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Use of an educational, audiovisual podcast to maximise safety with variable rate intravenous insulin infusions

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ABSTRACT

Variable rate intravenous insulin infusions (VRIII) are used to maintain stable blood glucose in hospitalised patients with diabetes who are unable to eat or have a severe illness where good glycaemic control is paramount. With VRIII it is important to prescribe an adequate substrate to avoid hypoglycaemia and maintain electrolyte balance. Traditionally the substrate would have been varied to achieve this; current guidelines advise varying the infusion rate rather than the type of substrate. The local hospital Trust updated their VRIII prescription chart to reflect the Joint British Diabetes Societies' suggestions for inpatient care in October 2014. A local audit in January 2015 highlighted that 48% of patients on VRIII were prescribed the correct fluid as per the guideline. A questionnaire to assess prescriber knowledge regarding VRIII showed 40.4% of prescribers selected appropriate fluid for a patient with normal renal function and 11.5% of prescribers selected appropriate fluid for a patient with renal failure. An educational podcast was devised to explain the rationale behind appropriate fluid prescription with VRIII; this was shown to prescribers. Following the podcast, 75.8% of prescribers selected appropriate fluids for normal renal function and 54.5% for renal failure. Questionnaires were completed to assess prescriber knowledge prepodcast and postpodcast. Following the podcast, there was a significant increase in questionnaire scores, indicating improved prescriber knowledge surrounding VRIII. A reaudit of prescriptions for VRIII showed improvement in practice, where 63% of patients on VRIII were prescribed correct fluids. The use of a simple audiovisual podcast on VRIII led to a significant improvement in prescriber knowledge. Podcasts are an ideal medium to raise awareness around safety issues, including safe prescription of insulin. Further work will include the follow-up of participants to evaluate sustained knowledge and improvements of prescriptions in practice, with the overall aim of improving patient safety.

PROBLEM

There have been several patient safety alerts from NHS England reporting serious incidents of harm due to inappropriate handling of insulin.[1] From direct observation on the wards at a large, local, acute hospital Trust, practice suggested that some patients might be receiving insufficient supplementary fluid with their variable rate intravenous insulin infusion (VRIII), or no fluids at all. To understand the problems with local intravenous insulin usage, an audit was carried out in January 2015 for patients on VRIII considering 'safe use of insulin'. This audit showed that 48% of patients were prescribed the appropriate fluid with their VRIII.

The local Trust involved in this work is one of the busiest acute hospital Trusts in England, serving a population of 2.5 million with over 1700 inpatient beds.[2] A significant number of patients may be on VRIII at any one time across the Trust, including surgical patients.

In October 2014, the Trust developed a new insulin prescription chart as per the recommended guidance from the Joint British Diabetes Societies (JBDS) for inpatient care.[3] The new chart included advice from the guidance on supplementary fluid prescription with insulin.

Exploratory work identified the following problems occurring when patients were prescribed the wrong fluid with VRIII:

1. Inappropriate fluid prescription resulting in hypokalaemia or hyperkalaemia causing electrolyte imbalance and increased risk of arrhythmia.
2. Inappropriate fluid prescription leading to rebound hypoglycaemia when attempting to stop the VRIII.
3. Inappropriate fluid prescription making it difficult to stop a VRIII, which can lead to prolonged hospital admission.

These problems prompted the project team to explore the prescriptions of VRIII for inpatients to focus improvements with compliance of fluid prescription with the outcome of making patients safer. The aim of the project was to 'improve fluid prescriptions with VRIII, as per guidance, to 80% over a four month period'.

