4G CLINICAL

Depot Demand Forecasting

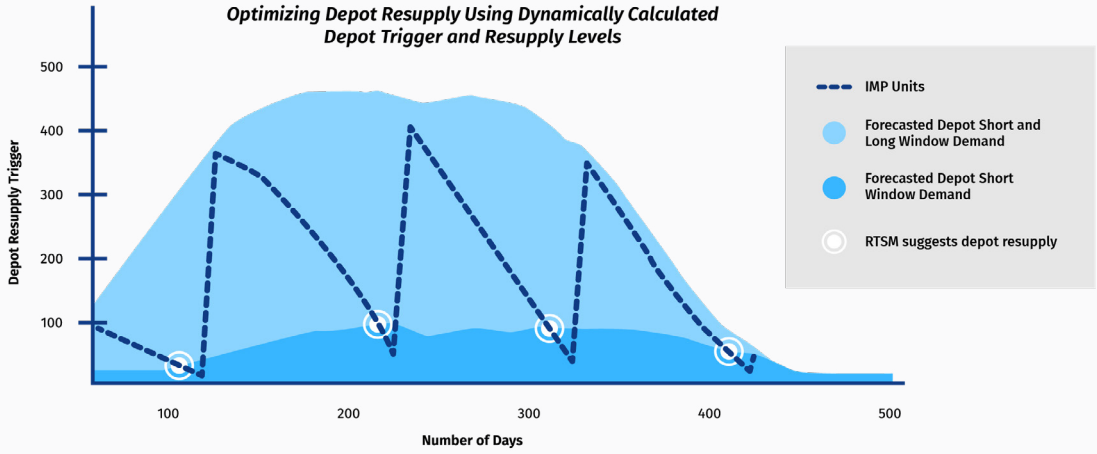
Knowledge Sharing Series

Depot Demand Forecasting

Introduction

For the right investigational medicinal product (IMP) to be distributed to the right place at the right time, IMP kits have to be shipped from the production facility through a depot network to the clinical sites where they are needed for patient dispensing. On its way through the depot network, an IMP kit might be sent to a single depot or, in more complex distribution networks, pass through several depot levels before being sent to a clinical trial site.

The management of depot and site resupplies with IMP kits has common objectives: On the one hand, it is necessary to ensure that the depot or site is never at risk of stocking out. On the other hand, it is necessary to prevent resupply shipments to the depot or site from occurring in rapid succession.



Depot demand and supply over time. *The depot short window (SW) demand is the forecasted demand in the time it takes to resupply the depot. This is the trigger for resupply. The depot SW + long window (LW) demand is the forecasted demand in the short window plus the forecasted demand in the desired depot resupply interval. This is the replenish-to level of depot resupply. The depot inventory sinks over time as site resupply shipments are created. When the depot inventory reaches the depot SW demand, then a depot resupply is created, which replenishes the depot inventory to the level of depot SW + LW demand.*

