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# Program evaluation and early outcomes of a severe preeclampsia and eclampsia maternal safety bundle in a single institution in the Philippines

Zarinah Garcia Gonzaga<sup>1</sup>, Maria Rosario Castillo-Cheng<sup>1</sup>, Joseph Carl Macalintal<sup>1</sup>, Lizzette Caro-Alquiros<sup>1</sup>, Stephanie Causin<sup>1</sup>, Grace Lynn Santos Estanislao<sup>1</sup>

## Abstract:

**BACKGROUND:** To reduce maternal morbidity and mortality associated with hypertension, standards for maternal safety and efforts to implement a structured team approach have been undertaken. Following the formulation of a policy document, a maternal safety bundle was developed. The implementation of bundle components including eclampsia kits, clinical pathways, and educational module occurred in phases due to pandemic restrictions. An eclampsia kit and clinical pathways were implemented in 2020. An online lecture was launched in 2021 followed by in-person eclampsia simulation workshop beginning 2022.

**OBJECTIVES:** This paper aims to report the early outcomes of a severe preeclampsia and eclampsia maternal safety bundle implementation in a private hospital between 2020 to 2023.

**MATERIALS AND METHODS:** Demographic information, posttest knowledge assessment and pre- and post- eclampsia workshop confidence scores were recorded. Structure, process, and outcome measures were determined. Descriptive statistics were used for participant demographics and score percentages. Paired t-Test with a significance level of  $P < 0.05$  was used to compare the pre- and post-simulation confidence scores. Summary data for outcome and process metrics were manually calculated. Summary categorical data was used for structure metrics.

**RESULTS:** Two hundred eighty-eight (288) participants completed the online didactic lecture. Average posttest knowledge assessment score was 88.1%, 88.88%, and 82.6% from 2020 to 2023. Ninety-nine participants completed the eclampsia simulation workshops. Mean post-simulation confidence scores were greater than mean pre-simulation confidence scores (42.3 vs. 39,  $p = 0.0259$  in 2022 and 41.975 vs 36.65,  $P = 0.0035$  in 2023). There is 100% compliance with timely management of severe hypertension and eclampsia prevention and a decreasing trend in hypertension related severe maternal morbidity rates.

**CONCLUSION:** A severe preeclampsia and eclampsia maternal safety bundle is a feasible quality improvement initiative that promotes peer learning, strengthens clinical competencies, and improves access to emergency resuscitation supplies. The results of this program evaluation may serve as a framework for implementing quality improvement initiatives on maternal safety.

## Keywords:

Eclampsia workshop, maternal safety bundle, severe preeclampsia and eclampsia, simulation-based training

<sup>1</sup>Institute for Women's Health, Section of Maternal-Fetal Medicine, The Medical City, Pasig City, Philippines

## Address for correspondence:

Dr. Zarinah Garcia Gonzaga, Women's Health Care Center, 6<sup>th</sup> Floor Podium Building, The Medical City, Ortigas Avenue, Pasig City, Philippines.  
E-mail: zggonzaga@gmail.com

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## Introduction

In the Philippines, 78 women die per 100,000 live births due to pregnancy-related

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causes.<sup>[1]</sup> Of maternal deaths registered by the Philippine Obstetrical and Gynecological Society in 2020, 14% are related to hypertensive disorders of pregnancy.<sup>[2]</sup> It is estimated that 60% of preeclampsia-related

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deaths are preventable.<sup>[3]</sup> Factors that contribute to preeclampsia and eclampsia deaths include provider factors such as misdiagnosis and ineffective treatments, as well as systems of care factors such as lack of coordination and communication among providers.<sup>[4]</sup>

To reduce maternal mortality associated with hypertensive disorders of pregnancy, efforts to implement a structured team approach for the care of women with preeclampsia have been undertaken.<sup>[5,6]</sup> The National Partnership for Maternal Safety (NPMS) developed a patient safety bundle aimed at reducing hypertension-related maternal morbidity during pregnancy and the postpartum period. This bundle is organized into four action domains, namely readiness, recognition and prevention, response and reporting, and systems learning.<sup>[7]</sup> Its implementation was associated with an increase in the number of patients receiving timely intervention for severe hypertension.<sup>[8]</sup> Similarly, the implementation of a maternal quality improvement toolkit to improve health-care response to hypertensive disorders of pregnancy was shown to be effective in reducing the incidence of eclampsia.<sup>[9]</sup>

