/bottle
   iv. Nearly all (less than half the pills/bottle remaining)
   v. All of the pills/The full bottle

11. Please estimate how much of the medication you disposed of (answered only if #8 was answered “Yes” and #9 was answered “Yes”):
   i. None
   ii. Less than half the pills/bottle (if liquid formulation)
   iii. About half of the pills/bottle
   iv. Nearly all (less than half the pills/bottle remaining)
   v. All of the pills/The full bottle

12. Which statement best describes why you haven’t disposed of the leftover opioid pain medication? (Choose all that apply) (answered only if #9 was answered “No”)
   a. It’s inconvenient
   b. I’m not sure how to get rid of it
   c. I want to keep it in case my child needs it later
   d. I want to keep it in case someone else in my household needs it later
   e. I wasn’t told how to dispose of it
   f. I plan to dispose of it, I just haven’t gotten around to it

13. Which statement best describes how you [disposed of the leftover opioid pain medication]/ [plan to dispose of the leftover opioid pain medication]? (Answered only by participants who answered ‘Yes’ to #9 or “I plan to dispose of it, I just haven’t gotten around to it” to #12. The first phrase in brackets appears for the first group and the second phrase for the second group.)
   a. Flush it down the toilet/sink
   b. Throw it away in the trash as is
   c. Throw it away in the trash after combining with kitty litter, used coffee grounds, or similar substance
   d. Throw it away using a drug deactivation bag or powder
   e. Take it to a drug take back drive
   f. Take it to a law enforcement agency
   g. Take it to an authorized pharmacy
   h. I don’t know
   i. Other (please describe): _________________________

14. Why did you choose this method of disposal? (Select all that apply) (Answered only by participants who answered ‘Yes’ to #9 or “I plan to dispose of it, I just haven’t gotten around to it” to #12.)
   a. I think it’s the safest method
   b. I think it’s the most convenient method
   c. It’s the only method I know of
   d. I’ve used this method before
   e. Other (Please describe): _________________________

15. Has your child taken any of the following medications for pain after their surgery? (Select all that apply)
   a. Aspirin
   b. Ibuprofen (i.e. Advil, Motrin)
   c. Acetaminophen (i.e. Tylenol)
   d. Naproxen (i.e. Aleve)
   e. None of the above
16. Which of the following describes how your child has taken this other pain medication most of the time?  
   (answered only if they answered a-d in #15)  
   a. Instead of opioid pain medication  
   b. Before taking opioid pain medication  
   c. At the same time as opioid pain medication  
   d. Alternating with opioid pain medication  
   e. Other (please describe): ____________________

The following four questions ask about the Deterra® Drug Deactivation System you received before discharge  
(These will be asked only of participants who received the Deterra® Drug Deactivation System).

17. On a scale of 0-10, where 0 means very inconvenient and 10 means very convenient, how convenient do you think the Deterra® Drug Deactivation System is for drug disposal?  
   0  1  2  3  4  5  6  7  8  9  10

18. On a scale of 0-10, where 0 means you will never use it and 10 means you would use it without hesitation, how likely would you be to use the Deterra® Drug Deactivation System for drug disposal if it were given to you again in the future?  
   0  1  2  3  4  5  6  7  8  9  10

19. Do you have any concerns with the Deterra® Drug Deactivation System?  
   a. Yes  
      Please describe your concerns:__________  
   b. No

20. Did you use the Deterra® Drug Deactivation System to dispose of any leftover medications in your home other than the medication just prescribed after your child’s recent surgery?  
   a. Yes  
      Name of disposed of medication:__________  
   b. No

21. Please share any comments or feedback you might have regarding your participation in this study: ________