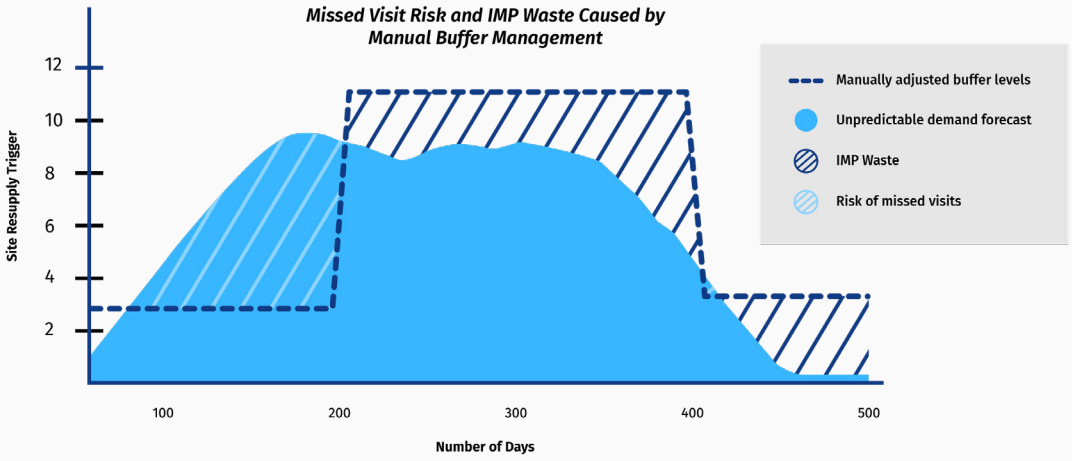
In most larger trials, the shipment of IMP kits to clinical trial sites is managed automatically by the site resupply algorithm, which runs daily in the randomization and trial supply management (RTSM) software supporting the clinical trial. This algorithm triggers site resupply shipments as soon as the site inventory of a kit type is at risk of running too low. When a site resupply shipment is triggered, the resupply algorithm calculates the shipped quantities such that the following resupply shipment doesn't happen too soon. This algorithm ensures that sites don't run out of medication, while at the same time ensuring adequate intervals between the resupply shipments to a particular site. But how does this same principle apply to depot resupply shipments?

Depot Demand Forecasting

Industry Standard

The future demand at clinical trial depots is driven by the resupplies to the underlying clinical trial sites, which in turn is driven by the forecasted demand of the patients at these sites. Therefore, the depot demand is ultimately driven by the forecasted patient demand. On each day, the RTSM forecasts the patient demand of each kit type at each study site. However, in most RTSM systems, the forecasted patient demand is only used to calculate site resupply shipments. It isn't used to determine when depots require resupply shipments and which quantities should be shipped. Instead, this task is left to the supply manager, who has to (1) continuously monitor the stock at each depot to determine when a depot resupply shipment is needed and (2) calculate the depot shipment quantities to cover the demand at sites supplied by that depot. The only support provided by most RTSM systems is the low depot stock alert. For this alert, an alert level is configured for each kit type and depot, and an alert is dispatched when the available inventory of a kit type at a depot falls below this level.

The low depot stock alert is designed to act as a trigger for depot resupply. However, it isn't well-suited for this purpose because it is manually defined by the supply manager and remains static unless updated. For it to function effectively, the depot resupply trigger level should be based on the forecasted depot demand during the resupply lead time (depot short window, SW). This means the trigger level needs to adjust over time as the forecasted demand for patients at underlying sites evolves.



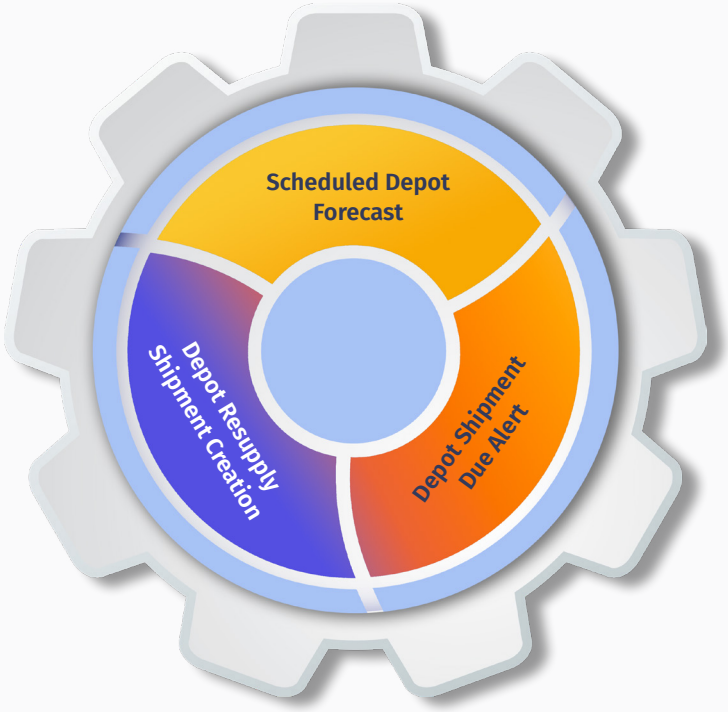
Depot low stock alert level vs. forecasted demand in the time it takes to resupply the depot (short window, SW). The low depot stock alert level for a kit type is user-defined and static unless manually updated. The forecasted depot SW demand for a kit type changes over time according to the forecasted patient demand for that kit type at underlying study sites. The forecasted depot SW demand is a valid trigger for depot resupply shipments, while even a well-maintained depot low stock alert level is always either too low (depot stock out risk) or too high (medication scrapped at depot).

