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RESEARCH

Evaluation of temperature excursions from USP <659> recommendations during mail transit

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ABSTRACT

Background: Patients use mail delivery as a convenient alternative to acquiring medications in person. Federal laws require nonspecialty oral medications to be stored at controlled room temperature during distribution; however, no laws or regulations govern temperature requirements for medication transport among patients, which may expose medications to harmful temperature excursions.

Objective: The purpose of this study was to evaluate temperature excursions during mail transit based on the shipment method, carrier, and season.

Methods: This prospective study monitored temperature fluctuations during simulated mail transit between New Jersey, California, and Tennessee over winter (December 2019–February 2020) and summer (August–September 2020) time frames. Packages with data-logging thermometers were shipped to 3 U.S. destinations via 3 common mail carriers and 2 popular shipping methods. Three packages were mailed for each combination of season, carrier, and shipping method, representing 36 individual packages. The primary end point was percent of transit time out of range (OOR) based on the United States Pharmacopeia <659> recommended range, 68°F to 77°F. Additional end points include package transit durations and extreme temperatures.

Results: Evaluated packages spent an average of 68.3% of transit time OOR. In winter, 3-day and next business day packages spent similar time OOR (80.1% vs. 78%). In summer, 3-day packages spent more time OOR compared with next business day shipping (43.1% vs. 13.6%). Mean transit time was statistically significantly longer for 3-day packages (406.6 hours vs. 303.1 hours; $P < 0.0001$). Mean winter transit time was statistically significantly longer than summer (475.7 hours vs. 233.9 hours; $P < 0.001$) regardless of the shipping method. The minimum and maximum temperatures recorded were 5.1°F and 102.3°F, respectively.

Conclusion: Package temperatures were outside of the recommended range for most of the transit time regardless of the shipping method, carrier, or season.

Background

Mail delivery is a common method used by patients to procure medications. Mail-order pharmacies alone compose a substantial portion of the pharmacy market and have expanded from 21% to 37% in community pharmacy sales between 2007 and 2017.[1] This likely underestimates the prevalence of total mailed medications because it does not account for ship-to-home services from community pharmacies or personal shipments between patients. Pharmacy services via mail delivery provide the convenience of having medications sent directly to patients. Many health plans provide incentives to use these services, such as lower copayments or larger

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Key Points

Background:

- Mail delivery of medications is commonly used by patients as a convenient alternative to in-person pharmacy services. The coronavirus disease 2019 pandemic has accelerated the growth of digital services, including mail delivery of medications and point-of-care testing.
- Federal laws and regulations require nonspecialty oral medications to be stored at controlled room temperature during transport among manufacturers, wholesalers, and pharmacies but do not establish temperature requirements for medication transport from pharmacies to patients and among patients.
- Medications may be exposed to harmful temperature excursions, compromising medication integrity and drug potency.

Findings:

- Mailed packages spent a substantial percent of transit time outside of the United States Pharmacopeia–recommended temperature range for medication storage.
- Temperature extremes occurred in both directions regardless of the shipping method, carrier, or season.

supplies of medications dispensed.[2] Patients with part-time residences, such as college students or retired persons, may prefer maintaining their community pharmacy and having an individual mail forward their packages. In addition, studies have shown improved cholesterol control in new statin users and lower total medical costs in oral diabetes medication users in patients who use mail delivery services.[3,4] These convenient alternatives to in-person pharmacy visits may lead to positive clinical outcomes by improving access to medications and increasing patients' medication adherence.[5]

The coronavirus disease 2019 global pandemic has additionally increased the demand for digital alternatives to routine in-person services. In 2020, mail package volume in the United States increased by 32% compared with 2019 as a result of stay-at-home mandates for the majority of the year.[6] This further catalyzed the expansion of mail deliveries, including medications and point-of-care testing (POCT). In early 2022, the U.S. federal government relied on the U.S. Postal Service to distribute nearly 275 million at-home coronavirus disease 2019 test kits, which required storage between 35.6°F and 86°F to maintain reagent potency.[7-9]

Federal pharmacy laws and regulations require prescription drugs to be stored in accordance with the United States Pharmacopeia (USP) chapter <659> temperature conditions during distribution and transport among drug manufacturers, drug wholesalers, and pharmacies. For nonspecialty oral medications, controlled room temperature, defined as 68°F to 77°F, is required for storage.[10,11] USP <659> also describes an expanded temperature range of 59°F to 86°F to accommodate for mild excursions, given the mean temperature does not exceed 77°F; however, medication package inserts only recommend storage at controlled room temperature (68°F–77°F). Following these guidelines is essential to maintain the integrity of medications and prevent decreased drug potency, which can compromise medication efficacy and may lead to progression of disease.[12-14]

Current federal pharmacy laws do not govern temperature requirements for medication transport from pharmacies to patients and among patients. Previous studies on mail package temperatures have primarily focused on the associations between delivery distance or season and temperature changes.[15,16] With increased popularity of mailing medication packages and POCT devices, this study adds to the body of evidence by addressing the potential impact of various carrier conditions on temperature excursions during mail transport.