The Joint Commission (TJC) published a report on new elements of performance applicable to accredited hospitals to reduce the likelihood of harm related to maternal hemorrhage and severe maternal hypertension/preeclampsia.<sup>[10]</sup> A quality improvement project on severe preeclampsia and eclampsia management was implemented in our institution in compliance with these elements of performance. The study setting is a Joint Commission-accredited, 500-bed capacity private hospital in the Philippines. The quality improvement project described in this paper was conducted to assess whether care for pregnant women with severe preeclampsia could be improved using a patient safety bundle. The project followed the organization of the NPMS consensus bundle on severe hypertension<sup>[7,10]</sup> and its implementation utilized the model for improvement methodology as suggested by the Institute for Healthcare Improvement (IHI).<sup>[11]</sup>

This paper aims to report the early outcomes of a severe preeclampsia and eclampsia patient safety bundle implemented in a private hospital in Metro Manila. Specifically, we aim to examine the impact of an educational module on severe preeclampsia and eclampsia on participant knowledge level and confidence in skills and management of the condition. In addition, we aim to report the outcome, process, and structure quality measures after the implementation of our patient safety bundle. Because of the limited information on maternal quality improvement initiatives and outcomes in the Philippines, the results of this program evaluation may serve as a framework for implementing future quality improvement initiatives on maternal safety at the labor and delivery wards in the country.

## Methodology

### Context

We designed this evaluation report following the SQUIRE 2.0 standards for quality improvement research.<sup>[12]</sup> For context, the study setting is a private hospital in Metro Manila catering to 1000–1200 deliveries yearly, more than 60% of which are high-risk pregnancies. Hypertensive disorders in pregnancy are the most common condition seen in high-risk women, comprising 15%–20% of deliveries. Of these hypertensive pregnant women, 25% have severe hypertension during pregnancy. Within our institution, women's health care is provided in several units, including a 30-bed capacity clinical nursing floor, a 24/7 obstetric triage unit, and a dedicated operating room/delivery room complex which houses 2 delivery theaters, 3 operating theaters, 1 laparoscopy theater, as well as a 7-bed capacity labor room, 2 Lamaze rooms, and 1 birthing suite and a 4-bed capacity intensive maternal unit (IMU). The latter is manned by maternal-fetal medicine (MFM) specialists who have met subspecialty society certification and are assisted by MFM fellow trainees. All patients are attended by obstetrician–gynecologists who have met the specialty society certification and are assisted by resident trainees. Resident and MFM fellow trainees take an active role in the management of high-risk pregnant women as frontline health-care providers in all units.

### Intervention

We started our quality improvement project in 2020 in compliance with TJC's Provision of Care (PC) standards to reduce the likelihood of harm related to severe maternal hypertension/preeclampsia (PC.06.01.03).<sup>[10]</sup> Following the formulation of a policy document, a core team of MFM specialists developed a severe preeclampsia and eclampsia maternal safety bundle based on the best available evidence from literature, revised as it applies to our local setting. The maternal safety bundle was based on the 4R framework applied in quality improvement initiatives for maternal health care, which includes four domains, namely readiness, recognition, response, and reporting.<sup>[13]</sup> The components of the bundle include the provision of an emergency kit, implementation of clinical pathways in severe preeclampsia and eclampsia, and conduct of educational modules, which were developed based on well-established, evidence-based practice guidelines through an iterative process.<sup>[7,14,15]</sup> The initial review and feedback on the patient safety bundle, particularly the educational module, was done by a health professions education expert. The final feedback was conducted by the chiefs of the subspecialty sections. The full implementation of the patient safety bundle, including the educational module, initially intended for 2020, was affected by the COVID-19 pandemic and thus occurred in phases over the next 3 years.

