Tomorrow’s path to improved early-phase oncology drug development

Maximizing quality and efficiency of go/no-go decisions in early-phase studies

Philip Breitfeld, M.D., Vice President Therapeutic Strategy, Quintiles
Eric Groves, M.D., Ph.D., Vice President Center for Integrated Drug Development, Quintiles
Chris Learn, Ph.D., PMP, Senior Clinical Program Manager, Oncology, Quintiles

Executive summary

Due to the size and scope of clinical trials in this therapeutic area, traditional early oncology development has evidenced high start-up costs and long durations to advance to the Phase II setting. While the website ClinicalTrials.gov reveals that there are many products and programs in development, soaring costs, long timelines, and high failure rates result in relatively few investigational drugs progressing all the way to marketing approval. This is unfortunate for patients who may have benefited from pharmacotherapy earlier, and makes it challenging for biopharmaceutical companies to achieve a return on investment and hence to be in the financial position to continue with research and development (R&D) programs for other potential drug candidates.
Executive summary, continued

The high attrition rate occurring between progression to clinical development and marketing approval suggests that initial candidate selection processes are not optimal. Given the high costs of development and the demands upon patients who participate in clinical trials, it is essential to select only those molecules from preclinical development programs that are truly worthy of advancing to Phase I clinical trials and likely to meet the criteria for success in later-phase trials. More focused and informed decision-making is therefore vital. Fortunately, advances in molecular biology and patient molecular profiling that may facilitate targeted therapy have ushered in new hope and enthusiasm for better clinical outcomes. Targeted therapy represents a transition from broader-acting cytotoxic agents with high toxicity levels toward agents with high specificity and hence therapeutic benefit for a well-defined group of patients with a particular molecular biological profile.

For such advances in clinical practice and outcomes to be maximized, it is important to better understand the biological consequence of treating a biological pathway of interest in the preclinical setting. Identifying candidate biomarkers for mechanism of action (MOA) and selection of patients to participate in a given clinical trial is of considerable importance, since drugs without a biomarker-based patient selection strategy are at a profound disadvantage. A vision of the future, therefore, would be for newly diagnosed patients to have a comprehensive molecular profile performed and then be matched to participate in the right trial based on that profile. Leveraging ‘intelligent biomarker selection’ of patients to participate in early phase clinical trials has potential to make more efficient go/no-go decisions on product candidates at the earliest possible stage.
Introduction

Early-phase oncology development realities
This White Paper examines current issues in progressing oncology compounds from the preclinical arena through early clinical development in humans to predict future best practices. Given the increasing R&D costs and regulatory hurdles that must be navigated in getting new drugs to global markets, coupled with the high failure rate of Phase III studies in oncology, setting the right course early in clinical development is critical. The framework for deciding whether and when to progress to human studies, and the goals and expectations of early clinical development, requires critical appraisal.

Landscape review: Early oncology development

Oncology pipeline pressures have intensified the demand for speed and productivity. Today, oncology teams need approaches to make better, faster decisions about whether to kill or progress potential new products. There is a pressing need for better quality Phase I/II data to help decrease risk and improve decision making. New approaches are needed in oncology to better indicate an investigational drug’s viability, identify risks and increase compound knowledge, and facilitate better go/no-go decisions earlier in the development process.

The good news is that across the continuum of indications, the oncology pipeline remains robust. There are 1,400 oncology drug development programs in progress (Figure 1), with 81% in the Phase I, Phase II or Phase I/II combined space. Of note, breast cancer therapeutics are the most active area of dedicated research (around 155 programs in progress), followed by leukemia (around 149) and colorectal cancer (around 80). While solid tumors have historically dominated the pipeline, possibly the greatest strides in the clinic in the last few years have been in the effective treatment of hematologic malignancies, with the addition of new products in non-Hodgkin’s and Hodgkin’s lymphoma, myeloma, myelodysplastic disease and others, offering substantial therapeutic improvements for patients.

