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ISMP
An ECRI Affiliate

Acute Care
ISMP Medication Safety Alert!®
Educating the Healthcare Community About Safe Medication Practices

ISMP survey provides insights into preparation and admixture practices OUTSIDE the pharmacy

In our August 2020 ISMP ***Nurse AdviseERR*** newsletter (www.ismp.org/node/19769), we invited practitioners who prepare and/or admix sterile, injectable medications and/or infusions OUTSIDE the pharmacy to participate in a survey. The purpose of the survey was to learn about the frequency of preparing and admixing medications and/or infusions outside the pharmacy; the extent of implementing safe preparation and admixture practices; the training associated with medication preparation and admixture; the occurrence of preparation and admixture errors; and the perceived safety challenges associated with medication and/or infusion preparation and admixture. A description of the survey findings follows.

Respondent Profile

ISMP thanks the 444 practitioners who participated in our survey, providing us with an in-depth look at current sterile, injectable medication and/or infusion preparation and admixture practices outside the pharmacy. Most survey respondents were nurses (77%, including advanced practice nurses) and anesthesia providers (8% certified registered nurse anesthetists and anesthesiologists). The remaining respondents (15%) included decentralized pharmacists or technicians who prepare and admix medications and/or infusions in clinical areas, as well as physicians, supervisors, and others.

Most (81%) survey respondents worked in an acute care or specialty hospital while others worked in an ambulatory surgery center (5%), ambulatory infusion center (3%), physician practice setting or clinic (3%), or long-term care facility (1%). The remaining respondents (7%) described a variety of other work settings such as a critical access hospital, home health organization, emergency medical services provider, freestanding emergency department, infirmary, or outpatient dialysis center. The clinical setting in which respondents worked was also diverse, with most reporting adult medical-surgical (28%), adult critical care (14%), perioperative (13%), and emergency (13%) settings. Seven percent of respondents reported their clinical setting as outpatient; 6% worked in labor and delivery; 5% worked in pediatric settings; and 3% worked in oncology settings. Most (11%) of the remaining respondents reported working in multiple clinical settings or a highly specialized clinical setting (e.g., cardiac catheterization, interventional radiology, hyperbaric chamber, hemodialysis).

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Table 1. Frequency of preparing/admixing sterile, injectable medications/infusions outside the pharmacy

Sterile, Injectable Medications and Infusions	Frequency (% of Responses)			
	Never/ Rarely	Some-times	Often	Always
IV push medications	17	25	34	24
IV intermittent infusions	28	19	31	22
IM injection medications	38	23	20	19
IV continuous infusions/titrations	52	20	14	14
Epidural/neuraxial injections/infusions	88	5	5	2

Key: Never/Rarely = 0 to 10% of the time; **Sometimes** = 11 to 50% of the time; **Often** = 51 to 95% of the time; **Always** = more than 95% of the time

SAFETY briefs

HIGH-ALERT

Warning regarding strength listed on oxytocin vials. Several oxytocin 10-fold dosing errors occurred at a hospital recently, due in part to a pharmacy technician's misunderstanding of the product strength listed on the vial label. The technician meant to compound oxytocin 30 units in 500 mL of normal saline. However, she accidentally used three 10 mL vials (10 units per mL) instead of three 1 mL vials (10 units per mL). This resulted in a final concentration of 300 units per 500 mL instead of 30 units per 500 mL. Similar to the 1 mL vial, the 10 mL vial label reads, "10 USP Units/mL," with the total volume in the container (10 mL) located at the bottom of the label (**Figure 1**). The technician thought this meant the 10 mL vial held 10 units in total. The infusions were administered to several patients. Fortunately, the reporter who told us about these errors said none of the patients were harmed.

Both oxytocin vials are manufactured by Fresenius Kabi, which also manufactures a

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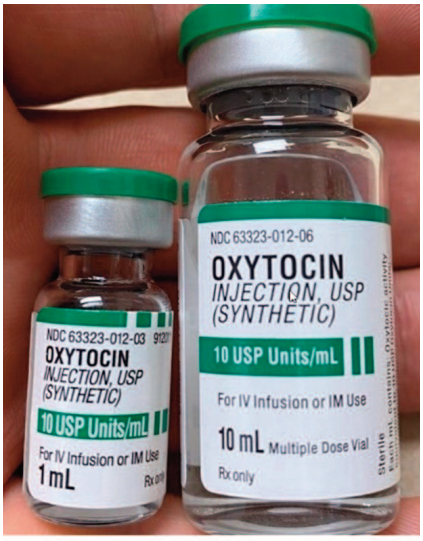

Figure 1. Fresenius Kabi's 1 mL and 10 mL oxytocin vials are labeled identically as 10 USP Units/mL. The 10 mL vial does not prominently express the total amount of drug per total volume in the vial. There is also a 30 mL vial (not pictured) that is similarly labeled.