Objectives

The objective of this study was to evaluate temperature excursions during simulated mail transit based on shipping conditions such as the shipment method, carrier, and season.

Methods

Study design

This prospective study monitored temperature fluctuations during mail transit over 2 time frames: winter (December 2019–February 2020) and summer (August 2020–September 2020). Packages with digital, USB-compatible, data-logging thermometers were shipped to 3 U.S. destinations. The shipping destinations were identical for all packages, from New Jersey to California, then to Tennessee, and back to New Jersey, based on institutional affiliations and desired climate differences. Testo 184-T3 temperature data loggers were used to track temperature readings at 5-minute intervals throughout transit for each package.

Packages were shipped via 3 common mail carriers using 2 popular shipping methods to assess potential temperature fluctuations based on these factors. For consistency, shipping methods were categorized as "next business day" and "3-day" shipping, as all 3 carriers had different names for similar services. Reflecting the "Nested Doll Principle,"[17] each temperature data logger was placed in an envelope (inner), which was placed inside of another envelope (middle), and finally placed inside of a third envelope (outer). This principle was used in efforts to standardize the mailing process, as the affiliates could mail out the temperature loggers with minimal confusion. All envelopes had prepaid fixed shipping labels, which allowed for convenient receipt and transfer of envelopes to their next destination and consistent temperature monitoring throughout transit. Each affiliate would open the package on receipt and send out the inner package to the next destination until the conclusion of the study trip. Standard transit envelopes were used per carrier, and for those without standard packaging, a brown manila envelope was used. There was no insulation or padding in the envelopes, and no additional bubble wrap was used except the use of bubble mailers. Three packages were mailed out for each combination of season, carrier, and shipping method, for a total of 36 packages. The

Table 1
Temperature excursions and transit times

Season average transit time (h) (95% CI)	Shipping method	Carrier	No. of packages	Average transit time (h) (95% CI)	Average percent of time out of range (%)	Average percent of time above range (%)[a]	Average percent of time below range (%)[a]
Winter cohort 207.4 (188.3, 226.5)	3-d shipping	Group	9	268.0 (241.9, 294.2)	92.9	0.9	92.0
		Carrier A	3	221.8 (203.4, 240.1)	95.2	0.0	95.2
		Carrier B	3	380.2 (361.9, 398.5)	96.2	1.6	94.6
		Carrier C	3	202.2 (183.9, 220.5)	84.0	0.7	83.4
	Next business day	Group	8	146.8 (118.8, 174.7)	86.6	0.1	86.5
		Carrier A	3	155.4 (137.1, 173.7)	80.0	0.0	80.0
		Carrier B	2	159.3 (136.9, 181.7)	94.1	0.3	93.8
		Carrier C	3	129.3 (110.9, 147.6)	88.2	0.0	88.2
Summer cohort 156.7 (138.2, 175.2)	3-d shipping	Group	9	195.0 (168.9, 221.2)	68.3	68.3	0.0
		Carrier A	3	244.8 (226.5, 263.1)	65.0	65.0	0.0
		Carrier B	3	197.5 (179.2, 215.8)	90.5	90.5	0.0
		Carrier C	3	142.7 (124.4, 161.0)	43.2	43.2	0.0
	Next business day	Group	9	118.4 (92.3, 144.6)	29.8	18.1	11.6
		Carrier A	3	155.3 (137.0, 173.6)	17.6	6.0	11.7
		Carrier B	3	112.4 (94.1, 130.7)	42.2	29.1	13.2
		Carrier C	3	87.6 (69.3, 105.9)	35.3	25.6	9.7

[a] Percentages may not total "average percent of time out of range" due to rounding.

combinations were triplicated to account for variability, such as shipping delays, technological difficulties with the data loggers, and lost packages.