Figure 1 Oncology R&D pipeline

Source: ADIS R&D Pipeline Database, Sept. 2012
As might be expected from a development process of winnowing the most promising from the least promising, and one that proceeds stepwise with each phase of development, the number of molecules in early phase is substantially higher than in late phase. This is consistent with the oncology field having a strong pipeline of new candidates. Figure 2 illustrates that the great majority of oncology studies are currently in Phase I/II, as noted earlier and as expected in a productive field. However, it also shows that while a substantial percentage of molecules advance from Phase I to Phase II, the overall success rate for molecules progressing from Phase I to approval is low, with the high attrition rate suggesting that initial candidate selection processes are not optimal. Given the high costs of development and the demands upon patients, it is essential to select for Phase I only those molecules that are truly worthy of advancing, and that are likely to meet the criteria for success in later-phase trials.

**Figure 2 Oncology trials and success rates by phase**

![Success rates by phase](image)

<table>
<thead>
<tr>
<th></th>
<th>Small molecule</th>
<th>Large molecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 to P2</td>
<td>63%</td>
<td>84%</td>
</tr>
<tr>
<td>P2 to P3</td>
<td>38%</td>
<td>53%</td>
</tr>
<tr>
<td>P3 to NDA/BLA</td>
<td>61%</td>
<td>74%</td>
</tr>
<tr>
<td>Subm. to approval</td>
<td>91%</td>
<td>96%</td>
</tr>
<tr>
<td>P1 to approval</td>
<td>13%</td>
<td>32%</td>
</tr>
</tbody>
</table>

Source: cancer.gov, fastcompany.com

In addition, due to the size and scope of trials, early oncology development is plagued by high start-up costs and long durations to get to the Phase II setting, which can take from about 2.5 to 8 years. As a result, while metrics from ClinicalTrials.gov show that there are many products and programs in development, soaring costs, long timelines and high failure rates make it very challenging to achieve a return on investment.

**Targeted therapies as a route to R&D success**

What can the biopharma industry do to improve its R&D success in oncology? In the era of “-omics,” systems biology, and patient molecular profiling, targeted therapy has ushered in new hope and enthusiasm for better clinical outcomes, moving away from broader-acting cytotoxic agents with high toxicity levels. To date, targeted therapy development has generated a significant number of compounds with improved toxicity profiles for Phase I investigation, with almost all of these having or needing a surrogate biomarker to define the mechanism of action and/or efficacy. Unfortunately, however, even with so many targets in play for therapeutic development, the number of significant clinical advances with targeted therapies has fallen short of initial hopes, with few good biomarkers effectively utilized in early phase oncology development (Figure 3).
Figure 3 The promise of targeted therapeutics

Need for more preclinical information
The reason for this is simple: cancer is complex. There are hundreds, perhaps thousands, of genetic changes in the over 200 diseases comprising cancer. The dysregulated pathways in a tumor are well elaborated, redundant, and responsive. This means that more drugs are not necessarily better, and since combinatorial therapy can be too toxic, sequential therapy is currently necessary. However, sequential therapy carries its own caveats and risks to the patients and their treatment. These include:

- **Exclusion criteria** – The patient may not be eligible for future studies/therapies, because this eligibility is now excluded by receiving current therapy
- **Duration of treatment** – The study may go on for a period that precludes or excludes timely treatment with other therapies
- **Cumulative toxicity** – The patient may experience accumulating sequelae due to consecutive lines of therapy
- **Sequential therapy** – Treatment may not allow for the benefits of targeting pathways with multiple drugs.

It is therefore important to better understand the biological consequence of treating a pathway in the preclinical setting in order to develop an effective drug for the clinic.

Falling clinical productivity
At the level of clinical trials, this decreased efficiency is clear. The pharma industry has responded to the decrease in R&D productivity by attempting to control R&D investment. After a peak in 2008, pharma R&D spend has decreased and flattened, and the total number of trials in all phases has fallen (Figure 4). Even with this reduction in spend, the gross-adjusted efficiency of clinical R&D productivity, which historically has not been overly impressive, continues a downward trend. Against this backdrop, more focused and informed decision making is vital.
Figure 4 Declining R&D productivity

Overall trend in R&D efficiency (inflation-adjusted)

Source: Scannell et al, Nature Reviews, 2012

A key step in informing decisions is to gain a better understanding of the drug during the preclinical phase, helping to diminish risks at later, more costly, phases of study (Figure 5). In addition, faster decisions are needed on whether to advance, hold or stop a compound’s development, such that needless spend is re-appropriated to better development opportunities. Even idle programs burn substantial money; faster decision making helps to avoid this. Faster, better informed decisions are also in the best interest of patients consenting to be subjects in early phase oncology trials. Such decisions help make it possible to avoid critical pitfalls in Phase I, especially scientifically, operationally, and from an overall business perspective. Finally, a better understanding is needed of how best to apply biomarkers and genomic medicine in the future for Phase I studies.