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Type and Frequency of Preparation and Admixture

Respondents reported that the types of sterile injectables most frequently prepared outside the pharmacy (**Table 1**, page 1) were:

- Intravenous (IV) push medications, mostly medications transferred from vials to syringes (e.g., opioids, antiemetics, antibiotics, proton pump inhibitors)
- IV intermittent infusions, mostly minibag diluent containers with integral vial adaptors (e.g., MINI-BAG Plus)
- Intramuscular (IM) injections, mostly vaccines, antipsychotics, and antibiotics (e.g., cef**TRIAX**one)

More than a quarter (28%) of respondents also reported *often* or *always* admixing IV continuous infusions or titrations, particularly insulin, vasopressors, or lifesaving drug infusions required during emergencies. An additional 20% of respondents reported *sometimes* admixing IV continuous infusions or titrations. Most (88%) respondents reported *rarely* or *never* preparing or admixing epidural/neuraxial injections or infusions outside the pharmacy. Respondents who reported *always* or *often* preparing or admixing epidural/neuraxial injections or infusions (7%, n = 32) were mostly anesthesia providers, advanced practice nurses, and pharmacists, although more than one-quarter (n = 9) of those respondents were nurses.

Preparation and Admixture Practices and Training

When respondents were asked about their agreement or disagreement with five best practices associated with preparing or admixing sterile, injectable medications and/or infusions outside the pharmacy (**Table 2**), preparing or admixing one medication/infusion at a time generated the highest level of agreement, with 84% of respondents *agreeing* or *strongly agreeing*. Establishing standard processes for preparation, admixture, and labeling generated moderate agreement; however, fewer respondents *strongly agree* that these procedures are being followed. More than half (53%) of all respondents *disagree* or *strongly disagree* that their organization requires practitioners who prepare

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Table 2. Percent of agreement or disagreement with best practices

Best Practice	Responses (Percent)				
	Strongly Disagree ⟷ Strongly Agree				
	1	2	3	4	5
Practitioners prepare or admix one sterile, injectable medication and/or infusion at a time	3	4	9	18	66
My organization has established a standard process for labeling sterile, injectable medications and/or infusions prepared or admixed outside the pharmacy	3	7	12	19	59
This labeling process is followed (answered by respondents who selected 3 or higher)	2	5	27	32	34
My organization has established standard procedures for preparation and admixture of sterile, injectable medications and/or infusions prepared outside the pharmacy	10	6	18	25	41
These admixing procedures are followed (answered by respondents who selected 3 or higher)	0	2	27	35	36
I have been formally trained to prepare and admix sterile, injectable medications and/or infusions outside the pharmacy, and my competency for these tasks is assessed and verified annually	33	16	17	11	23
My organization requires practitioners who prepare and admix sterile, injectable medications and/or infusions outside the pharmacy to undergo formal training and an annual competency assessment and verification	34	19	17	12	18

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30 mL oxytocin vial with similar labeling issues. Fresenius Kabi is in the process of updating the labels on all vials to meet USP <7> labeling requirements to express the total amount of drug per total volume in the container as the primary designation. The 10 mL vial should read, "100 units/10 mL," followed by the amount per mL (10 units/mL) in parentheses, and the 30 mL vial should be labeled, "300 units/30 mL (10 units/mL)."

While this error happened in part due to the way the concentration was listed on the vial label, it is also interesting to note that the reporter told us that barcode scanning was used but did not intercept the error. The system only confirmed that enough of the right drug was available for compounding the intravenous (IV) infusion; however, the system did not alert the practitioner that there was too much product. Thus, the system allowed either 1 mL or 10 mL vials to be accepted for the compounding recipe. It is unclear if the compounding technician was required to scan all three 10 mL vials used. The hospital also reported that its compounding recipe stated to use "three vials" but did not clarify the vial size and amount to use until later. Furthermore, the pharmacists checking the compounded products failed to catch the errors, which likely would have been evident even with the error-prone "syringe pull-back" method of verification.