Depot Demand Forecasting

Continuous monitoring of depot stocks with the low depot stock alert as only technical support is highly challenging, particularly for supply managers with responsibility for multiple trials. Therefore, supply managers tend to overstock depots, because this is really the only option at their disposal to prevent highly critical depot stock out situations. However, this approach has the downside of causing a substantial increase in preventable medication scrap when exaggerated depot stocks reach the end of their shelf life before they are needed in site resupply shipments.

Depot Forecasting in Prancer RTSM®

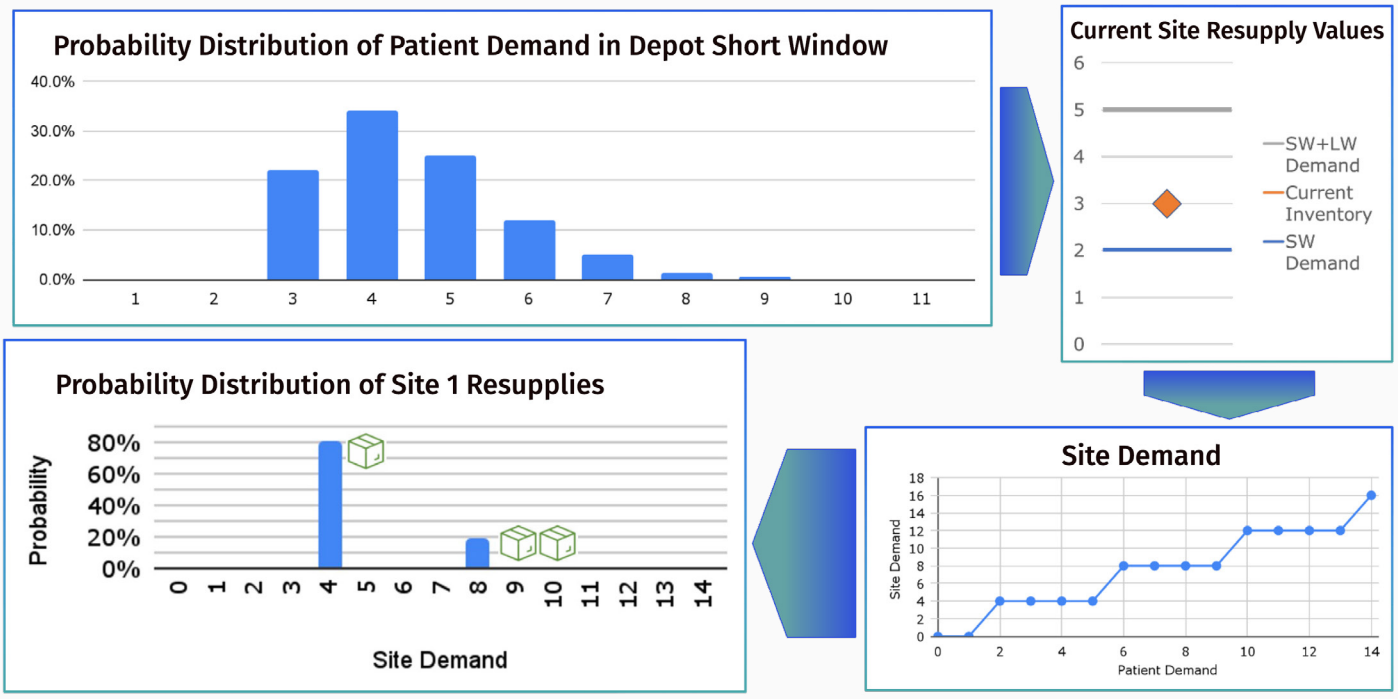
In addition to the industry standard depot low stock alert, Prancer RTSM® features a dedicated depot demand forecasting function. This function uses a forecasting algorithm which is based on the patient demand forecasting logic that is already used in the site resupply algorithm. The demand depot forecasting algorithm runs once a day as a scheduled task for each depot and forecasts site resupplies based on the current situation of projected and existing patients at each site that is supplied by the depot. The forecasted site resupplies are then used to determine the depot resupply trigger level as well as the depot replenish-to quantities for each kit type. If the algorithm determines that a depot resupply shipment is needed, then the supply manager is notified and supported in creating the depot resupply shipment.