Figure 5 Improving Phase I oncology trials

Understand your drug better (and subsequently decrease risks for later phases)

Reach faster decisions on whether to advance, kill, or hold your compound

Avoid critical pitfalls in Phase I — scientifically, operationally, and overall business perspective

How to incorporate biomarkers and genomic medicine in the future of Phase I studies

Quintiles Oncology Center of Excellence

The pharmacy has responded to the lack of R&D productivity by attempting to control R&D investment.
Future approaches to improving Phase I oncology studies

The main elements of a Phase I program are shown in Figure 6.

Figure 6 Elements of a Phase I program

Key steps to success

Data requirements for Phase I studies are well established and include: toxicology, animal pharmacokinetics (PK)/pharmacodynamics (PD); Chemistry, Manufacturing, and Controls (CMC); and limited pharmacology. When combined, these are usually sufficient to establish a starting dose and potential multi-dose schedule. However, this information is not enough for a successful program; key additional steps need to be included:

- Clearly identifying the potential commercial target and its commercial context. It is never too early to draft a Target Product Profile (TPP).
- Obtaining management approval of the draft product development plan/timeline/cost, putting a development team in place, and securing adequate funding and Intellectual Property protection.
- Determining whether the in vitro and in vivo pharmacology data are adequate to support the proposed TPP, and whether there is sufficient information about the drug’s mechanism of action (MOA).
- Ensuring that CMC is at sufficient scale and stability to support the proposed development program, and that the formulation is appropriate.
- Identifying candidate biomarkers for MOA and patient selection, since drugs without a biomarker-based patient selection strategy are at a profound disadvantage. Ensuring that the necessary assays are validated and set up for rapid turn-around.

These steps are illustrated in Figure 7 – a complex process further complicated by the fact that, typically, many team members on a given oncology development program have never participated in an oncology development program before.
An efficient development process needs to go beyond the goal of establishing the classic maximum tolerated dose (MTD). The MTD alone is not sufficient to ensure an expedited Phase II program. A more appropriate goal may be to establish an optimal biologic dose where possible, as well as focusing on establishing an appropriate target dosing schedule. The product’s safety profile must be mapped out, but Phase I safety data are limited, as the small patient numbers give restricted information about infrequent adverse events (AEs). PK data for the molecule and its major metabolites (as defined in preclinical studies), including any food effects, should be documented. The MOA should be confirmed by documenting receptor or enzyme modulation/blockade. It is also important to confirm at an early stage that biomarker assays really work, to focus on the most useful ones, and if possible, to develop new biomarker indicators. Positron Emission Tomography (PET) or other imaging reagents and techniques should be co-developed and piloted as a baseline for subsequent development phases.

Early development should include tracking markers of efficacy, for example via imaging or neo-adjuvant pathology. Looking ahead, it may be possible to track circulating tumor DNA or circulating tumor cells (CTCs). Biomarkers can also be used to refine the link between MOA and patient benefit. In order to facilitate patient selection in Phase II, it can be useful to add a Phase Ib trial at MTD in target diseases to the end of Phase Ia.

**Biomarker-driven approaches**

A core philosophy towards greater achievement in Phase I studies is to support the effort with a biomarker-driven approach. At the preclinical stage, this includes biomarker discovery and technical validation, and establishing an understanding of the biology of disease targets and pathways. The effect of the compound on cell lines should be analyzed, and up- or down-regulated genes should be identified. Thus, the MOA is hypothesized and mechanism-based biomarker candidates are elucidated. At the clinical stage, this information is used to support planning and design of clinical trials, patient screening, prognosis and disease monitoring. It also helps with correlation to clinical endpoints, confirming prognostic and therapeutic utility, and demonstrating cost-effectiveness.