ISMP published a review of errors associated with oxytocin use in our February 13, 2020 newsletter (www.ismp.org/node/14240). In the article, we recommended conducting an assessment of medication vials and premixed infusion bags prior to use (or purchase) to ensure they do not look similar to other vials or bags used in the facility and that the label is clear regarding the amount of drug per total volume. This process should occur even for a drug that is used temporarily during a drug shortage or for another reason. IV oxytocin is commonly used during antepartum care to induce, stimulate, or reinforce labor and as an adjunct in the management of incomplete or inevitable abortion. It is also used during postpartum care to produce uterine contractions during expulsion of the placenta and to control bleeding. Improper administration of oxytocin can cause hyperstimulation of the

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or admix sterile, injectable medications and/or infusions to undergo formal training. Similarly, almost half (49%) of respondents *disagree* or *strongly disagree* that they have been formally trained for this important and complex task.

Half (50%) of respondents reported learning how to perform sterile, injectable medication and/or infusion preparation and admixture tasks during their professional training or residency program. Only 16% of respondents said they had received "on the job" training during orientation; however, 32% reported no formal training or annual competencies at all for these tasks.

Selecting among all applicable choices, most respondents reported preparing and admixing medications and/or infusions in an area dedicated for this purpose, such as a medication room (71%), segregated area designated for mixing sterile ingredients (25%), anesthesia workstation (18%), or in a laminar airflow hood located outside the pharmacy (4%). However, less ideal locations for preparation and admixture were also reported, including at the bedside (37%), on a counter or desk in the nursing station (28%), and on a computer workstation (16%). Eight percent of respondents reported preparing and/or admixing medications in the operating/procedure room, patient's home, ambulance, or elsewhere.

Only 35% of respondents are required to have another practitioner independently double check that certain medications or infusions have been prepared properly outside the pharmacy prior to administration. Among these respondents, 30% reported that all high-alert medications require an independent double check, while another 44% indicated

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Table 3. Biggest safety challenges with the preparation/admixture of sterile, injectable medications/infusions outside of the pharmacy (n = 281 respondents)

Challenge	Percent of Comments*	Description
Rushing, especially during emergencies	20	Ill-prepared for emergencies in a fast-paced, stressful environment; constantly rushing through the preparation/admixture process
Interruptions/distractions	16	Constant interruptions that cause lack of focus; frequent multitasking
Accuracy	14	Incorrect drug (look-alike vials), concentration, dose, diluent, or diluent volume; incompatibilities
Sterility	12	Sterility of preparation area, preparation/admixture process, and end product
Unsafe practice habits	9	Procedural deviations, including use of 0.9% sodium chloride flush syringes to dilute/reconstitute IV push medications and removing medications from syringe cartridges
Lack of training and experience	9	No formal education or competency verification; lack of training by experts; unfamiliarity with standard processes
Labeling issues	8	Lack of proper and complete labeling; lack of labeling guidelines; poor access to labels
Lack of standard preparation/admixture processes	6	Absent, unclear, incomplete, or wrong preparation/admixture processes; reliance on package insert
Independent double check failures	6	Inability to obtain an independent double check due to staffing constraints, emergencies; lack of procedures requiring critical independent double checks
Environmental concerns	5	Lack of space; poor lighting; noisy environment; clutter
Lack of pharmacy coverage	5	No coverage 24/7; lack of pharmacy presence in the perioperative setting; inadequate pharmacy staffing to prepare and dispense ready-to-administer products
Lack of needed medications, diluents, devices	5	Unavailable needles, filter needles, Carpuject holders, transfer devices; shortages of diluents (e.g., normal saline); drug shortages

**More than one challenge might have been reported per respondent*

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uterus, which can result in fetal distress, uterine rupture, and the need for an emergency cesarean section.

Topical thrombin given systemically during bypass surgery. A patient undergoing cardiac surgery received **RECOTHROM** (thrombin topical [recombinant]) systemically instead of **THROMBATE III** (antithrombin III [human]). Thrombate III may be used via a cardiopulmonary bypass machine for patients who are identified as being heparin resistant. The drug is administered to potentiate the heparin effect to meet predetermined activated clotting time (ACT) thresholds and allow for cardiopulmonary bypass (www.ismp.org/ext/566). The error happened when the perfusionist typed "T-H-R-O-M" into the automated dispensing cabinet (ADC) to obtain the desired drug, Thrombate III. However, topical thrombin (Recothrom) was displayed on the screen as an option, which the perfusionist selected in error.