The first bundle component was implemented beginning in March 2020 and consisted of the provision of eclampsia emergency kits and the use of clinical pathways for severe hypertension and eclampsia. The eclampsia kit is a medicine toolbox containing essential drugs and supplies used for severe hypertension and eclampsia. After mapping patient flow processes in our units, we identified two strategic locations where the eclampsia kits are installed: one at the obstetric triage area, which serves as the point of entry for all obstetric admissions, and another located within the OR/DR complex between the IMU and labor rooms. Also, beginning in 2020, two clinical pathways were implemented including the hypertensive emergency clinical pathway and the eclampsia clinical pathway. The clinical pathways are activated by either the resident or MFM fellow trainee on recognition of well-defined clinical triggers. Once activated, the clinical pathway consists of an algorithmic list of action steps to be taken by the responding team, including diagnostic work-up, treatment of the condition, and nursing precautions.

The main component of the maternal safety bundle is the educational module which was implemented beginning in 2021. This learning module has two elements, a didactic lecture and a simulation-based training workshop, both intended to improve health-care provider competence in the management of critically elevated blood pressure and eclampsia. The didactic learning module was made available through the hospital's virtual education platform. The link to the virtual platform and the link to the course were provided to health-care providers, including residents and fellow trainees, nursing and midwifery staff, and consultants, to access with their unique username and password at their convenient time.<sup>[16]</sup> The online learning module consisted of a 60-min audiovisual didactic lecture followed by a 10-point posttest evaluation. It included a standardized protocol for initial assessment and diagnosis, initiation of treatment for severe hypertension, and ongoing care and treatment for eclampsia. All maternity health-care providers are required to pass the posttest evaluation after completing the online module. Participants who scored at least 80% in the posttest evaluation were able to download their certificate of completion. This certificate was made a requirement for regular employee evaluation and consultant staff credentialing and privileging, as well as for inclusion in the simulation-based training course. Only those with a certificate of completion of the online module are eligible to take the simulation-based training workshop. The second element of the educational module, an interprofessional simulation-based training workshop on severe preeclampsia and eclampsia, was designed to practice providers' skills in the management of hypertensive emergency and eclampsia. The workshop was conducted on one training day as the culminating

activity for the preeclampsia month activities. It was conducted using an iterative approach, with the first cycle conducted in May 2022 and the second cycle the following year, after a course review by the core team. During its first cycle, the core team served as workshop facilitators. On the second cycle, four head nurses who had completed their eclampsia simulation workshop the previous year were invited to serve as course facilitators. Participants included consultants, residents and fellow trainees, medical students, nurses, and midwives who had completed the online learning module and passed the posttest assessment. They were assigned to attend either a morning or an afternoon session, and further assigned into subgroups. The workshop began with the distribution of an individual assessment tool to assess each participant's confidence in managing severe hypertensive emergency and eclampsia. The participants were asked to conduct the same assessment tool after their subgroup skills testing. Following welcoming and briefing on the learning aims, skills checklists were distributed to each participant. Elements of the checklist include the same standardized protocol included in the online didactic lecture. This was followed by a simulation video demonstrating team management of a clinical scenario of hypertensive emergency and eclampsia, followed by a brief review of the video demonstration. The participants then proceeded to their subgroup stations, where a brief orientation was followed by subgroup skills testing. During subgroup skills testing, participants took part in a simulated scenario with their colleagues to practice incorporating the newly improved or acquired skills. A learner's formative evaluation tool was used to assess a participant's skills during subgroup skills testing, using a different tool for each profession. On completion of training and demonstration of skill acquisition to the course facilitator, each participant was eligible for a certificate of course completion. The last part of the course involved subgroup feedback and group debriefing sessions.

### Study of the intervention

To assess participant knowledge, a self-administered posttest evaluation was used after the online module. To measure participants' confidence in the management of hypertensive emergency and eclampsia before and after the eclampsia simulation workshop. To assess the effectiveness of our patient safety bundle implementation, outcome, process, and structure measures were determined and analyzed.

