



Korean nurses' adherence to safety guidelines for chemotherapy administration

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ABSTRACT

Purpose: Nurses are at risk from handling chemotherapeutic agents. This study aimed to determine adherence to safety guidelines for chemotherapy administration by Korean nurses and to examine the relationship between the hospital safety climate and nurses' adherence to safety guidelines.

Method: A descriptive, correlational design with a cross-sectional survey using data from the Korea Nurses' Health Study. For this study, participants included 872 female nurses who had administered chemotherapeutic agents to patients in the last 30 days.

Results: Only a quarter of the participants had high adherence to the safety guidelines, while the majority had moderate to low adherence. The absence of job hindrances and feedback/training – two sub-factors of the hospital safety climate – enhanced the likeliness for nurses to comply with the safety guidelines by almost 1.3 and 1.7 times, respectively.

Conclusion: The results imply that the hospital safety climate, particularly feedback/training, and the absence of job hindrances are significantly correlated with adherence to the safety guidelines for chemotherapy administration. Therefore, organisational and policy support is needed to improve the hospital safety climate.

1. Introduction

Over the past several years, cancer has been the leading cause of death in Korea, and in 2017, 27.6% of the deaths were due to cancer (Statistics Korea, 2017). However, the 5-year relative survival rate over the period from 2011 to 2015 recorded 70.7%, with a continued upward tendency. It is estimated that more than 2 out of 3 people diagnosed with cancer survive over 5 years in Korea (National Cancer Information Center, 2018). Together with surgery and radiation therapy, chemotherapy is one of the main treatments for cancer. Today, patients are admitted for chemotherapy not only in oncology units but also in other general units. It was found that 26.6% of Korean hospital nurses had been exposed to chemotherapeutic agents (Kim et al., 2016) and nurses in the general wards frequently handle chemotherapeutic agents. In other words, nurses who are not trained to work in oncology units are now facing the burden of preparing and administering chemotherapy in general wards. Hence, there is a great need to fully consider the risk of nurses' handling chemotherapeutic agents.

Chemotherapy poses a potential health risk to health care providers, particularly to nurses who are often exposed to aerosols or droplets of drugs during the administration of chemotherapy. Accidental exposure may not be noticed and can occur in several ways, such as inhalation, dermal absorption, ingestion, and contact with conjunctiva (National Institutional for Occupational Safety and Health, NIOSH, 2004). Such exposure can result in adverse reproductive effects, including fetal defects, subfertility, and infertility (Connor et al., 2014). A study conducted through a partnership between the NIOSH and the Nurses' Health Study 2 reported that regular antineoplastic drug exposure for more than one hour a day was related to a twofold increased risk of spontaneous abortion, particularly before the 12th week, and a 3.5 times higher risk of spontaneous abortion among women with no previous pregnancies (<https://voice.ons.org/news-and-views/risk-of-miscarriage-is-increased-for-nurses-handling-chemotherapy>). It is highly important to understand these adverse reproductive effects since most nurses in Korea are females and in their childbearing years. Therefore, it is particularly important to prepare all nurses working in

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oncology and general units to safely handle chemotherapeutic agents (Kim et al., 2016).

The Korean Occupational Safety and Health Agency identified hazardous chemicals in the Health Care Manual for hospital workers in 2001 and published guidelines for management of chemotherapeutic drugs in 2006. Despite growing awareness of the negative effects of exposure to chemotherapeutic agents, nurses' exposure to chemotherapeutic agents in the workplace, and incomplete adherence to the safety guidelines, remains a major problem (Silver et al., 2016). Recent studies report that, even though the adherence to safety guidelines by Korean nurses is now improving, the management of situations where nurses are exposed to chemotherapeutic agents is still insufficient. Hospitals must establish organisation-wide safety guidelines on chemotherapeutic agent management, and better support the purchase of necessary personal protective equipment and tools (e.g. needless connector, luer lock connector, and luer lock syringe) (Yun and Park, 2016). Studies conducted abroad also report that appropriate levels of staff and resources at the hospital level reduce nurses' exposure to chemotherapeutic agents (Friese et al., 2012).