The perfusionist removed Recothrom from the ADC, reconstituted it using a Luer syringe and a Luer transfer device provided inside the Recothrom carton, drew up the reconstituted drug, then connected the syringe to an injection port on the bypass machine and administered it. The perfusionist began to monitor the patient's ACT and noticed that it was not prolonging, so another dose of Recothrom, not antithrombin, was administered via the bypass machine. Still, the ACT was not prolonging, so the perfusionist called another perfusionist into the room. The second perfusionist saw the box labeled thrombin and immediately recognized the error. The surgical team was notified, and the patient then needed 11 vials of antithrombin III to reverse the effects of the systemically administered topical thrombin. The patient was also anticoagulated with heparin and thankfully did well, experiencing no adverse effects from the error.

Steps need to be taken to assure that topical thrombin is never administered systemically. It is only for topical hemostasis by application to the surface of bleeding tissues. The above patient was fortunate that the surgical team was able to act quickly and successfully to reverse its effects. Accidental systemic use can lead to extensive intravascular clotting and death. Our January 12, 2017, issue

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that only certain high-alert medications (e.g., vasoactive agents, oxytocin, insulin, opioids, thrombolytics) require such checks. However, it is likely the types of medications or infusions requiring an independent double check is dependent upon the types of medications prepared or admixed outside of the pharmacy in any given organization. Furthermore, it was not clear from the survey results whether independent double checks for admixtures occurred before a medication was added to a diluent, as it should be required in a pharmacy, or much later at the bedside.

Preparation and Admixture Errors

Almost one-third (31%) of respondents were aware of or personally experienced errors when preparing or admixing sterile, injectable medications and/or infusions during the past 12 months. Among all respondents, 69% were unaware or uncertain whether an error had occurred. Since the practitioner preparing the medication or solution is often the one administering it, the detection of an error is less likely, especially given the low rate of independent double checks noted by respondents. Most respondents who reported awareness of an error reported various types of errors, including:

- Use of an expired drug (or not administering the medication/infusion immediately after preparation) (90%)
- Use of the wrong drug, dose, concentration, diluent, or diluent volume (82%)
- No label or labeling error (81%)
- Wrong preparation technique (e.g., improper use of multiple-dose vials, not using a filter needle) (80%)

Numerous respondents also mentioned the failure to activate minibags with integral vial adaptors as an error type, leading to the administration of just the diluent without the drug.

The most common errors that were personally experienced included wrong preparation technique (21%); incorrect diluent/diluent volume (20%); incorrect dose/concentration/volume (19%); and no label/labeling error (19%).

Biggest Safety Challenges

ISMP received comments from 281 survey respondents when asked about the biggest safety challenge they face related to preparation and admixture of sterile, injectable medications and/or infusions outside of the pharmacy. We have aggregated almost all of the comments into various categories and presented the most common in **Table 3** (page 3). While the reported challenges were diverse, the most frequently cited challenge was rushing through the preparation or admixture process, especially during emergencies requiring lifesaving, high-alert medications. Many respondents reported feeling ill-prepared to follow processes designed for routine situations under critical, time-sensitive conditions. Numerous respondents noted that, when rushed, the admixture process was often completed by memory, without time to reference standard procedures. Many respondents reported they also worry about the sterility of the preparation area, admixture process, and the end product.

Interruptions, distractions, and concerns about the accuracy of the final product were also frequently mentioned as challenges, especially when more than one vial or a partial vial was needed or when admixing high-concentration infusions. Along with a lack of training and experience, unsafe practices like using flush syringes to dilute or reconstitute IV push medications were also cited as safety challenges. Of note, several respondents commented that they were worried about unfamiliarity with the process when the rare lifesaving task of preparation and admixture is required. Additional challenges were mentioned related to labeling issues; lack of standard preparation and admixture processes; independent double check failures; environmental concerns; lack of pharmacy coverage; and lack of needed medications, diluents, and equipment.

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(www.ismp.org/node/234) reviewed other errors with topical thrombin.

