White Paper: RDI Calculator

What is RDI?
Relative Dose Intensity (RDI) is “the amount of a particular chemotherapy given over a specific time in relation to what was ordered or is considered standard.”¹ RDI is expressed as a percentage of the actual dose and dose schedule in relation to the planned dose and planned dose schedule.

Why RDI Matters
There is an increasing amount of data available describing the importance of maintaining the relative dose intensity of a chemotherapy regimen across many tumor types, including adjuvant breast cancer and non-Hodgkin’s lymphoma.²³ Overall survival rates are highest when 85% or more of the planned chemotherapy is delivered.⁴

Challenges of Calculating RDI – and Chemotherapy Dosing, in General
Calculating RDI is complex. In fact, calculating the planned (or “suggested”) dose is surprisingly difficult. And, in spite of the fact that every oncology professional faces this task each and every time a cancer patient comes in for treatment, no other tool exists for automating this task.

Variable Methods of Calculating Planned Dose
Chemotherapy agents are dosed in several different ways. Most are calculated based on body surface area or “BSA.” There is a straightforward equation for computing BSA based on weight and height though, of course, it varies depending upon whether metric or U.S. Standard is used for the measurements.

Others agents, such as carboplatin – a drug commonly used to treat lung cancer – are calculated based on area under the curve or “AUC.” AUC calculations have an additional level of complexity in that one of the key inputs – the patient’s Glomerular Filtration Rate or “GFR” – can be arrived at in several different ways. Some oncology professionals use the Cockcroft-Gault method to calculate GFR; others use the Jelliffe method; and still others measure the patient’s creatinine clearance rate rather than calculating it.

Others chemotherapy agents are dosed based on weight alone. Yet others have a fixed dose. And, regardless of the method for calculating dose – BSA, AUC, etc. – some agents, such as vincristine, additionally have a maximum dose or cap.

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³ Chirivella I, et al. Poster presented at: 42nd Annual Meeting of the American Society of Clinical Oncologists; June 2-6, 2006; Atlanta, Ga. Poster G-12
⁴ Bonadonna G, et al. N Engl J Med. 1995;332:901-906, and Bonadonna G, et al. BMI. 2005;330.217-222. A 30-year study of 12,000 breast cancer patients showed that patients who received optimal doses of 85% or greater showed a long-lasting, superior benefit (relapse-free survival 42%; overall survival 40%) compared with patients who received lower and/or delayed doses (26% and 21% respectively).
The process of figuring out the planned dose is so onerous that oncology professionals have implemented practices to avoid recalculating it each and every time a patient is treated – even though doing so represents the standard of care. It is common to adjust the dose of BSA-calculated agents only if the patient has lost more than 10% body weight. Unfortunately, this can have negative consequences. Imagine a 150-pound women loses 14.5 lbs. Her dose isn’t recalibrated. As a result, she receives more chemotherapy than she should have. That, in turn, leads to increased risk of toxicities, skipped or delayed treatment cycles, lower RDI, and a poorer outcome.

**Calculating Dose Delays**

A second challenge in calculating RDI is accounting for the timeliness factor. This is complicated by the fact that not every agent is administered in every treatment cycle. For instance, in Hyper-CVAD, a common regimen for Mantle Cell Lymphoma, 3 chemotherapy agents are administered in cycles 1, 3, 4 and 7; the other 2 are administered in cycles 2, 4, 6 and 8. Dose delays, then, need to be calculated on a per-agent basis, and then rolled up into the regimen RDI.

**Regimen Standardization**

The final challenge in calculating chemotherapy dosing and, by extension, RDI is the lack of standardization in the representation of regimen information. For example, the commonly used breast cancer regimen “TC” (Docetaxel Cyclophosphamide) involves administering 2 agents, four times, at 3 week intervals. That is most appropriately referred to as “4 cycles” administered on a “21-day cycle.” However, the same oncologist may refer to this as “4 3-week cycles” in one patient record, and as a “weekly” regimen in which “the drugs are administered in weeks 1, 4, 7 and 11” in another. That variability makes it difficult for practices to implement an automated method of calculating dose; and it makes it impossible for them to conduct cross-patient evaluations of RDI.

**The RDI Calculator**

The goal of the **RDI Calculator** is to enable oncology professionals to easily calculate and track RDI, and to use it as a benchmark for evaluating practice patterns and outcomes. The **RDI Calculator** is also designed to support research on RDI outcomes for other cancer types.