### Measures

To evaluate the effectiveness of our patient safety bundle implementation, we followed the metrics developed by the Alliance for Innovation on Maternal Health and adapted them to our setting.<sup>[17]</sup> Outcome measures assess the change in patient's health status and include the following: Severe maternal morbidity (SMM), defined

as the proportion of women who experienced SMM excluding those who experienced transfusion alone against all qualifying pregnant and postpartum women during their birth admission, and hypertension-related SMM, defined as the proportion of women who experienced SMM excluding those who experienced transfusion alone against all qualifying pregnant and postpartum women during their birth admission with preeclampsia. Process measures track whether specific essential interventions were implemented and include timely treatment of persistent severe hypertension, defined as the proportion of all women with acute-onset severe hypertension who received the recommended antihypertensives in  $\leq 30$  min, timely administration of magnesium sulfate for seizure prophylaxis, defined as the proportion of all women with hypertensive emergency or eclampsia who received magnesium sulfate, provider education, defined as the cumulative number of physicians and nurses who completed within the last 2 years the online didactic lecture, and eclampsia workshop, defined as the number of simulation drills performed within the last 2 years. Structure measures assess whether core infrastructural elements have been established, and include unit policy procedure, reviewed, and updated in the last 2 years, and multidisciplinary case review and reporting.

### Analysis

Descriptive statistics were calculated for participant demographics. Knowledge score data were analyzed using score percentages. A paired *t*-test with a significance level of  $P < 0.05$  was used to compare the presimulation and postsimulation assessment scores using Microsoft Excel Analysis ToolPak. Summary data for outcome and process metrics were manually calculated using Microsoft Excel spreadsheets. Summary categorical data were used for structure metrics.

### Results

Two hundred and eighty-eight total health-care providers completed the online didactic lecture between May 2021 and May 2023 [Figure 1]. The majority of participants are consultants ( $n = 80, 27.8\%$ ), followed by nurses ( $n = 80, 27.8\%$ ), midwives ( $n = 45, 15.6\%$ ), medical clerks, and interns ( $n = 42, 14.5\%$ ) and resident/fellow trainees ( $n = 41, 14.3\%$ ). For the online didactics, posttest knowledge assessment showed an average score of 88.1% in 2021, 88.88% in 2022, and 82.6% in 2023 [Figure 2]. For the eclampsia simulation-based training course, a total of 99 health-care workers completed the course conducted in May 2022 and May 2023. Of the 54 participants in 2022, the majority were nurses ( $n = 23, 41.8\%$ ) and residents ( $n = 23, 41.8\%$ ), followed by midwives ( $n = 8, 14.5\%$ ). The mean postsimulation confidence score in this subset was found to be greater than the presimulation

confidence score (42.3 vs. 39,  $P = 0.0259$ ) [Table 1]. Of the 45 participants in 2023, the majority were nurses ( $n = 29, 64.4\%$ ) followed by residents ( $n = 14, 31.1\%$ ). The mean postsimulation confidence score in this subset was found to be greater than the presimulation confidence score (41.975 vs. 36.65,  $P = 0.0035$ ) [Table 2].

Two process measures were used to track whether essential interventions were implemented. Table 3 shows 100% compliance with the timely treatment of severe hypertension. Table 4 shows an improvement in compliance with the timely administration of magnesium sulfate from the start of implementation in 2020. Two outcome measures were used to assess the change in patients' health status at the onset of the implementation of the patient safety bundle. Table 5 shows the overall SMM ratio from 2020 to 2022, with an SMM ratio of 16.3 per 1000 in 2021, mostly related to COVID-19 infection. There is a decrease in the hypertension-related SMM ratio from 32 per 1000 in 2020 to 0 in 2022.

### Discussion

Before a patient safety bundle on severe preeclampsia and eclampsia was implemented, the institution had a system in place for monitoring and reporting SMM cases using a quality improvement perspective, following the published recommendations of the American College of Obstetricians and Gynecologists and Society for Maternal-Fetal Medicine.<sup>[18]</sup> This could explain the high baseline compliance in the timely administration of

**Table 1: Pre- and postsimulation confidence scores after eclampsia simulation workshop, May 2022**

	Presimulation	Postsimulation
Mean	39	42.3
Variance	9.486666667	4.626666667
$P(T \leq t)$ two-tail	0.025921997	

**Table 2: Confidence scores after eclampsia simulation workshop, May 2023**

	Presimulation	Postsimulation
Mean	36.65	41.975
Variance	2.963	4.05175
$P(T \leq t)$ two-tail	0.003497895	