Depot forecasting and resupply process. A periodic task determines the trigger and resupply levels for each kit type and each depot. If the inventory of any kit type at any depot is below the trigger level, then the depot resupply function alerts the supply manager and provides support in creating the depot resupply shipment.

Depot Demand Forecasting

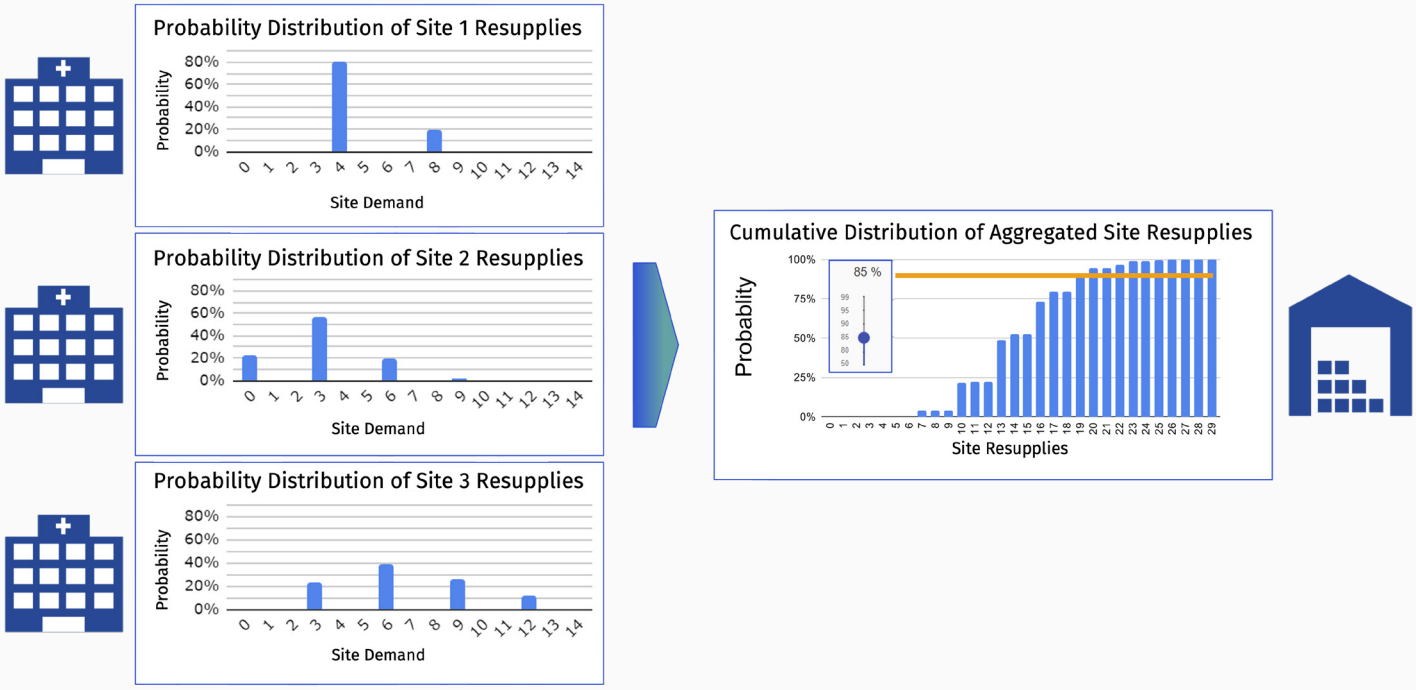
To determine the resupply trigger level for each kit type at a depot, the depot forecasting algorithm first calculates the demand of all patients at all sites which are supplied by that depot in the time it takes for a resupply shipment to reach the depot (depot short window, SW). Then, the algorithm uses the site resupply settings to calculate the expected shipments to the sites supplied by the depot.