Naturally, biomarkers come at a cost. Pitfalls exist, with each approach having risks and benefits. These choices need careful consideration, paying attention to factors such as how the samples will be collected and how frequently, whether it is possible to ship samples outside the country where the trial is being conducted, and whether the consent form is written to allow samples to be re-examined at a later date.
There are three main options for Phase I study design:

- **Patient-based Phase I**: Traditionally, first in man, single agent oncology Phase I trials are conducted in multi-dose patient trials. These can be quite lengthy, but work reliably.

- **Healthy volunteer-based Phase I**: Alternatively, single dose and potentially multi-dose Phase I trials can be conducted in healthy volunteer subjects to save time and money, provided the agent does not modify DNA, is not likely to be a carcinogen, and does not carry a long term safety risk. However, when the target patient population is expected to require different exposure levels than healthy subjects (which would be unusual in oncology), a bridging study from healthy volunteers to patients will be required and may cancel out the time savings.

- **Mix and match Phase I**: In volunteer designs, single dose is usually separated from multi-dose and single dose information may be used to reduce the number of multi-dose cohorts. This allows for a switch to patients for a more limited number of levels of multi-dose escalation.

**Optimizing dose escalation cycles**

To accelerate Phase I multi-dose trials, a useful approach is to define a functional cycle of two to six weeks in duration; each dose level cohort receives a cycle of dosing and then is observed before the next cohort receives the escalated dose. The Phase I target goal needs to be defined, and the MTD, optimal biological dose and schedule then established. If possible, the number of dose escalation steps should be reduced, since these impact study duration and cost. Approaches to reducing the number include:

- Reduce the number per cohort for lowest doses.
- Change from traditional 3+3 design (which does not define the MTD very well) to a Continuous Reassessment Design (which defines it better).
- Add a PK/PD-guided procedure to define the dose level for the next cohort.
- Avoid focusing on specific disease populations until Phase Ib.

Early clinical modeling and simulation can help translate preclinical data into an accelerated dose escalation scheme. PK/PD approaches can expand the information from preclinical studies into Phase I, allowing simulation of exposures and multiple exposures, with the goal of increasing the efficiency of dose escalation. These are not easy to put in place, but help make the process work more efficiently, and provide more information about the drug at an earlier stage.

**Study conduct mechanics**

For the mechanics of study conduct, smooth processes are important in order to avoid surprises. The requirements at various stages of early development are illustrated in Figure 8.
Figure 8 Study conduct mechanics

Summary: proposed improvements
In summary, key areas for improvement in early phase oncology development, along with proposed solutions, are as follows:

- **Commercial potential is not defined**: A gap assessment should be performed and a TPP and Product Development Plan (PDP) developed at the earliest possible point.

- **Criteria for go/no-go are ill-defined** and lack tethering to the TPP at key points. This can be addressed by a TPP and PDP with well-defined criteria for go/no-go decisions. Management needs to sign on to these criteria.

- **Data from the Phase I study are limited** and fail to speed program progress to next stage: Here, more robust and complete preclinical data provide a solution.

- **Product program is not adequately resourced** to drive quickly and efficiently to key decision: This can be addressed by real-world objective assessment and data-driven decisions.

All these elements must be addressed upfront, and followed with ongoing attention to all details. Total solutions will not be achieved overnight.

Opportunities for molecular profiling in oncology drug development
Speaking at this year’s Economist Global Healthcare Summit, Dr. Stephen Spielberg, Deputy Commissioner of the U.S. Food and Drug Administration, predicted that diseases would eventually be classified based on their biological mechanism. “We are dividing up diseases into ever smaller categories. It has huge implications for those who are discovering and developing new drugs and huge implications for us as a regulatory agency.” Spielberg referred to the successful drug candidates in this new paradigm as “mini-busters” for their relatively small piece of the pie compared to the blockbusters of the past. More efficient and productive early phase oncology development, and specifically genomic or molecular profiling of patients potentially eligible for such studies, has potential to leverage this new paradigm and take these new mini-busters to patients.