Because the **RDI Calculator** incorporates dosing information for many commonly used regimens, all the user needs to do to calculate RDI is:

1. Open a Patient Worksheet
2. Select the regimen
3. Enter patient’s height, weight, age and gender
4. Enter the actual cycle start-dates, and amount of each chemotherapy agent administered

The **RDI Calculator** does the rest, computing and displaying RDI for each chemotherapy agent and for the regimen overall in straightforward tables and charts (as shown above).
Features and Components

At the heart of the **RDI Calculator** are five key components:

1. **Regimen Library**
2. **Treatment Scheduler**
3. **Chemotherapy Dosing Calculator**
4. **Real-Time Monitoring**
5. **Report Builder**

**Regimen Library**

The RDI Calculator’s Regimen Library includes over 200 commonly used chemotherapy protocols. The regimens are sorted by cancer type, and available for selection from the Patient Worksheet. In the Regimen Setup users can:

- Add, edit or delete their own regimens
- Copy and modify an existing regimen
- Indicate the regimens that should be included or omitted from the selection list in the Patient Worksheet

When a regimen is selected, the treatment table is automatically set with the individual agents listed down the far left column, and the correct number of cycles set for each agent. Depending upon the dosing type, there may be additional fields, such as a serum creatinine fields for AUC-dosed agents. In the example below, doxorubicin and cyclophosphamide are administered in cycles 1-4, and docetaxel in cycles 5-8.

*Figure 2. Sample treatment table*

![Patient Worksheet](image-url)
**Treatment Scheduler**

Once the treatment table is set-up – based on the regimen selection – the user’s next task is to enter the treatment schedule. When the user clicks into the 1st date field, it defaults to today’s date. When the user clicks into subsequent date fields, the date defaults to the start-date of the previous cycle plus the length of the treatment cycle (according to the regimen). This makes it very easy for users to set the correct schedule, and see the immediate impact of any deviations.

In the example below, the treatment cycle is 21 days and the first cycle started on 7/1/2010. When the user clicked into the date fields for cycles 2, 3, etc., the default dates were 7/22, 8/12, etc. – the dates when those treatment cycles should have started. In this case, however, the oncologist skipped the 4th cycle (and edited the field accordingly), resulting in cycle 3 being extended by 21 days. Such deviations are highlighted in the tooltip.

*Figure 3. Treatment schedule*

**Patient Worksheet**

![Patient Worksheet](image)

**Chemotherapy Dosing Calculator**

The Chemotherapy Dosing Calculator is similar to the Treatment Scheduler. It firsts calculates what the dose should be based on a number of factors, including weight, height, dosing constraints (i.e. maximum dose), and other factors. The planned dose can be viewed in a tooltip when the user holds the cursor over the Agent Administered field, as shown below. Holding the cursor over the weight fields displays the BSA. Holding the cursor over the serum creatinine level fields displays the AUC calculation. (The user is first prompted to select the method by which they arrive at GFR.)

The user is then expected to enter the amount of each agent that was actually administered during each cycle in the blank boxes.
Real-Time Monitoring

Having entered the actual dosing information and schedule, the user can see how it compares to the standard of care by clicking the “I” icon to the right of the RDI number, as shown below.

This explanation of RDI can be very important because, often times, *unintentional* reductions and delays are not readily visible to the oncologist. For example, dose is routinely reduced at the start of treatment to comply with packaging demands. In the example above, the planned dose for this patient for doxorubicin is 96.3 mg. But, doxorubicin comes in 10 mg increments, so, the oncologist will typically round down to 90 mg because it makes economic sense. This, of course, means that the patient *starts* chemotherapy with a reduced RDI. In the example above, the patient also skipped a cycle. This frequently happens because cancer patients frequently wish to visit family, or go on long-
deferred vacation during treatment. The combination of those unintentional (non-medical) dose delays and reductions means that this patient’s RDI was dangerously low halfway through treatment.

The **RDI Calculator** ensures that the impact of both intentional and incidental dose reductions and delays are obvious throughout treatment.

**Report Builder**

The Report Builder enables users to look at RDI across multiple patients, evaluating trends and identifying key factors that correlate to a low or high RDI value. There are two basic types of reports that one can create with the **RDI Calculator**: The Default Report looks at **all** of the completed worksheets in the Patient Worksheet folder. The Custom Report looks at a subset of Patient Worksheets, as defined by the user.

In the example below, the user created three custom reports, one looks at average RDI among patients that experienced toxicities of a grade 3 or higher during treatment. The other two look at the average RDI for all patients before and after a specific date when the practice implemented certain changes.

**Figure 6. Report Builder dialog**

RDI reports provide the average RDI for the group, as well as a comparison of other factors within that group, such as average RDI by physician, practice, patient characteristics, toxicities, interventions, etc.

RDI reports can be printed, or exported as an Excel, Word or PDF file.
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NearSpace Medical is an interactive agency focused on custom healthcare software. We work with our clients (and, often, their full service agencies) to design, develop and distribute distinctive tools and resources that engage our clients’ core constituents, including doctors, nurses and other healthcare professionals.