Once the packages arrived at each destination, the designated affiliates completed an electronic form to document the time of receipt, current ambient temperature, and any notable issues that could compromise results (e.g., tampered envelope, lost package, obvious exposure to water). Affiliates then removed the outer envelope and dropped off the package to the respective carrier's drop boxes or offices for transit to the next destination. At drop-off, the affiliates completed another electronic form to document the same information as the receipt form. The information from the electronic forms was cross-referenced with information received via carrier tracking updates to confirm that accurate starting and ending travel times were used in the analysis.

On final return to New Jersey, data were downloaded from the USB-compatible data loggers using Testo Comsoft Professional Pro software with data archiving. Data were exported to Microsoft Excel and parameters were set to only include temperature readings during times in which the package was in a mail carrier's possession, as confirmed by carrier tracking information. The intervals did not include time after carrier delivery (i.e., packages stored in mailbox or mailroom, left on porch) because these variables could be modified by the affiliates and this study aimed to focus only on transit within mail carriers' control. Data were reviewed to assess intervals in which the packages were outside of the recommended USP <659> temperature range, 68°F to 77°F. Data were evaluated against this range, as opposed to the expanded temperature range, to align with medication package insert storage recommendations. This research project was exempt from institutional review board review.

Data analysis

The primary end point was the percentage of transit time each package spent out of the USP <659> recommended range (68°F–77°F).The secondary end point was mean transit time. Exploratory end points described minimum and maximum temperatures during transit.

To control for obvious differences in transit time, data were normalized to represent the percent of package observations spent out of range (OOR). Temperature observations were recorded every 5 minutes; therefore, the total number of observations was used to estimate the total transit time. Thus, the number of observations spent OOR directly correlated to the percent of transit time spent OOR. Percent of transit time spent both above and below the recommended range was calculated similarly (Table 1).

Primary and secondary end points were assessed in terms of the independent influences of season, shipping method, and carrier. Because of the nested design of the experiment (i.e., packages among 3 carriers, within 2 shipping methods, each within 2 different seasons), a hierarchical analysis approached was used. When repeated observations are embedded within groups, there is a level of correlation within groups that must be considered. The influence of these effects within each group (and subgroup) can be classified as fixed or random effects.[18] The PROC Generalized Linear Model of SAS/STAT software (Version 15.1) was used to assess the effects of the season, shipping method, and carrier. Each factor was considered to be a fixed treatment effect. The proportions of time spent OOR and overall transit times were compared using least square means, and tests for differences between the least square means used paired *t* tests with Tukey's adjustment for each comparison. Ninety-five percent confidence intervals (CIs) were estimated for each mean value and for the calculated difference in means. Statistical significance was defined at *P* value less than or equal to 0.05. Described analyses were conducted using Microsoft Excel.

Results

A total of 36 packages were mailed in 2 batches representing both winter and summer seasons. Among the original

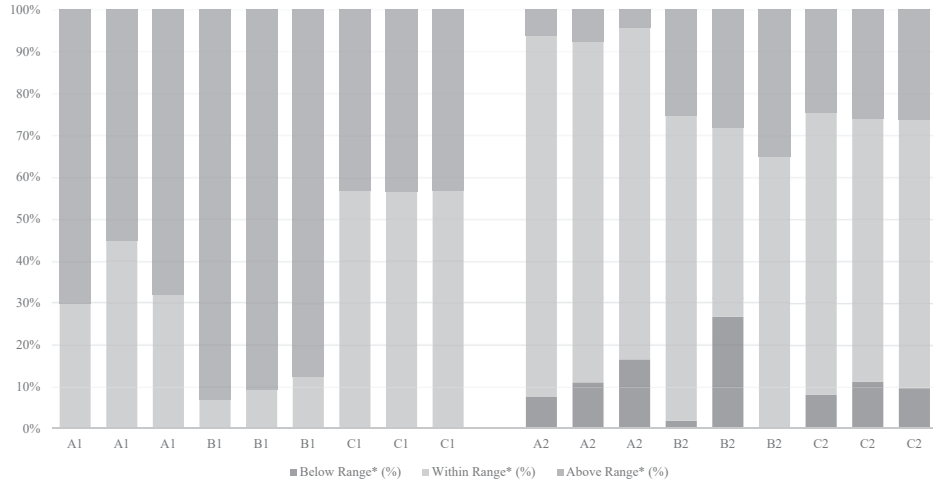

Figure 1. Percent out of range (summer cohort).*Range = 68°F–77°F. A, B, C refer to carriers; 1 indicates 3-day shipping; 2 indicates next business day shipping.

packages, 35 were included in statistical analysis (17 in winter and 18 in summer). One package in the winter, next business day shipping, carrier B was excluded from analysis because the device failed to record temperatures during transit. The 35 packages yielded a total of 76,874 temperature readings for analysis.