Forecasted site resupplies. Patient demand is calculated for each kit type (top left panel) and then the site resupply settings (top right panel) are used to determine the expected site resupply shipments (bottom panels).

Once the expected resupply shipments to all study sites supplied by a depot have been determined, the depot forecasting algorithm uses statistical calculations to determine the maximum expected demand for each kit type which will occur at the depot in the depot short window. This calculation approach is employed because the depot short window demand forecast is used to determine the depot resupply trigger level and is thus responsible for mitigating the risk of depot stockouts. If the actual depot demand turns out to be higher than forecasted, then the consideration of the maximum demand in the depot short window ensures that depot stockouts are still prevented.

Depot Demand Forecasting



Forecasted depot demand in the depot short window. Statistical calculations are used to determine the maximum depot short window demand for a kit type from the expected resupply shipments to all sites supplied by the depot.

When the current depot inventory falls below the calculated depot resupply trigger level, then Prancer RTSM® alerts the supply manager that a depot resupply shipment is needed. In contrast to site resupplies, however, the system does not automatically generate depot resupply shipments. This is the first building block which ensures that ultimate control over depot resupplies always remains with the supply manager.

The forecasting logic to determine the quantities for a suggested depot resupply shipment is conceptually the same algorithm as the one described for the calculation of the depot resupply trigger level. However, it is the demand in the depot long window which is calculated to determine the depot resupply shipment quantities for each kit type. The depot long window is a number of days after the end of the depot short window which is defined and maintained by the supply manager and represents the desired interval between depot resupply shipments. A small long window leads to smaller, more frequent depot resupply shipments, while a larger long window leads to larger, less frequent depot resupply shipments. Another aspect which differentiates the depot long window demand calculation from the depot resupply trigger calculation is that the depot long window demand calculation doesn't consider the maximum demand. Instead, the algorithm determines the average demand in the depot long window.