**Table 3: Compliance with timely treatment of persistent severe hypertension, 2019–2022**

	2019	2020	2021	2022
20 weeks and above or postpartum with unresolved SBP >160 or DBP >110 given anti-HTN within 30 min	100	64	57	78
20 weeks and above or postpartum with unresolved at SBP >160 or DBP >110	100	64	57	78
Compliance rate (%)	100	100	100	100

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HTN: Hypertension



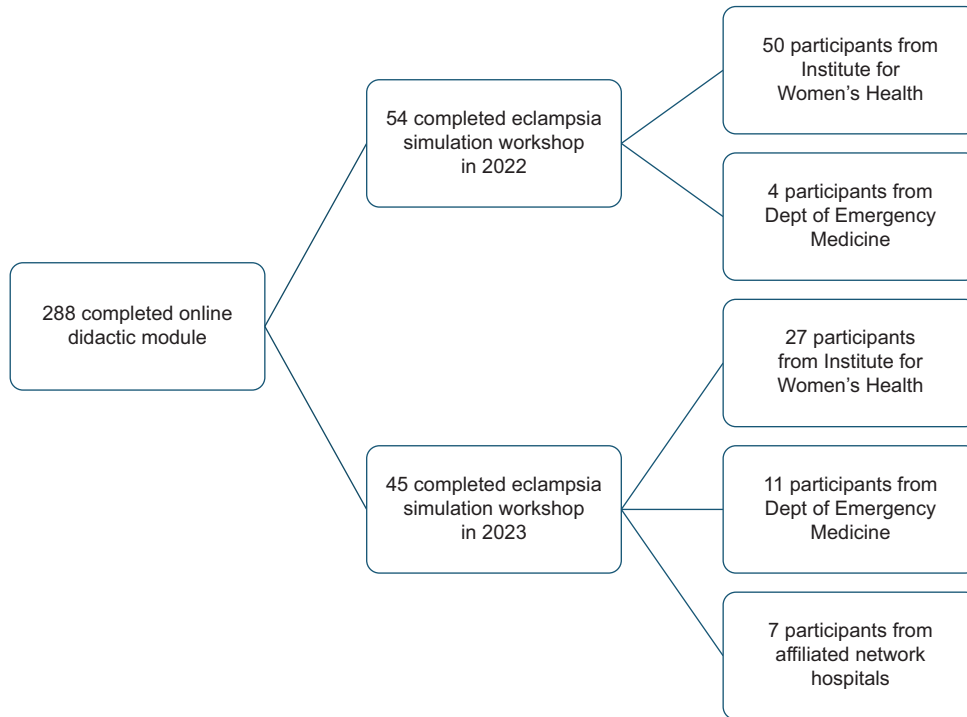


Figure 1: Participants of severe preeclampsia and eclampsia education module (online didactics and eclampsia simulation workshop) as of May 2023.

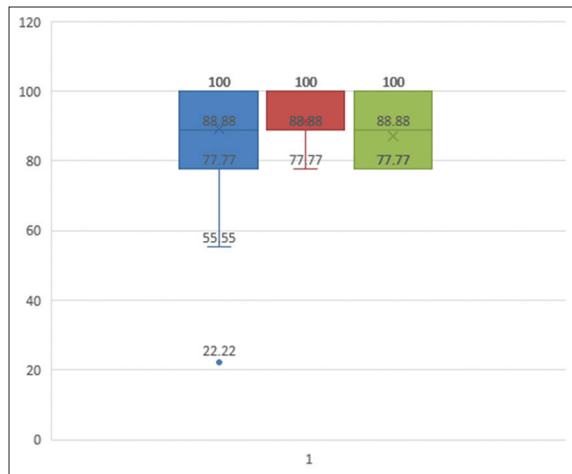


Figure 2: Mean posttest score over time after online didactic lecture

antihypertensives and magnesium sulfate, as well as the low SMM ratio observed in our institution. In fact, our annual SMM rate has been consistently lower than estimates for Asia-Pacific countries.<sup>[19,20]</sup> Our clinical outcome metrics reflect the importance of an established quality monitoring and reporting system in achieving optimal clinical outcomes.