BACKGROUND

The prevalence of diabetes is growing globally; in the UK 6.2% of the population had a diagnosis of diabetes in 2015.[4] The recent National Inpatient Diabetes Audit (NaDIA) of over 15 000 patients across 218 hospitals in England and Wales found that 17% of hospital inpatients were diabetic[5]: a population shown to have 10% higher mortality compared with inpatients without diabetes,[6] and an increased average length of stay of 6.3 days compared with 3.5 days for patients without diabetes. This has major health implications and financial implications for NHS Trusts.[7]

VRIIIs (previously known as a sliding scale) are a tool used to control blood sugars in patients with diabetes who are unable to eat (eg, nil by mouth or vomiting) or have a severe illness where good glycaemic control may lead to better outcomes (eg, sepsis).[3] In these patients, intravenous insulin will be infused continuously to provide a basal level of insulin to optimise blood glucose. Nine per cent of the inpatients with diabetes in the NaDIA report had been on an insulin infusion in the previous 7 days.[5] This report found that patients often stay on insulin infusions longer than necessary and suggested better guidance and training surrounding insulin infusions are needed.[5]

There are no randomised control trials of VRIII to measure their efficacy and impact in clinical practice, but comments in the literature advocate a move away from traditional 'sliding scales' towards supplemental insulin.[8 9] Some hospitals have tried to improve use of VRIII through introducing clear guidelines.[10 11] In Australia, a tertiary hospital saw better glycaemic control for inpatients with the introduction of a new insulin prescribing chart.[11]

With VRIII it is important to provide an adequate substrate with the intravenous insulin to avoid hypoglycaemia as well as maintain a stable blood glucose through varying the infusion rate rather than the type of substrate.[3] Intravenous fluids act as this glucose substrate and are important to maintain fluid and electrolyte balance as glucose with insulin leads to hypokalaemia; so, additional potassium must be prescribed unless contraindicated.[3 12]

The local Trust developed an insulin prescription chart consistent with the recommendations from the National Patient Safety Agency alert as per the JBDS for inpatient care suggestions in October 2014 detailing appropriate prescription of VRIII with advice on fluid selection and rate of infusion.[1] Due to local stock issues, their guideline recommends the second-choice fluids suggested by the JBDS. These are the following:

1. 5% glucose with 40 mmol KCl in 1000 mL at 100 mL/hour in patients with potassium <4.9 and estimated glomerular filtration rate (eGFR) >15 mL/min.
2. 10% glucose with 20 mmol KCl in 500 mL at 50 mL/hour in fluid-restricted patients with potassium <4.9 and eGFR >15 mL/min.
3. 10% glucose 500 mL at 50 mL/hour in patients with potassium >5 or end-stage renal failure or eGFR <15 mL/min.

During this project, the primary intervention used was an audiovisual podcast or 'vodcast'. These forms of educational media are short and snappy, using short videos or visual presentations with overlying audio. They are designed to be easily accessible in the modern digital age and to provide the key information in a short period. Their use is increasing in healthcare education across multiple domains because of their flexibility.[13] While evidence on the impact is currently being explored, they are suggested to increase knowledge and retention,[14] satisfaction,[15] and even skill acquisition.[14]

BASELINE MEASUREMENT

A baseline audit was conducted (January 2015) into the safe use of intravenous insulin and fluid prescribing with VRIII. A preregistration pharmacist identified inpatients on VRIII across two diabetes and three surgical wards at the acute Trust through pharmacy communications. They scrutinised these drug cards to assess the supplementary fluid prescribed and the rate of administration, as well as recording patients' blood biochemistry and renal function. Thirty-one drug cards were analysed over eight sessions in a one-month period.

This audit highlighted that only 48% of patients on VRIII were prescribed the correct fluid as per the recommended guideline for their renal function and potassium level. Of those prescribed incorrect intravenous fluid, 25% of patients were prescribed conditional fluids where the prescriber had indicated a condition to the manner the fluid should be administered. Of the patients, 6.25% were prescribed potassium-containing fluids when hyperkalaemic and 12.5% were prescribed no fluid at all, both these prescriptions could result in patient harm.

Following this baseline audit, two measures were considered. The first was a measure of foundation doctor knowledge regarding the Trust guideline for fluid prescription with VRIII. The second was the continual process measure of which supplementary fluids are being prescribed for patients on VRIII in clinical practice and if this is compliant with the guideline.

Foundation doctor knowledge can be measured through a questionnaire study; fluid prescription in clinical practice can be assessed with the method used in the initial audit, assessing prescription charts and blood results of hospital inpatients on VRIII (see online supplementary file 1).