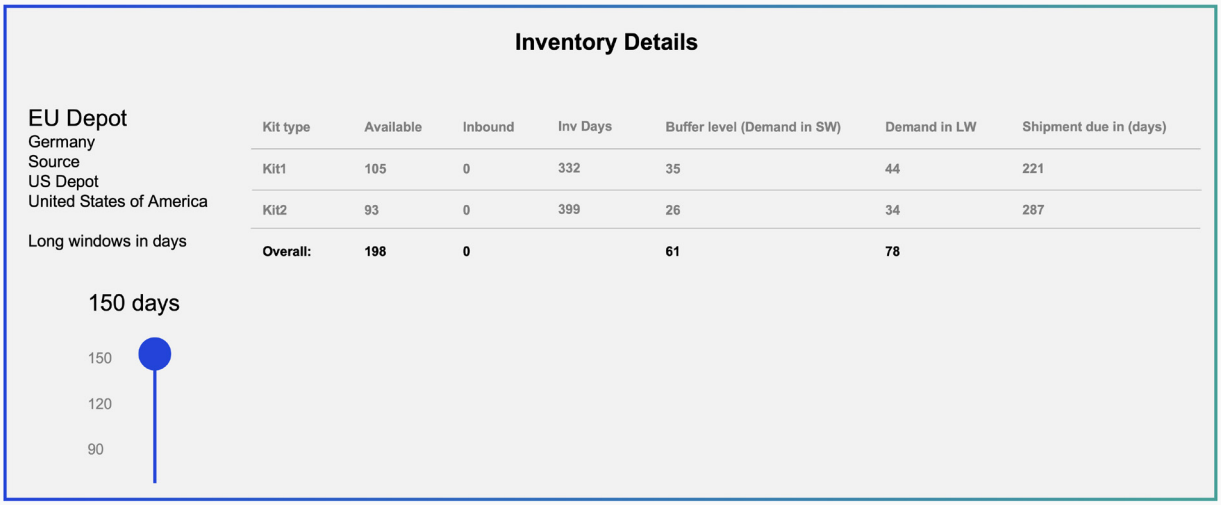
Depot Demand Forecasting

This occurs because the objective of the depot long window demand calculation isn't to mitigate the risk of the depot stocking out but rather to achieve the desired depot resupply shipment frequency as closely as possible.

The calculated depot long window demand for each kit type is used to suggest depot resupply shipment quantities when these are proposed. However, the supply manager always has the option to edit the proposed resupply shipment quantities during the depot resupply shipment creation process. This is the second building block to ensure that ultimate control over depot resupplies always remains with the supply manager.

Working with Depot Forecasting in Prancer RTSM®

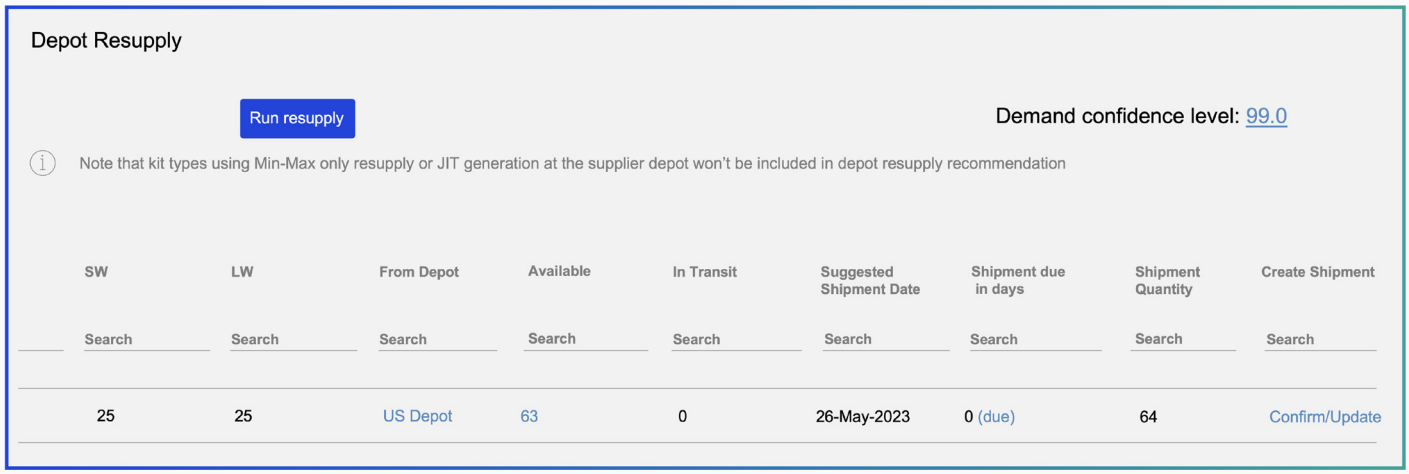
The depot forecasting section of the supply manager user interface is the information hub for depot forecasting. Here, the depot short window demand (depot resupply trigger level), depot long window demand, available inventory, and inbound inventory are shown for each kit type and each depot. In addition, the forecasted depot demand is used to calculate and display the number of days until a depot resupply shipment is expected to be due for creation, as well as the number of days the current depot inventory (including inbound inventory) is expected to last if no further depot resupply shipments are raised (Inv. days).



Excerpt of depot forecasting section showing the data for a single depot. Table columns from left to right: Kit type, Available (quantity of valid kits in depot stock), Inbound (quantity if valid kits in existing inbound depot resupply shipment), Inv days (number of days until a depot stock out is expected if no further inbound depot resupply shipments are created), Buffer level (forecasted depot demand in depot short window), Demand in LW (forecasted depot demand in the long window defined by the slider on the left), Shipment due in (number of days until it's expected that a new inbound depot resupply shipment will be needed).