Part of the problem is that "thrombin" appears in both drug names. Perhaps if the names of these products were listed in the electronic health record (EHR) and the ADC only as "topical thrombin" and "antithrombin III," it would promote proper drug identification, making selection errors less likely. Aside from the name similarity, both Recothrom and Thrombate III are available in cartons and require reconstitution. In the hospital where this error occurred, independent double checks were not required, and there was no special training of perfusionists regarding medication handling. Either of these safety processes would make this error less likely. So this hospital is now adding medication administration training for new perfusion staff, standardizing workflows, and adding an independent double check for certain medications, including these products, in the operating room (OR). Also, the topical thrombin product is being removed from the ADC in the OR and will be stored in a different location.

It should be noted that the carton of the Recothrom product used at the above hospital contains Luer syringes and a Luer transfer device (**Figure 1**). **THROMBIN-JMI** (thrombin topical [bovine]), which was also available at the hospital but is bovine-derived

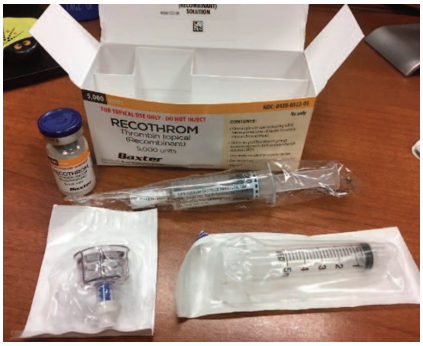

Figure 1. Recothrom carton contents include a Luer prefilled syringe with normal saline, an empty Luer syringe, and a Luer transfer device.

and not recombinant, does not have Luer devices in the carton (**Figure 2**, page 5). Instead, the carton includes a Mix2Vial, a needleless reconstitution system for vial-to-vial transfer. The Recothrom vial-and-syringe packaging might mislead a practitioner to believe it is a parenteral product. Still, with either topical thrombin product, a Luer syringe with a needle could be used

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Summary

Although a great deal of emphasis has been placed on the safety and quality of preparing and admixing compounded sterile preparations in the pharmacy, the preparation and admixture of sterile, injectable medications or infusions outside the pharmacy occurs frequently, particularly for IV push medications, IV intermittent infusions, and IM injections. Almost half of the survey respondents admix IV continuous infusions and titrations more than 10% of the time, often involving high-alert medications that can result in serious patient harm if errors occur. Eighty-one percent of respondents report that preparation and admixture occur in less than ideal locations such as the bedside, the counter in a nursing station, or on a computer workstation. Only about one-third of survey respondents reported their institution requires an independent double check of certain sterile, injectable medications and/or infusions that have been prepared or admixed outside of the pharmacy.

Most survey respondents report their organization has established standard processes for preparing, admixing, and labeling of sterile injectables and/or infusions outside of pharmacy; however, they also report lower confidence with staff following these processes, especially during emergencies when human memory is relied upon.

Staff training for preparation and/or admixture of sterile, injectable medications and/or infusions is a significant challenge, with about half of the survey respondents reporting no formal training, which was often not required by their organizations. Almost one-third of respondents reported no formal training or annual competencies at all, and another 16% reported "on the job" training only during orientation, which may have occurred years ago. The lack of formal training was also listed as the biggest challenge by 9% of respondents.

Almost one-third of survey respondents were aware of or personally experienced an error during preparation and/or admixture of injectable medications and/or solutions in the past 12 months. Most of the known errors were associated with the accuracy of the final product, which could result in patient harm.

The biggest safety challenges cited by respondents were rushing through the preparation/admixture process, especially during emergencies, completing preparation/admixture by memory, interruptions and distractions, and concerns about sterility and accuracy.

AORN SAFE SURGERY TOGETHER

Join ISMP as we celebrate **Perioperative Nurses Week** from **November 8th** through **November 14th**! Our well-deserved recognition of perioperative nurses and their ongoing commitment to patients comes during a heroic time in the midst of a pandemic that has equally challenged and rewarded all essential healthcare workers. For details about the celebration, visit: www.ismp.org/ext/575. While we are on the subject of "perioperative," look for the ***ISMP Medication Safety Self Assessment for Perioperative Settings*** early next year! We have moved the launch of the assessment from November 2020 to early 2021 after the holidays. Details will be provided in the next newsletter.