DESIGN

When considering an underlying cause of the problem surrounding VRIII, a project group was set up consisting of a consultant diabetologist, senior pharmacist, junior doctors and the Trust's patient safety improvement lead. From baseline work it became clear that doctors were not familiar with the recommended guideline or which fluids to prescribe with VRIII. An intervention needed to be designed to help improve prescribers' understanding of the guideline. A discussion was had between

the consultant diabetologist, pharmacy, diabetes nurse specialists and a junior doctor representative. We considered an educational presentation to prescribers or developing an e-module for completion; however, neither idea appeared to be sustainable.

The agreed intervention was to develop an educational audiovisual podcast that would be a visual way to explain the importance of the guideline for VRIII and supplementary fluid prescription. This podcast would be time-efficient and therefore cost-effective for the Trust. It could be reproducible and viewable independent of the trainers and therefore could be made easily available throughout the Trust.

A 3 min 30 s audiovisual podcast was developed with assistance from the Trust's Medicines Education Group (who have expertise in developing these types of media) to explain the rationale behind fluid prescription and electrolyte monitoring with VRIII as per the Trust guideline. It was decided that this should be shown at regular foundation year 1 and year 2 teaching across local hospital sites. Although this would not reach all prescribers of VRIII across the Trust, it was a useful platform and the intention was to display the podcast on the Trust intranet so that it could be accessed at any time by any healthcare professional.

STRATEGY

The improvement aim was to improve compliance of fluid prescription for VRIII with the recommended guideline to 80% over a 4-month period and ultimately improve patient safety.

Baseline

Through assessing prescriptions of patients on VRIII on medical and surgical wards, the team discovered that 48% of patients were prescribed the correct fluid as per the recommended guideline. Some patients were prescribed conditional fluids based on their blood sugars, others were prescribed potassium-containing fluids when hyperkalaemic, and some patients had no fluid prescribed at all. The results were discussed at the departmental diabetes meeting with medical, pharmacy and nursing colleagues. It was decided that junior doctors' knowledge surrounding the guideline was a key contributor to poor compliance with the guideline. This baseline exploration showed a need to explore prescriber knowledge and raise awareness of the current VRIII guideline.

The team developed a multiple-choice questionnaire to assess prescriber knowledge surrounding VRIII. The questionnaire asked participants' level of training, experience and confidence in prescribing VRIII. Participants were asked to select the appropriate fluid and the rate of fluid for two clinical scenarios: a patient with normal potassium and renal function, and then a patient with hyperkalaemia and renal failure. They were also asked which of the patient's insulin to continue, if any. Participants were asked if they knew where to access guidance on prescribing VRIII. Questionnaires were distributed in foundation year 1 and year 2 doctor teaching. The results showed that 40.4% (n=52) of prescribers selected the appropriate fluid for a patient with normal renal function and 11.5% selected appropriate fluid for a patient with renal failure. The results highlighted a significant gap in prescriber knowledge.

PDSA (Plan, Do, Study, Act) cycle 1

Following baseline exploration of fluid prescribing and knowledge surrounding VRIII, a plan was developed to improve knowledge of prescribers. An audiovisual podcast was developed that explained the VRIII guideline and the importance of appropriate fluid prescription in relation to patients' biochemistry and renal function (see figure 1 as exemplar). The 3 min 30 s audiovisual podcast was shown at foundation year 1 and year 2 doctor teaching. At the end of the following teaching session (1–2 weeks later), a questionnaire was redelivered with an additional question to see if participants had seen the audiovisual podcast before completing and if they had done a prepodcast questionnaire. Thirty-four of the foundation doctors who completed the second questionnaire stated they had seen the audiovisual podcast. There was an improvement in junior doctors' knowledge following the podcast, with 75.8% of foundation doctors who had seen the podcast (n=34) selecting the appropriate fluid for a patient scenario with normal renal function as per the Trust guideline (40.4% prepodcast) and 54.5% of foundation doctors who had seen the podcast (n=34) selecting the appropriate fluid for a patient scenario with poor renal function as per the Trust guideline (11.5% prepodcast). Of the five responders who had not seen the podcast, 20% selected the appropriate fluid for a patient scenario with normal renal function and none selected appropriate fluid for a patient scenario with poor renal function. Before the podcast, participants were selecting fluid for patients with hyperkalaemia with renal failure that had the potential to overload them. They were also opting not to continue any of the patient's background long-acting insulin, which can mean patients remain on VRIII longer than is necessary as it is more difficult to stop the infusion. On discussion with the team it was highlighted that doctors did not know that a version of the guideline was present on the insulin prescription chart, and it was clear that participants were wary of prescribing 5% glucose to patients with diabetes despite this being the Trust substrate of choice for VRIII. Many were still prescribing conditional fluids based on the patient's blood glucose level. It became clear that participants needed a formal guideline to show what practice is recommended at the Trust and to explain the importance of appropriate fluid prescription with supplementary electrolytes. Therefore, we decided to develop an independent VRIII guideline for the Trust intranet to explain the rationale behind supplementary fluid prescription with VRIII.