Depot Demand Forecasting

When a depot resupply shipment is due, Prancer RTSM® will suggest that a depot resupply shipment is created. The supply manager then has the opportunity to confirm that the depot resupply shipment should be created



Depot resupply shipment proposal user interface. Prancer RTSM® proposes that a depot resupply shipment is created and specifies the proposed shipment contents. The supply manager has the opportunity to confirm the creation of the shipment, which starts the actual shipment creation process.

If the supply manager chooses to confirm that a depot resupply shipment should be created, then the shipment creation dialogue is opened with pre-populated values for the shipment contents. The supply manager then has the opportunity to modify the quantities of each kit type to be shipped and subsequently complete the shipment creation process.

Depot shipment creation user interface. Prancer RTSM® pre-populates the shipment details, including the shipment contents of each kit type, based on the depot forecasting results. The supply manager then has the opportunity to modify the shipment details, including the shipment contents, and to complete the shipment creation process.

Depot Demand Forecasting

Once a depot resupply shipment has been created, the shipment contents are considered as inbound inventory at the receiving depot and impact (increase) the number of days until the subsequent depot shipment is expected to be due (column Shipment due in), as well as the number of days the available and inbound inventory is expected to last (column Inv days).

Conclusion

Depot demand forecasting and resupply management are essential components of the IMP supply chain in clinical trials. However, the industry standard of RTSM technology offers very little support to supply managers to ensure that depot resupply shipments are consistently generated at the right time and with the right shipment quantities. This lack of support makes it very challenging for supply managers to accurately determine when a depot resupply shipment is needed and how much to resupply. In the worst case, this can cause depot stock outs and, consequently, site stock outs and missed patient visits due to inadequate medication supply. More commonly, however, the result is that depots are overstocked to prevent stock out risks, which can lead to a substantial increase in preventable medication scrap.

Prancer RTSM® features a unique depot demand forecasting and resupply functionality which runs a scheduled task each day to forecast the demand of each kit type at each depot in the number of days it takes to resupply the depot (depot short window) as well as in a defined number of days after that (depot long window). If the current depot inventory of any kit type isn't enough to cover the forecasted demand in the short window, then Prancer RTSM® proposes that a depot resupply shipment is created and suggests shipment contents which consider the forecasted short window demand, the forecasted long window demand,depot and the current depot inventory. The supply manager then has the choice to create a depot resupply shipment as proposed, to modify the proposed depot shipment contents, or to not create a depot resupply shipment. Once a depot resupply shipment has been created, the shipment contents are considered in the depot demand forecasting logic.

Thus, the depot demand forecasting and resupply functionality supports supply managers in ensuring that risks to supply security are mitigated while minimizing medication waste, but ultimately leaves the decision of whether a depot shipment is created and with which contents in the hands of the supply manager.

Meet the **Author**

Benjamin Etschmann has spent more than 10 years in clinical trial supply management in various roles, including operational trial supply logistics management and trial supply setup management. However, his primary focus has been in IVRS/IRT/RTSM management and demand forecasting using dedicated stochastic simulation tools. In his current role, he consults clients and internal teams on probabilistic site and depot demand forecasting in IVRS/IRT/RTSM.

For more details on how 4G Clinical can assist you visit **4gclinical.com**

Contact us **info@4gclinical.com**

About us

4G Clinical's suite of innovative RTSM and clinical supply optimization software provides the right-sized support for any phase or trial complexity. At 4G Clinical, all studies are supported by a team of RTSM experts to advise trial teams on the best path forward. Our operations team distinguishes itself through their extensive industry expertise and deep understanding of trial designs and mid-study adjustments. As a critical partner throughout clinical development, we can help you seamlessly transition and scale your trials through both protocol and supply complexities to help **bring crucial medicines to those who need them, *faster.***