Percentage of time OOR

The 35 packages spent an average of 68.3% of time OOR. Packages were skewed toward a larger range with a median value of 80% of transit time OOR and range of 13.6% (Figure 1: summer cohort, next business day shipping, first A2) to 97.5% OOR (Figure 2: winter cohort, 3-day shipping, second B1).

In the winter cohort, 3-day shipping packages spent an average of 80.1% of transit time OOR. Next business day shipping packages spent 78% of transit time OOR. Twelve of the 17 packages (70.6%) shipped in the winter recorded OOR temperatures that were below range only.

In the summer cohort, 3-day shipping packages spent an average of 43.1% of transit time out of the recommended temperature range. Next business day shipping packages spent 13.6% of transit time out of temperature range. Ten of the 18 packages (55.6%) recorded OOR temperatures that were above the range only. Thirteen of 35 packages (37.1%) experienced temperature excursions that were both below and above the recommended range, regardless of shipping method (Appendix 1).

The mean percent of time OOR was higher for 3-day versus next business day shipping (78.9% vs. 57.0%; $P < 0.0001$) although both methods spent a majority of their transit time out of the recommended ranges. Packages in winter spent a higher percentage of time OOR compared with summer packages (89.7% vs. 48.3%; $P < 0.0001$). The percent OOR among the 3 carriers were variable ($P < 0.0001$, $P = 0.7064$, $P < 0.0001$).

Mean transit time

Table 1 describes the mean transit times for each of the packages. Mean transit times differed statistically significantly among the season, shipping method, and carriers as independent effects. Among the winter cohort, the mean transit times (95% CI) of 3-day and next day shipping were 268.0 (241.9–294.2) and 146.8 (118.8–174.7) hours, respectively. Among the summer cohort, the mean transit times (95% CI) of 3-day and next day shipping were 195.0 (168.9–221.2) and 118.4 (92.3–144.6) hours, respectively.

Overall, mean transit times were statistically significantly longer in winter than summer (207.4 hours vs. 156.7 hours, $P < 0.0001$), regardless of shipping method or carrier. When pooled across seasons and shipping methods, the mean transit times (95% CI) by carrier were as follows: carrier A 194.3 hours (171.1–216.9); carrier B 211.4 hours (187.6–235.3); and carrier C 140.4 hours (117.8–163.1). Paired *t* tests among the 3 carriers demonstrated that the average transit time for carrier C was statistically significantly less than carriers A and B. However, the mean transit times between carriers A and B were not statistically significantly different from each other.

Temperature extremes

The minimum and maximum temperatures in the winter cohort were 5.1°F and 96.4°F, respectively. Both extremes were recorded from 3-day shipping packages. The highest temperature reading in the winter cohort was 19.4°F above the upper limit of the accepted range. The minimum and maximum temperatures recorded in summer were 51.4°F and 102.3°F, respectively. The minimum temperature occurred in next business day shipping and the maximum temperature occurred in 3-day shipping. The lowest temperature reading in the summer was 15.9°F below the lower limit of the accepted range. Specific carriers had no statistical impact on minimum and maximum temperatures.

Discussion

Previous studies have focused on the independent associations between delivery distance or weather season and temperature changes.[15,16] Our results further add to this literature by describing the prevalence of temperature excursions in simulated mail packages with the multivariable