However, to date, most studies conducted with South Korean nurses on how to reduce the obstacles for nurses in the process of adherence to the safety guidelines have focused either on the identification of the impact of safety education (Chang et al., 2016) or knowledge about, and attitudes towards, chemotherapeutic agents (Jeong et al., 2015; Kim et al., 2016; Yun and Park, 2016). However, Gershon et al. (2000) found that employees' perceptions of hospital-level efforts to ensure safety in their work environments were significantly related to the employees' adherence to safety guidelines. This finding suggests that, in order to improve adherence to the standards of handling chemotherapeutic agents, organisations have to overcome the shortfalls in this area.

The workplace safety climate has been defined as participants' perceptions of their employer's commitment to the promotion of a safe working environment (Zohar, 1980). Work environments and organisational support has been shown to be associated with nurses' adherence to safety guidelines for chemotherapy administration in clinical oncology settings (Rozenbojm et al., 2015; Polovich and Martin, 2011). Positive employee perceptions of a safety climate that emphasises safety-related behaviours and safety adherence are associated with lower work-related occupational injuries (Cook et al., 2016).

Therefore, the purpose of this study was to examine the safe handling practice of chemotherapeutic agents by Korean nurses working in inpatient units and to examine the relationship between Korean nurses' perceptions of the hospital safety climate and adherence to the safety guidelines for handling chemotherapeutic agents.

2. Methods

This study is part of a larger study, the Korea Nurses' Health Study (KNHS), which is an ongoing prospective cohort study of Korean registered nurses initiated in 2013 (Kim et al., 2017). The KNHS was jointly conducted by the Korean Nurses Association and the Korea Centers for Disease Control and Prevention. The KNHS adopted the protocols and survey questions of the United States of America (U.S.) Nurses' Health Study 3, with minor changes to reflect cultural and organisational differences (Gaskins et al., 2015; Belanger et al., 1978). The KNHS 1 was open for nurses to participate from 2013 to 2015, and served as baseline data for the KNHS. The second phase of the study (KNHS 2), which started in 2016, was completed in 2018.

2.1. Participants

Participants in the KNHS 1 were female nurses working in hospitals, aged 20 to 45. These participants were also included in all follow-up surveys (Kim et al., 2017). Out of 6731 nurses who participated in both KNHS 1 and 2, 872 nurses who had performed treatments involving the

administration of chemotherapeutic agents to patients in the last 30 days from the date of survey were included in the analysis of data for this study.

2.2. Setting and data collection

Data for this study were collected across South Korea as part of the KNHS, over the period of November 7, 2016 to February 28, 2017. Nurses voluntarily participated in the survey via online and mobile platforms. Potential participants were informed about the survey through e-mails, text messages, and promotional posters.

2.3. Ethical considerations

The study was approved by the Institutional Review Board of the researcher's university (No. 117–4). Anonymity and confidentiality were assured, and the participants' informed consent was obtained as part of the online survey.

2.4. Measures

Demographic characteristics of the study participants were assessed by collecting information on age, education, recent usage of chemotherapeutic agents, years of nursing experience, geographical location, and hospital size. The exposure of nurses to chemotherapeutic agents was measured through two questions: "Have you administered chemotherapeutic agents to a patient in the last 30 days?" and "On average, how many times per week have you administered chemotherapeutic agents in the last 30 days?"

The Hospital Safety Climate Scale developed by Gershon et al. (2000) was used to measure the hospital safety climate. The questionnaire contains 20 items across 6 dimensions on the hospital safety climate. In this study, however, 17 questions were used after removing three questions; two HIV/AIDS related questions from the dimension of management support and one question about protection against HIV exposure from the feedback/training session. These questions on HIV were removed as few HIV/AIDS related occupational exposures have been reported in Korea (Lee et al., 2017). Six Hospital Safety Climate Scale dimensions were included as dependent variables: the availability of personal protective and engineering control equipment (2 items), management support (2 items), the absence of job hindrances (3 items), feedback/training (4 items), cleanliness/orderliness (3 items), and minimal conflict/good communication (3 items). The answers to each question were rated according to a 5-point Likert-type scale ranging from '1' = 'strongly disagree' to '5' = 'strongly agree.' Higher scores indicate that the nurses highly assess their organisation's commitment to safety. The original study's Cronbach's alpha value ranged from 0.71 to 0.84 for all subscales (Gershon et al., 2000), and in this study ranged from 0.74 to 0.90.