It was felt that the podcast had a positive effect on junior doctor VRIII prescribing knowledge, so it has been

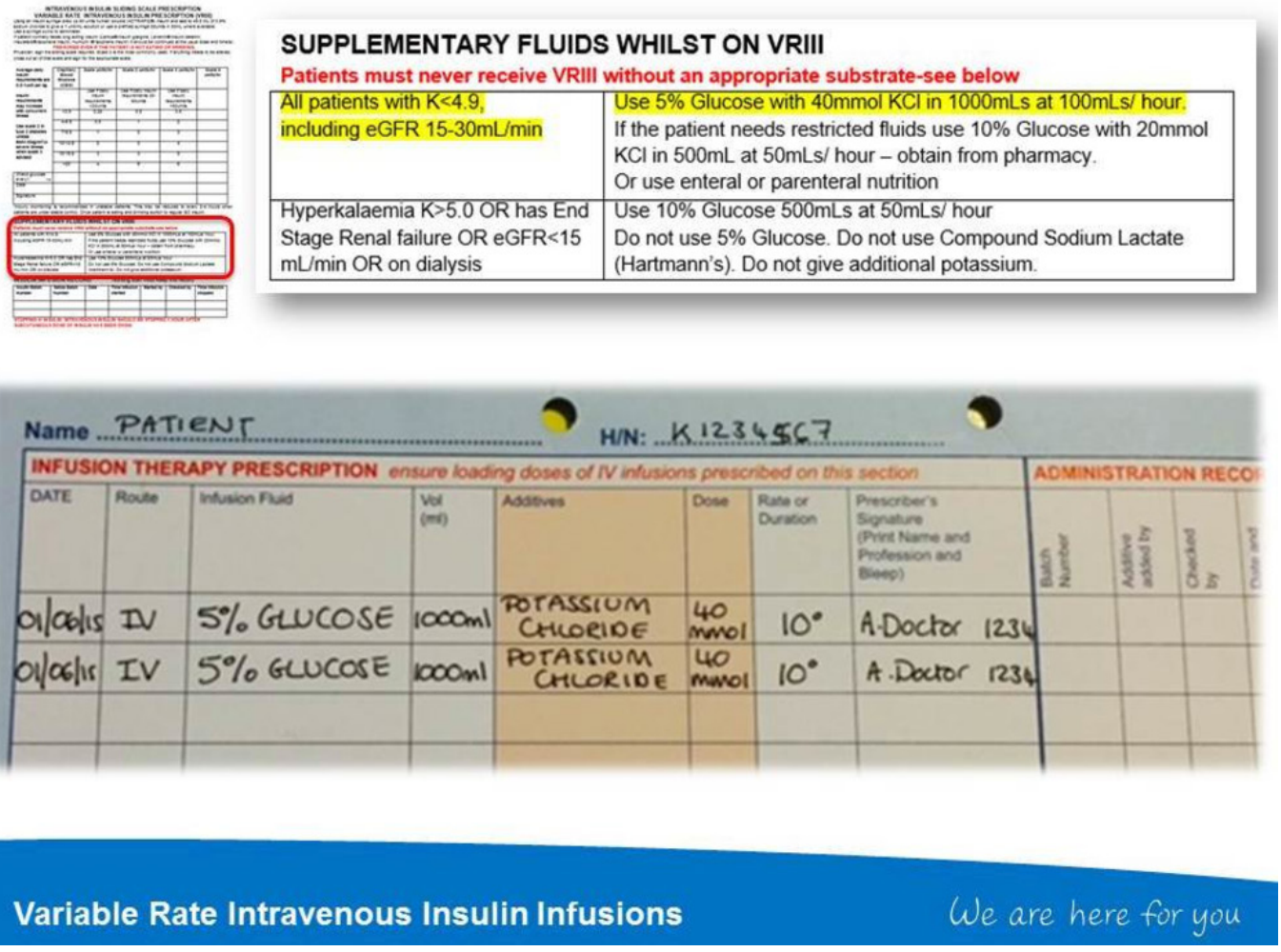

Figure 1 Example slide from the vodcast. eGFR, estimated glomerular filtration rate; VRIII, variable rate intravenous insulin infusions.

continued to be shown at junior doctor teaching and is available on the Trust intranet for other professionals to view.

PDSA cycle 2

PDSA 1 highlighted the need for clear guidance for prescribers around VRIII in the Trust. For PDSA 2 this was developed and launched in the Trust. Following showing the podcast as well as developing an official Trust guideline, reauditing of the effect on clinical practice with VRIII prescriptions was undertaken as an outcome measure. Sixty-three per cent of prescriptions had the appropriate supplementary fluids prescribed as per the Trust guideline, an improvement from 48% in the initial audit in January 2015.

On team discussion, the podcast and VRIII guideline improved prescriber knowledge and clinical practice, although there is still room for improvement. The podcast will continue to be shown at foundation doctor teaching as well as induction for new doctors, and the guideline is actively shared across the Trust (see online supplementary file 2).

RESULTS