If you would like to subscribe to this newsletter, visit: www.ismp.org/node/10

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ISMP Medication *Safety Alert!* Acute Care (ISSN 1550-6312)

Report medication and vaccine errors to ISMP: Call 1-800-FAIL-SAF(E), or visit our website at: www.ismp.org/report-medication-error. ISMP guarantees the confidentiality of information received and respects the reporters' wishes regarding the level of detail included in publications.

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with the vials, thus allowing connection to a bypass machine injection port. An auxiliary label applied to prepared syringes to warn against intravenous injection may be helpful. All the vials we examined are marked "Do Not Inject," but that is not reliable itself to prevent this type of error.

Figure 2. The contents of Thrombin-JMI carton include a non-Luer transfer device.

Special Announcements

FREE smart pump webinar

Learn to identify and address safety gaps in medication delivery through utilization of the ***ISMP Guidelines for Optimizing Safe Implementation and Use of Smart Infusion Pumps***. Tune into the FREE webinar, ***Optimizing the Safety of Smart Infusion Pumps***, on **November 12, 2020**, at 11:00 a.m. ET to hear how other organizations have identified opportunities for improvement and have leveraged the guidelines to improve performance. This educational webinar is being hosted by ICU Medical. To register, please visit: www.ismp.org/ext/569.

ECRI and ISMP Medication Safety Membership

The launch of the **ECRI and ISMP Medication Safety Membership** creates the leading, comprehensive solution to proactively mitigate medication risks. Driven by data and expertise from ISMP, this membership provides actionable guidance and practical strategies for anyone involved in managing risk or medications. Expert research and advice address a wide range of risk factors—including automated dispensing cabinets, high-alert medications, and medication order processes. To learn more about this membership program, visit: www.ismp.org/ext/570.

BUILDING BRIDGES TO SAFETY

ISMP 23RD ANNUAL CHEERS AWARDS

Join ISMP on Tuesday evening, **December 8, 2020**, at 6:00 p.m. ET for the 23rd Annual **CHEERS AWARDS**. Attendance is **FREE** this year, as the event will be virtual to ensure the health and safety of all! **To register for the virtual event, please visit:** www.ismp.org/node/18425.

This year's theme is "**Building Bridges to Safety**." During the virtual event, ISMP will be honoring six individuals and organizations that have set the standard for excellence for others to follow by finding innovative ways to span the gaps in their ongoing quest to promote safe medication practices.

We will also be presenting the **ISMP Lifetime Achievement Award** to an exceptional medication safety pioneer.

Lifetime Achievement Award Winner
David Cousins, MSc, MRPharmS, PhD

Dr. David Cousins has tirelessly pursued a medication safety agenda throughout his lifetime, sowing the seeds and then successfully developing a medication safety policy agenda in England that has since been modeled around the world. He is best known for his leading role in the former National Patient Safety Agency in England where he introduced a national reporting program. For many healthcare practitioners starting out in their careers today, error reporting and medication safety are accepted as part of routine practice, but they may not be aware of how Dr. Cousins helped shape this agenda and how difficult it has been at times to promote such a sensitive and contentious issue.

ISMP Virtual Activities during the 2020 ASHP Midyear Meeting

Workshop *(preregistration required)*

Thursday, December 3 & Friday, December 4

- **ISMP Medication Safety Intensive (MSI) Workshop**
  To register, visit: www.ismp.org/node/13788

ASHP Educational Sessions with ISMP Speakers

Tuesday, December 8

- **When Your Technology and Safety Solutions Collide**
  10:00 a.m. – 11:15 a.m.

- **Let the Data Do the Talking:**
  Looking for Signals in Technology Data to Improve Safety
  5:00 p.m. – 6:15 p.m.

On-Demand

- **ISMP Medication Safety Update for 2021**

- **Safe Practices for Drug Allergies:**
  Using Decision Support and Health Information Technology

Please consider supporting this year's FREE CHEERS AWARDS event with a nominal donation

Your donation to our nonprofit organization helps ensure the future of the **CHEERS AWARDS** and allows ISMP to continue its lifesaving work in preventing medication errors. All donors associated with our **CHEERS AWARDS** will receive special recognition in ISMP's many communication avenues, including publications and social media.

To make a tax-deductible donation and/or register for the FREE virtual CHEERS AWARDS event, please visit: www.ismp.org/node/18425.

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