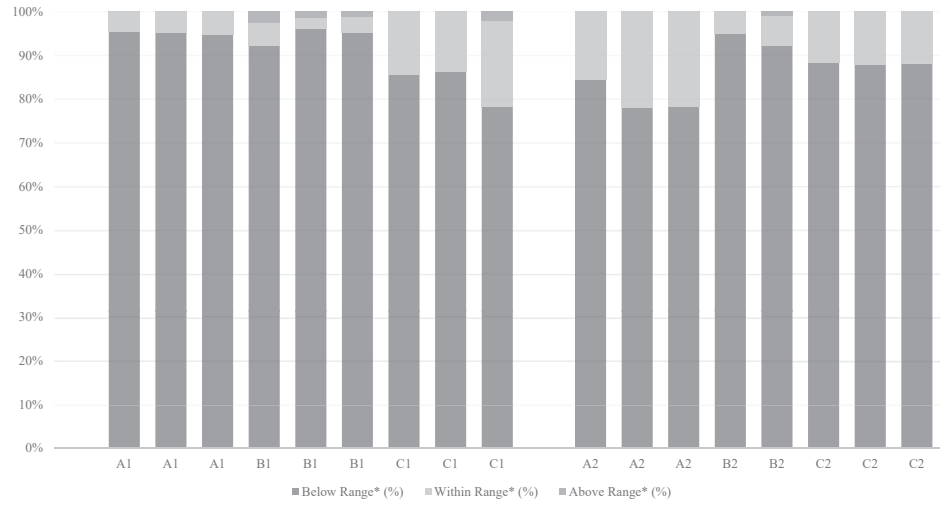

Figure 2. Percentage out of range (winter cohort).*Range = 68°F–77°F.A, B, C refer to carriers; 1 indicates 3-day shipping; 2 indicates next business day shipping.

influences of real-world practices (i.e., using 3 common mail carriers in the United States and 2 common delivery methods during opposite seasons). The results of this study revealed that packages exhibited temperature excursions regardless of the season, carrier, or shipping method. Each of these 3 independent variables was a statistically significant predictor of percent of transit time OOR, even when controlling for the influence of the other variables in a multivariable model. In both seasons, packages exceeded the recommended temperature range in high and low limits. These seemingly counterintuitive excursions may have resulted from the transport vehicles or storage spaces used throughout transit. Longer delivery routes had a greater number of data points, which may be assumed to result in a less statistically significant impact per temperature reading outside of the recommended temperature range. The carrier with the greatest mean transit time was different from the carrier with the highest percent of transit time spent OOR. This demonstrates the inability to correlate a package's overall travel time with the percent of time spent OOR. Therefore, expedited deliveries with shorter transit duration may not minimize temperature excursions. Regardless of the shipping method, carrier, or season, all packages experienced both temperature extremes, which should be considered when mailing medications.

Federal oversight of manufacturer, wholesaler, and pharmacy practices requires medication storage in adherence to USP <659> standards (68°F–77°F) within and among these parties. Mandatory inspections and routine surveillance practices exist to assess compliance with this temperature requirement. These include monitoring of temperatures during transit, insulating packages, and reporting potential excursions. In contrast, there are currently no regulations that require monitoring or reporting of storage conditions for nonspecialty oral medications after they leave the pharmacy. Because medications are formulated to remain stable within a specific temperature range, it is valuable to monitor the prevalence of temperature excursions across real-world conditions. The results of the study reveal that without federal oversight on adherence to temperature standards post-pharmacy, excursions commonly occur.

Many pharmacists are involved in direct patient care and have the opportunity to provide patient education on safe medication practices in retail and ambulatory care settings. If medications are exposed to temperature excursions outside the standards set by the USP, there is a possibility of medication instability to occur, as outlined by the package inserts of many nonspecialty oral medications. As such, pharmacists can play an important role in counseling patients on the possibility of their shipped medications being exposed to temperature excursions and extremes. During medication dispensing, pharmacists should review safe storage practices with patients, especially if there are plans for medications to be shipped. In addition, pharmacists should inform their patients to investigate the integrity of medications that have been shipped. Patients should examine medications to determine if they are stuck together or discolored, as that may be a sign that the medication's integrity may have been compromised owing to temperature excursions. If patients are concerned about shipping their medications or their medication's integrity, they should be advised to speak with their primary care providers or pharmacists to discuss next steps, which may include more frequent monitoring and the potential impact on clinical outcomes.

Limitations

Differences among carrier policies regarding specific packing requirements and materials used may have introduced systemic bias to the study. In addition, carrier variation in predetermined travel routes caused packages on the same route to be delivered at different times. Although the study investigators uniformly labeled the shipping methods as "next business day" and "3-day" for consistency in study definitions, slight variations may have existed in how specific carriers executed their services. Transit delays and rerouted packages also introduced variability in the total transit time among packages on the same route. For example, winter packages had longer transit times on average compared with summer packages, likely from delays secondary to inclement weather and high-volume holiday traffic. A thermometer from the

winter cohort (next business day, carrier B) failed to record temperature readings appropriately. This package was excluded from the analysis, which resulted in fewer total data points in the winter cohort. Because the focus of this study was temperature excursions during transit, it did not assess additional excursions that may result once a package was delivered to its destination and awaiting retrieval. This study evaluated temperature excursions when medications are transported across the United States, and as such, findings from this study may not apply to same-state shipping. Finally, this study was not designed to directly evaluate changes in molecular stability or potency, or damage to drug dosage forms (e.g., capsule degradation) as a result of temperature excursions.