Questions related to adherence to safety guidelines for chemotherapeutic administration contained in the Nurses' Health Study 3 (NHS3) (Gaskins et al., 2015) were partially revised to better fit the conditions of Korean hospitals in examining the following eight dimensions: 1) using the designated space, 2) preparing chemotherapeutic agents safely and using appropriate tools for administration (e.g., needless connector, Luer lock connector, Luer lock syringe), 3) wearing protective clothing (e.g., a waterproof gown), 4) wearing protective hand gear (e.g., latex gloves), 5) wearing protective eye gear (e.g., protective goggles), 6) wearing protective respiratory gear (e.g., a mask), 7) safely managing medical waste (e.g., sealing all materials used for the administration of the chemotherapeutic agents separately and disposing them as hazardous medical waste), and 8) preparing spill kits in the event of exposure to chemotherapeutic agents. While Cronbach's alpha of the NHS3 (Gaskins et al., 2015) was not calculated, this study generated Cronbach's alpha of .73. The participants responded to each of the questions by selecting "always," "sometimes," or "never." Nurses

who answered “always” to one or two items were placed into a group labeled “low safety adherence;” those who answered “always” to three to five items were placed into a group labeled “moderate safety adherence;” and those who answered “always” to six to eight items were placed into a group labeled “high safety adherence.”

In order to investigate the association between Korean nurses’ perceptions of the hospital safety climate and adherence to the safety guidelines for chemotherapeutic administration, age (Silver et al., 2016), education (Kim et al., 2004), years of nursing experience (Silver et al., 2016; Kim et al., 2004), frequency of recent usage of chemotherapeutic agents (Silver et al., 2016; Kim et al., 2004), geographical location (Boiano et al., 2014; Silver et al., 2016), and hospital size (Silver et al., 2016) were included as potential confounding variables.

2.5. Data analysis

Data was analyzed using SPSS Win 24.0. Descriptive and inferential statistics, including Spearman’s correlation coefficients and multivariate ordinal logistic regression, were used for the data analysis.

3. Results

3.1. Participant characteristics and study variables

Table 1 shows the characteristics of the study sample, including distributions and frequencies. Most participants (48.2%) were between the ages of 30 and 39, and the majority (67.3%) had been awarded a four-year university degree. Their nursing experience ranged from 5.0 to 9.9 years (37.0%) to more than 10.0 years (35.4%). 67.1% of nurses used chemotherapeutic agents once or 2–3 times a week. Hospital specific characteristics were included as potential confounders including geographical location (capital city, metropolitan areas, and

Table 1
General characteristics of participants (N = 872).

Variables	N	%	Safety adherence						Chi-squared (p-value)
			Low (0–2)		Moderate (3–5)		High (6–8)		
			N	%	N	%	N	%	
Age									
29 years or younger	342	39.2	65	7.5	201	23.1	76	8.7	.268
30–39	420	48.2	76	8.7	244	28.0	100	11.5	
40 years or older	110	12.6	13	1.5	63	7.2	34	3.9	
Level of education									
3-year college	167	19.2	37	4.2	81	9.3	49	5.6	.009**
4-year university	587	67.3	106	12.2	351	40.3	130	14.9	
Master or higher	118	13.5	11	1.3	76	8.7	31	3.6	
Years of work experience in nursing									
Less than 3 years	40	4.6	8	0.9	28	3.2	4	0.5	.342
3–4.9 years	200	22.9	36	4.1	119	13.6	45	5.2	
5–9.9 years	323	37.0	62	7.1	181	20.8	80	9.2	
≥ 10 years	309	35.4	48	5.5	180	20.6	81	9.3	
Recent usage									
Once a week	335	38.4	48	5.5	195	22.4	92	10.6	.064
2–3 times a week	250	28.7	51	5.8	139	15.9	60	6.9	
4–5 times a week	114	13.1	25	2.9	37	4.3	25	2.9	
6–10 times a week	65	7.5	17	1.9	73	8.4	11	1.3	
More than 11 times a week	108	12.4	13	1.5	84	9.6	22	2.5	
Geographical location of the hospital									
Capital city	299	34.3	53	6.1	182	20.9	64	7.3	.016*
Metropolitan	210	24.1	49	5.6	119	13.6	42	4.8	
Non-metropolitan	363	41.6	52	6.0	207	23.7	104	11.9	
Size of the hospital									
< 300	62	7.1	21	2.4	28	3.2	13	1.5	.013*
300–599	143	16.4	22	2.5	77	8.8	44	5.0	
600–999	459	52.6	76	8.7	277	31.8	106	12.2	
≥ 1000 beds	208	23.9	35	4.0	126	14.4	47	5.4	

*p < .05, **p < .01.