The questionnaire designed to assess junior doctors' knowledge surrounding VRIII highlighted more gaps in knowledge than just the appropriate fluid to prescribe. In the prepodcast questionnaire, 21.2% of foundation doctors (n=52) knew that the guideline for VRIII was available on the VRIII prescription chart, and 50.0% thought the guideline was available on the Trust intranet when it was not. Prepodcast, most doctors (42.3%) opted to not continue any insulin while a patient is on VRIII when the correct answer is to continue the long-acting insulin, chosen by 40.4% of participants. Most doctors (32.7%) selected 1000 mL 0.9% sodium chloride for the patients with hyperkalaemia with renal failure, with just 11.5% appropriately selecting 500 mL 10% glucose as per the local Trust guideline.

Following the podcast intervention, data were analysed using unpaired t-tests. There was a significant increase ($p<0.001$) in most questionnaire scores. More candidates selected the appropriate fluid (40.4% prepodcast to 75.8%) at the appropriate rate (from 48.1% to 69.7%) and continued the appropriate background insulin (from

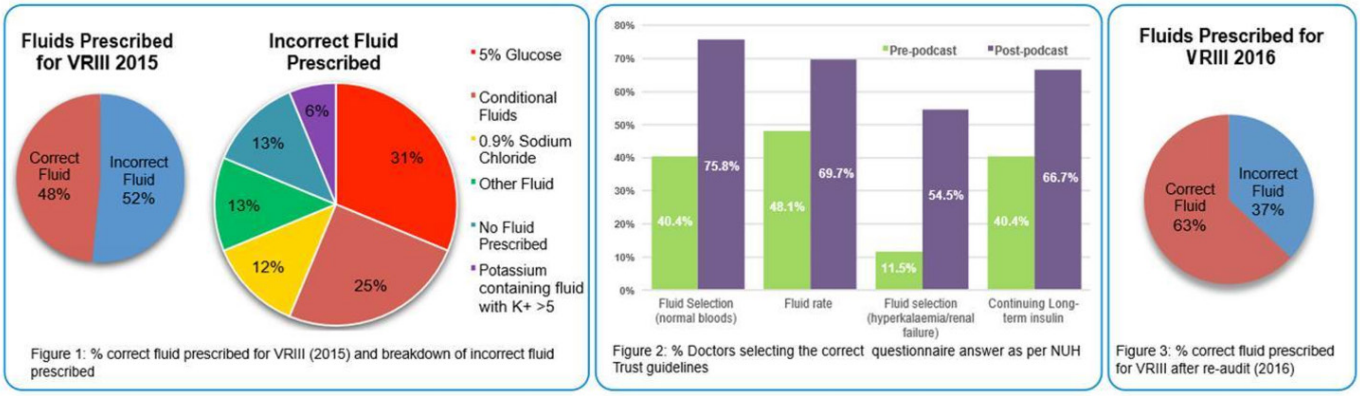

Figure 2 Final VRIII measurement results. NUH, Nottingham University Hospitals; VRIII, variable rate intravenous insulin infusions; PDSA, Plan, Do, Study, Act Cycles.