To achieve the ideal of targeting biologically- and biomarker-defined patient populations for early phase oncology clinical trials, a better understanding of fundamental cancer biology and how a drug candidate
MOA might counteract that biology is required. This knowledge, along with understanding of a short list of the biomarkers that influence a drug’s mechanism of action, can significantly help in improving R&D productivity. The current implementation of matching biomarker-defined cancer populations to specific trials is inefficient, and future best practice will depend on unprecedented cooperation between investigators, patients, biopharma companies and their partner CROs.

An important recent development has been an appreciation of the value to patients of agents targeting specific functional pathways or circuits in the cancer cell. These can be fully unlocked only when key nodes in those circuits can be identified. The nodes essentially dictate how effective the targeted agent might be for a given patient. Figure 9 shows the epidermal growth factor receptor (EGFR) pathway and highlights the central importance of k-ras status when predicting clinical benefit in colorectal cancer in the context of monoclonal antibodies designed to inhibit this circuit.

**Figure 9 Patient selection using biomarkers**

Therapeutic targeting of the hallmarks of cancer

Drugs that interfere with each of the acquired capabilities necessary for tumor growth and progression have been developed and are in clinical trials or in some cases approved for clinical use in treating certain forms of human cancer. Additionally, the investigational drugs are being developed to target each of the enabling characteristics and emerging hallmarks, which also hold promise as cancer therapeutics. The drugs listed are but illustrative examples; there is a deep pipeline of candidate drugs with different molecular targets and modes of action in development for most of these hallmarks.

**Improving go/no-go decision-making**

Leveraging the intelligent biomarker selection of patients for early phase clinical trials has potential to make more efficient go/no-go decisions on product candidates at the earliest possible stage. Figure 10 illustrates the current status on the left-hand side, where a novel target is discovered, a lead candidate inhibitor identified and moved through standard toxicological testing and xenograft tumor models, an Investigational New Drug application (IND) is submitted and Phase I development begins. In this case, the biology of the target and the MOA of the drug are often not fully understood, so initial testing takes place in an unselected patient population with enormous biologic heterogeneity.

This issue has been highlighted as a significant issue in the preceding sections. As expected, most of the time only modest clinical activity is seen in a few patients with this “all-corners” unselected approach. These inconclusive data, combined with imprecise go/no-go criteria, can lead to the promotion of drugs to Phase II and even Phase III without a good knowledge of what biologically-defined patient population is most likely to benefit and without a good positive clinical signal.

**Molecular-based selection of trial participants**

On the right-hand side of Figure 10 is an alternative scenario. Here, there is a good biologic understanding of the target and how this drives the target cancer. Likewise, the way the lead candidate inhibitor interacts with the target pathway and its biologic consequences are also understood. This suggests the possibility that patients entering early phase studies of the drug should be selected based on molecular characteristics believed to be essential for drug activity. With this set-up, such early phase studies have the potential to be true tests of drug activity. Such early-phase studies afford the best opportunity to see efficacy if the
While this approach is promising, a short list of critical success factors is needed to leverage it. These are: (1) a demonstrated link between a biomarker and efficacy in a preclinical model; (2) a robust assay for the marker; (3) an “all-comers” strategy not being suitable; and finally, (4) a scientific and clinical development team that has experience navigating these issues.

Clearly, many development programs are not in a good position to select patients for early phase studies using molecular markers. The fundamental hurdle can be the limits of our biologic understanding of a target and its inhibitor. There are many examples of targeted therapies approved for use where selection markers were simply not available at the time of approval, despite great efforts to understand the drug in these terms. In some cases, selection markers become known post-approval, improving the benefit-risk profile. However, even when there is a good biologic understanding of a target and its inhibitor, there are practical barriers to executing molecularly-based patient selection early clinical development. Commonly, patients do not come to trial screening with relevant molecular profiling already having been performed, especially for novel biomarkers. The resulting high screen failure rates in certain situations may limit investigator and patient enthusiasm. Molecular profiling of patients prior to consideration of trial participation could overcome some of these barriers.

**Molecular markers as a screening tool**

Figure 11 outlines the current approach for using molecular markers as a screening tool for clinical trials. This example involves a patient with non-small cell lung cancer (NSCLC) who is being screened for a trial where a specific EGFR mutation is an entry criterion. If positive, the patient has the potential for participation. If negative, then another trial, perhaps one requiring an Alk mutation, is considered and the screening testing proceeds. If this is negative, additional options can be considered. The downside of this process is clear: The iterative/sequential testing of a series of markers costs time and money.