The full implementation of the patient safety bundle was affected by the COVID-19 pandemic and thus occurred in phases over the next 3 years. Social distancing restrictions during the height of the pandemic precluded the implementation of the educational part, which was originally intended to be an in-person didactic lecture

Table 4: Compliance with timely administration of magnesium sulfate for seizure prophylaxis, 2019–2022

	2019	2020	2021	2022
Delivered PE with severe features with MgSO <sub>4</sub> for seizure prophylaxis	38	64	73	78
Delivered with PE with severe features	40	64	73	78
Compliance rate (%)	95	100	100	100

PE: Preeclampsia, MgSO<sub>4</sub>: Magnesium sulfate

Table 5: Trend in severe maternal morbidity and hypertension-related severe maternal morbidity rates

	2020	2021	2022
Total births	1247	981	935
Severe maternal morbidity	17	16	9
HTN-related maternal morbidity	4	2	0
Severe maternal morbidity rate*	13.6	16.3	9.6
HTN-related maternal morbidity rate*	32	2	0

\*Per 1000 total births. HTN: Hypertension

followed by an in-person simulation workshop. As a result, only the structure components of the bundle were implemented in 2020. With the nation under a state of quarantine, the team’s adaptability and creativity enabled the educational module to continue by converting to an online module for health-care providers. In addition, the team conducted patient education through webinars aired on the hospital’s social media sites, enabling us to promote patient awareness while the online module was being developed. The online module was completed and eventually launched in May 2021 through the hospital’s virtual education platform. This allowed us to open the course to other members of the hospital community,

with the Department of emergency medicine as our first target in 2022, before eventually opening the course to other affiliated network hospitals in 2023. The in-person eclampsia workshop was only possible with the lifting of physical restrictions beginning in 2022, and then only in small groups.

The strength of our patient safety bundle is in the educational component. A considerable change was observed for both iterations of the simulation-based eclampsia workshop training, with an 8.5% and 14.3% change in 2022 and 2023, respectively. On both cycles, our data suggest that our eclampsia simulation workshop has the potential to enhance provider competency and eventually improve clinical practice. Our eclampsia simulation workshop improved our health-care worker's confidence in the diagnosis and management of severe preeclampsia and eclampsia.

During the workshop, skills checklists were used for formal skills assessment of the course participants. While these checklists were helpful in standardizing the skills performed, we used an iterative training and assessment approach instead of recording individual skills assessment scores. We believe this is necessary to better evaluate and reinforce skills acquisition to enable our health-care providers to execute the simulated skills optimally and confidently before the completion of the course.

The average posttest knowledge score on the online didactic lecture remained the same over time, with notable outliers in its 1<sup>st</sup> year of running but none for the subsequent years. Unfortunately, knowledge assessment on the online didactic lecture from pretest to posttest was not assessed. A future iteration of our educational module would ensure that pretest assessment is performed and recorded to facilitate a better understanding of the participant's knowledge acquisition as a direct result of the online didactic lecture.

## Conclusion

We reported the early outcomes of a severe preeclampsia and eclampsia patient safety bundle implemented in our institution. It was designed to be a collaborative interprofessional quality improvement initiative that empowers maternity health-care providers by promoting peer learning, strengthening clinical competencies, and increasing access to clinical resuscitation supplies. Future directions include the digitalization and integration of the clinical pathways in the hospital's electronic medical records system and the incorporation of a pretest knowledge assessment on the online didactic lecture. The results of this program evaluation may serve as a framework for implementing future quality

improvement projects on maternal safety at the labor and delivery wards in the country.

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## Authorship contributions

ZARINAH GARCIA GONZAGA – Involved in conceptualization, methodology, validation, formal analysis, writing original draft, visualization, supervision.

MARIA ROSARIO CASTILLO CHENG – Involved in conceptualization, methodology, review and editing of draft, supervision.

JOSEPH CARL MACALINTAL – Involved in methodology, resources, review and editing of draft.

LIZZETTE CARO-ALQUIROS – Involved in methodology, resources, review and editing of draft.

STEPHANIE CAUSIN – Involved in resources, review and editing of draft.

GRACE LYNN SANTOS ESTANISLAO – Involved in resources, review and editing of draft.

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## Conflicts of interest

There are no conflicts of interest.

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