Table 2
Descriptive characteristics of study variables (N = 872).

Study Variables						
Hospital safety climate						
Equipment availability	Mean	SD				
Management support	4.456	.781				
Absence of job hindrances	3.597	.931				
Feedback/training	2.713	.875				
Cleanliness/orderliness	3.443	.777				
Minimal conflict/good communication	3.402	.769				
	3.315	.778				
Safety adherence						
	Always		Sometimes		Never	
	N	%	N	%	N	%
Using the designated space	447	51.3	150	17.2	275	31.5
Preparing chemotherapeutic agents safely and using appropriate tools for Administration	466	53.4	222	25.5	184	21.1
Wearing protective clothing	116	13.3	126	14.5	630	72.2
Wearing protective hand gear	683	78.3	140	16.1	49	5.6
Wearing protective eye gear	58	6.7	112	12.8	702	80.5
Wearing protective respiratory gear	390	44.7	232	26.6	250	28.7
Safely managing medical waste	730	83.7	84	9.6	58	6.7
Preparing spill kits in the event of exposure to chemotherapeutic agents	767	88	55	6.3	50	5.7
Categorised safety adherence						
	N	%				
Low (0–2)	154	17.7				
Moderate (3–5)	508	58.3				
High (6–8)	210	24.1				

non-metropolitan areas) and the size (number of beds). The geographical locations of the hospitals were proportionately dispersed, and 52.6% of the hospitals had 600 to 999 beds.

As shown in Table 2, the mean scores for each sub-factor of the

hospital safety climate ranged from 2.713 to 4.456, with standard deviations ranging from 0.769 to 0.931. The availability of personal protective and engineering control equipment (4.456) recorded the highest mean score, which is followed by management support (3.597), feedback/training (3.443), cleanliness/orderliness (3.402), and minimal conflict/good communication (3.315). The absence of job hindrances (2.713) marked the lowest score. Thus, the hospitals received higher scores for the availability of personal protection and lower scores for the absence of hindrances to work safely. Of the eight items regarding safety adherence for chemotherapy administration, nurses reported higher rates of safety adherence to the items 'preparing spill kits in the event of exposure to chemotherapeutic agents' (88%), 'safely managing medical waste' (83.7%), and 'wearing protective hand gear' (78.3%). Nurses reported very low adherence for 'wearing protective eye gear' (6.7%) and 'wearing protective clothing' (13.3%), demonstrating wide differences for the safety adherence rates among items. When the nurses' safety adherence level is categorised based on the number of items answered 'always', for the 8 items, only 24.1% of the nurses showed high adherence to the standard guidelines, while 58.3% and 17.7% reported moderate and low adherence, respectively.

3.2. Safety adherence for chemotherapeutic agents and hospital safety climate

In this study, Spearman's correlation analysis was used to investigate the associations among variables. Nurses' adherence to the safety guidelines for chemotherapy administration and the sub-factors of the hospital safety climate showed a significant positive association. However, recent usage of chemotherapeutic agents was negatively correlated with adherence to the safety guidelines and the sub-factors of the hospital safety climate. Most of the variables were moderately correlated.

To identify predictors of adherence to the safety guidelines for chemotherapeutic administration, multivariate ordinal logistic regression analyses were performed, and the results are displayed in Table 3. The participants' demographic factors, including age, education, and years of work experience, were included in model 1. Recent usage of chemotherapeutic agents and hospital characteristics, such as geographical location and hospital size, were added in Model 2. The hospital safety climate was included in Model 3, which was the final model. Of the confounding variables, recent usage of chemotherapeutic agents (6–10 times a week; $p < .05$), geographical location (metropolitan; $p < .01$; capital city; $p < .05$), and hospital size (300–599; $p < .01$; 600–999; $p < .05$; ≥ 1000 ; $p < .05$) were associated with adherence to the safety guidelines.