Conclusion

When medications are mailed between residential addresses, keeping the packages within the recommended temperature range throughout, transit may be more difficult than the general public may realize. Study results established that packages spent a majority of transit time outside of USP-recommended temperatures regardless of the shipping method, carrier, or season. Counterintuitively, both temperature extremes (above and below the recommended range) were observed when shipping in the summer and winter seasons. Pharmacists should counsel patients about potential temperature excursions that may occur when mailing medications. Further studies are warranted to evaluate the impact of different packaging types on temperature variations and excursions during transit.

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References

1. Dabora MC, Turaga N, Schulman KA. Financing and distribution of pharmaceuticals in the United States. *JAMA*. 2017;318(1):21–22.
2. Schmittdiel JA, Marshall CJ, Wiley D, et al. Opportunities to encourage mail order pharmacy delivery service use for diabetes prescriptions: a qualitative study. *BMC Health Serv Res*. 2019;19(1):422.
3. Schmittdiel JA, Karter AJ, Dyer W, et al. The comparative effectiveness of mail order pharmacy use vs. local pharmacy use on LDL-C control in new statin users. *J Gen Intern Med*. 2011;26(12):1396–1402.
4. Devine S, Vlahiotis A, Sundar H. A comparison of diabetes medication adherence and healthcare costs in patients using mail order pharmacy and retail pharmacy. *J Med Econ*. 2010;13(2):203–211.
5. Fernandez EV, McDaniel JA, Carroll NV. Examination of the link between medication adherence and use of mail-order pharmacies in chronic disease states. *J Manag Care Spec Pharm*. 2016;22(11):1247–1259.
6. United States Government Accountability Office. United States postal service: volume, performance, and financial changes since the onset of the COVID-19 pandemic. Available at: www.gao.gov/products/gao-21-261. Accessed April 5, 2022.
7. Biden offers more free covid tests as demand has slowed. New York Times. Available at: www.nytimes.com/2022/03/08/us/politics/free-covid-tests-biden.html. Accessed April 5, 2022.
8. Food and Drug Administration. BinaxNOW COVID-19 antigen self test. Available at: www.fda.gov/media/147254/download#:~:text=Store%20kit%20between%2035.6%2D86. Accessed April 5, 2022.
9. Food and Drug Administration. QuickVue at-home COVID-19 test. Available at: www.fda.gov/media/146312/download. Accessed April 5, 2022.
10. Food and Drug Administration. CFR - Code of Federal Regulations Title 21. Available at: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=205.50. Accessed January 17, 2023.
11. United States Pharmacopeia. <659>Packaging and storage requirements. Available at: www.uspnf.com/sites/default/files/usp_pdf/EN/USPNF/revisions/659_rb_notice.pdf. Accessed February 20, 2020.
12. Sood J, Sapra B, Bhandari S, Jindal M, Tiwary AK. Understanding pharmaceutical polymorphic transformations I: influence of process variables and storage conditions. *Ther Deliv*. 2014;5(10):1123–1142.
13. Vimalavathini R, Gitanjali B. Effect of temperature on the potency & pharmacological action of insulin. *Indian J Med Res*. 2009;130(2):166–169.
14. McMullan JT, Jones E, Barnhart B, et al. Degradation of benzodiazepines after 120 days of EMS deployment. *Prehosp Emerg Care*. 2014;18(3):368–374.
15. American Society of Health-System Pharmacists. Mail-order medications often exposed to unsafe temperatures, study shows: drug effectiveness could be impacted by storage and transit conditions. Available at: https://www.ashp.org/news/2020/12/09/mail-order-medications-often-exposed-to-unsafe-temperatures-study-shows?loginreturnUrl=SSOCheckOnly. Accessed January 17, 2023.
16. Last mile shipping conditions and temperature excursion handling for room temperature pharma products in Europe. Pharmaceutical Outsourcing. Available at: www.pharmoutsourcing.com/Featured-Articles/353102-Last-Mile-Shipping-Conditions-and-Temperature-Excursion-Handling-for-Room-Temperature-Pharma-Products-in-Europe/. Accessed April 5, 2022.
17. Dimenstein I, Rapids G, Dimenstein SI. The nested doll principle of educational laboratory niche website design. *Am J Clin Pathol*. 2013;140(suppl 1):A232.
18. Littell RC, Millikin GA, Stroup WW, Wolfinger RD, Schabenbenger O. *SAS for Mixed Models*. 2nd ed. Cary, NC: SAS Institute Inc; 2006.

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