40.4% to 66.7%). Improved knowledge was seen in fluid choice for hyperkalaemia and renal failure (from 11.5% to 54.5%).

On reauditing the VRIII prescriptions in practice, an improvement from 1 year previously (48% correct fluid prescription in 2015 increased to 63% correct fluid prescription in 2016) was seen (see figure 2, online supplementary file 3). This suggests that the intervention is having an impact in clinical practice.

Lessons and limitations

The team have learnt of the importance of a multidisciplinary approach to make effective, sustainable changes in clinical practice. Although the main stakeholders were the prescribers of VRIII, ward pharmacists were very good at identifying insulin errors and helping to drive improvement with insulin. Having multidisciplinary discussions in the diabetes meetings was very useful to make changes and improvements. This included the diabetic nurse specialists who were very positive towards the resource as a tool to supplement their own knowledge and also to use to educate colleagues or challenge errors detected on the ward. Through the diabetes team meetings, the team engaged pharmacy, diabetes nurse specialists and doctors working in this area. The team also worked closely with the postgraduate teaching department to help develop the podcast and then have the postgraduate team show the podcast at teaching sessions independent of the developers.

The intervention was initially targeted at foundation year 1 and year 2 doctors. They engaged well with the teaching as their mandatory training sessions were targeted. It was important that doctors understood the podcast and where to access this as well as the VRIII guideline. This information was shared through announcements in the foundation doctor teaching. However, through this method, not all prescribers were engaged.

The podcast is now available for healthcare professionals to view on the Trust intranet, but is dependent on staff knowing how to access this resource. Knowledge of the resource was through word of mouth and promotion from the diabetes team. Engagement of nursing staff was ineffective and should have been more of a focus as they are responsible for delivering the prescribed VRIII and fluids to the patient. The ward staff are in an ideal position to detect and challenge prescriber error.

We learnt that although the Trust had placed the specific guideline for VRIII infusions on the prescription chart, as this was not a separate guideline stored with all other Trust guidelines, few doctors knew of its existence. This led to the development of an independent guideline for VRIII infusions to be easily accessible with other Trust guidelines and available on the mobile phone Guidelines app, easily accessible to Trust employees.

When assessing the impact of the intervention in clinical practice, there was no way of knowing if the prescriptions for VRIII had been prescribed by a colleague who had seen the podcast or the new guideline for VRIII. There was also a small sample size as a limited number of inpatients with diabetes will be on a VRIII at any one time.

We have had positive feedback from the podcast and the VRIII guideline that were developed. Therefore, the team will continue to encourage these resources to be accessed and there is scope to design further topics for all aspects of educational need. The Trust will continue to promote the guideline via the podcast with the aim of raising awareness around the importance of regular blood monitoring in VRIII, appropriate substrate prescription

and other information required to continue to prescribe safely.

CONCLUSION

The project has shown that the use of a simple audio-visual podcast on VRIII led to a significant improvement in foundation doctor knowledge. The team set out to improve compliance of fluid prescription for VRIII with the recommended guideline to at least 80% over a 4-month period. In practice, fluid prescription with VRIII improved to 63% over a 12-month period, showing there is still room for improvement.

The project has shown that a podcast is an effective, simple tool to update clinical knowledge and educate prescribers around a particular area. However, the effectiveness of any podcast is limited to its promotion. Resources remain in use despite changing rotations, and as podcasts are concise and engaging they are an ideal medium to raise awareness about multiple patient safety issues, not limited to the safe prescription of insulin.

Contributors HTF led the project, supported by JC and NW; this core team were involved in the full project, including writing and proofing of the article. KST and PP assisted in the data collection during the project.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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