In the final model, which included the confounding variables, two of the factors related to the hospital safety climate, (absence of job hindrances (OR = 1.309, CI = 1.073–1.596) and feedback/training (OR = 1.749, CI = 1.315–2.325)) increased the likelihood of nurses complying with the safety guidelines.

4. Discussion

The hospital safety climate is a key component of the organisational climate, and it can be defined as the shared perceptions of workers regarding safety levels in their workplace (Grosch et al., 1999). Research has found that safety compliance of hospital employees is significantly related to the hospital safety climate (Gershon et al., 2000). Therefore, it is important to identify the relationship between hospital safety climate and adherence to safety guidelines by nurses who frequently handle chemotherapeutic agents.

4.1. Hospital safety climate

The mean percentage of each item in the measure of hospital safety climate to which the nurses responded as "strongly agree" or "agree"

was 52.3%. This was significantly lower than the results of the studies by Gershon et al. (2000) and Smith et al. (2009), which had mean percentages of 68.3% and 85%, respectively. Also, the participants in this study particularly reported low scores on the absence of job hindrances, which mainly questioned whether the nurses had enough time to follow safety guidelines. The low scores for the hospital climate safety in this study indicated that Korean nurses' recognition of the organisational safety culture is low, particularly compared to that of American nurses. Also, these results imply that Korean nurses do not have enough time to follow the safety guidelines. Therefore, nursing managers should reassess the safety culture of Korean hospitals and identify ways to improve the culture; specifically, they need to find the causes that prohibit nurses from securing time to follow safety guidelines.

4.2. Adherence to the safety guidelines

With respect to nurse adherence to the safety guidelines for chemotherapeutic administration, 58.3% of the Korean nurses reported moderate adherence, which means that they always performed 3 to 5 of the 8 total 8 items. The result is consistent with that of a study conducted by Kim et al. (2004), which examined the awareness and practice level regarding the chemotherapeutic agent safety guidelines by nurses working at university hospitals in Seoul and in another metropolitan city. The study reported moderate or low safety adherence, at 2.59 and 2.36 out of 4. Silver et al. (2016) study showed that registered nurses in a chemotherapy ward adhered to an average of less than two in a three- or four-item guideline set (when administering liquid antineoplastic drug), indicating moderate to low adherence to the safety guidelines. However, the result of the current study is significantly different from those of a study conducted on adherence to the safety guidelines for chemotherapeutic administration for nurses working in a tertiary general hospital - a single large-sized hospital with over a 1000 hospital beds (Yun and Park, 2016). In that study, nurses scored 4.2 out of 5 on adherence to the safety guidelines, which suggests high adherence.

The results of the current study showed the lowest level of adherence for 'wearing protective eye gear' (6.7%), and 'wearing protective clothing' (13.3%). Compared to the results of a previous study (Martin and Larson, 2003) on pattern of personal protective equipment usage from preparation to disposal of chemotherapeutic agent, 2–7% goggle usage and 53% 'usually' wearing gowns were reported. Substantial differences were shown between our study and Martin & Larson's study in terms of wearing protective clothing. Also, a study by Boiano et al. (2014) showed that about 60% of participants answered that they wore gowns when administering a chemotherapeutic agent. The differences from previous studies illustrate the need for improvement of adherence in use of protective gear while administering a chemotherapeutic agent for Korean nurses.

4.3. Hospital safety climate and adherence to the safety guidelines

Multivariable ordinal logical regression analyses were conducted to investigate the relationship between and adherence to the safety guidelines while controlling for confounders. In the final model, two of the factors related to the hospital safety climate, absence of job hindrances (OR = 1.309, CI = 1.073–1.596) and feedback/training (OR = 1.749, CI = 1.315–2.325), increased the tendency for nurses to adhere to the safety guidelines. These results are consistent with the results from a previous study that found that training and familiarity with guidelines for safe handling of antineoplastic agents and adequate time to adhere to the guidelines are key to ensuring adherence (Silver et al., 2016). Additionally, a study by Gershon et al. (2000) found a significant relationship between absence of job hindrances and nurse adherence to the safety guidelines for chemotherapeutic administration. Therefore, to improve nurse adherence, it is necessary to

Table 3
Multivariable ordinal logistic regression for predicting the safety adherence ($N = 872$).

Variables	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Age						
29 years or younger	1		1		1	
30–39	0.997	0.668–1.487	0.931	0.620–1.400	1.019	0.671–1.549
40 years or older	1.416	0.772–2.597	1.423	0.770–2.631	1.274	0.678–2.393
Education						
3-year college	1		1		1	
4-year university	0.874	0.622–1.227	0.901	0.639–1.271	0.850	0.596–1.211
Master's or higher	1.110	0.665–1.853	1.092	0.651–1.834	1.091	0.638–1.863
Years of work experience in nursing						
Less than 3 years	1		1		1	
3–4.9 years	1.535	0.788–2.991	1.435	0.731–2.818	1.484	0.732–3.005
5–9.9 years	1.599	0.803–3.188	1.555	0.773–3.128	1.438	0.693–2.984
≥ 10 years	1.546	0.709–3.371	1.501	0.681–3.310	1.367	0.598–3.121
Recent usage						
Once a week			1		1	
2–3 times a week			0.748	0.540–1.035	0.767	0.549–1.072
4–5 times a week			0.662	0.435–1.009	0.659	0.427–1.016
6–10 times a week			0.524*	0.309–0.890	0.599	0.349–1.028
More than 11 times a week			0.852	0.553–1.311	1.019	0.654–1.587
Geographical location						
Nonmetropolitan			1		1	
Metropolitan			0.597**	0.424–0.842	0.562**	0.395–0.799
Capital city			0.709*	0.521–0.965	0.692*	0.504–0.950
Size of the hospital						
< 300 beds			1		1	
300–599			2.460**	1.357–4.458	2.473**	1.334–4.587
600–999			1.780*	1.048–3.025	1.744*	1.004–3.029
≥ 1000			1.928*	1.097–3.388	1.891*	1.054–3.394
Hospital Safety Climate						
Equipment availability					0.904	0.746–1.095
Management support					1.152	0.925–1.435
Absence of job hindrances					1.309**	1.073–1.596
Feedback/training					1.749**	1.315–2.325
Cleanliness/orderliness					1.091	0.856–1.392
Minimal conflict/good communication					1.131	0.903–1.417
Nagelkerke R ²	0.012		0.048		0.191	

* $p < .05$.

** $p < .01$.

*** $p < .001$.

strengthen feedback and training and to further exert organisation-level efforts to eliminate obstacles. Since the sub-dimension on the absence of job hindrances was exceptionally low among Korean nurses, the overall hospital safety climate is expected to improve when the sub-dimension is improved by active organisational efforts.

4.4. Limitations

This study was conducted using data collected from the first large-scale cohort study of nurses in Korea (Kim et al., 2017) and has major implications in that it identified Korean nurse perceptions of the hospital safety climate and adherence to the safety guidelines for chemotherapeutic administration and the relationship between these two variables. However, the following limitations also exist. First, this study did control for the number of beds and the geographical location of the hospitals; however, it was not able to control for differences in the hospital facilities or equipment required to comply with the safety guidelines for chemotherapeutic administration. Second, even though the adherence to guidelines for chemotherapeutic administration was significantly related to nurse knowledge, attitudes, and safety education, this study did not control for these variables. This study, however, is noteworthy in that it identified the relationship between the hospital safety climate and adherence to the safety guidelines for chemotherapeutic administration. This study suggests that, to improve nurse adherence, on top of improving nurses' attitudes and knowledge through safety education about chemotherapeutic agents as mentioned in

previous studies, further efforts must be exerted at the organisational level to enhance the safety culture in hospitals.

5. Conclusion

Nurse exposure to chemotherapeutic agents at work due to inadequate adherence to the safety guidelines for chemotherapeutic administration can cause several health problems. Nevertheless, efforts to improve such matters at the organisational level are not sufficient. The results of this study demonstrate that the hospital safety climate and nurse adherence to the safety guidelines for chemotherapeutic administration are significantly correlated, even when controlling for confounding variables. Therefore, to improve Korean nurses' adherence to the safety guidelines for handling chemotherapeutic agents, it is necessary to provide them with adequate feedback and training about the safety guidelines. Furthermore, organisational policies and support are necessary to reduce job hindrances.

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