A vision of the future would be for newly diagnosed patients to have a comprehensive molecular profile performed and then be matched to the right trial based on that profile. The time and cost advantages are clear. This approach is now starting to be used at some sites and organizations. Examples include recently published efforts by Daniel Von Hoff of the Translational Genomics Research Institute (Arizona, USA) and

---

**Figure 10 Biological patient selection**

<table>
<thead>
<tr>
<th>Heterogeneous non-biological selection</th>
<th>Molecular-based patient selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology of target poorly understood</td>
<td>Good biologic understanding of target</td>
</tr>
<tr>
<td>MoA of drug poorly understood</td>
<td>Good understanding of drug MoA</td>
</tr>
<tr>
<td>Unselected patients in early phase development</td>
<td>Selected patients in early phase development</td>
</tr>
</tbody>
</table>

Early phase studies yield inconclusive data

Imprecise Go/No Go decisions prior to late phase development

Early phase studies are true test of drug

Can make Go/No Go decisions prior to late phase development with confidence

The fundamental hurdle to using molecular markers can be the limits of our biologic understanding of a target and its inhibitor.
colleagues, and by Fabrice Andre and colleagues at the Institute Gustave-Roussy (France). In each, the key theme is to gain a better understanding of the molecular profile of a patient’s tumor, followed by the intelligent matching of this profile to known targeted therapies or clinical trials relevant for the biology of the tumor. To properly leverage such a system, having access to a large number of studies to match to patients is an important success factor.

**Figure 11 Approaches for patient profiling for trial enrollment**

**Current approach:** Inefficient molecular screening to determine eligibility for enrollment

- Newly diagnosed NSCLC patient – non-smoker
- Protocol requiring EGFR mutation test
- 20% Enrolled
- Protocol requiring ALK mutation test
- 5% Enrolled
- Other Clin. Trials?
- 80%
- SOC/other options
- 95%

**Future approach:** Efficient molecular screening of cancer patients to determine clinical trial eligibility

- Newly diagnosed NSCLC patient – non-smoker
- Genetic profiling
- Protocol requiring EGFR mutation
- Protocol requiring ALK mutation
- If EGFR mut+, go to EGFR mut protocol
- If ALK mut+, go to ALK mut protocol
- If both negative, search for another trial with remaining molecular data

A vision of the future would be for newly diagnosed patients to have a comprehensive molecular profile performed and then be matched to the right trial based on that profile.

**Conclusion**

**Novel approaches hold potential to improve efficiency**

To summarize, drug development today is both expensive and inefficient, and there is a pressing need to improve productivity if we are to continue to succeed in developing oncology therapies in the future. This is especially relevant as our understanding of the biology of cancer is becoming more sophisticated and generating more opportunities, while also revealing fundamental challenges due to the complexities of this group of diseases. High quality is essential in early phase oncology development planning, with a particular need for experienced teams who pay attention to detail, planning and goals. During Phase I design, all options should be considered thoroughly, including novel approaches to PK/PD guided escalation and patient/subject selection to ensure we address the unmet medical needs of tomorrow. In the future, Biomarkers will be a crucial element in getting the maximum information from a Phase I program. Molecular profiling and leveraging molecular selection of patients has the potential to significantly improve early decisions in oncology drug development.
References

1. Pipeline information based on Adis R&D Insights data (Sept 2012).


About the authors

**Philip Breitfeld, M.D.**
Vice President and Therapeutic Strategy Head, Oncology Therapeutic Area, Quintiles
Dr. Breitfeld has over 25 years of work experience in oncology, including 20 years of experience in academic medical institutions in the US, and 7 years of experience in the pharma industry focused exclusively on oncology drug development and execution of clinical programs. Prior to joining Quintiles he held senior oncology clinical development positions at BioCryst and Merck Serono. He has around 50 peer-reviewed publications in the scientific literature, and was a Visiting Scientist at the Whitehead Institute at MIT.

**Eric Groves, M.D., Ph.D.**
Vice President, Center for Integrated Drug Development, Quintiles
Dr. Groves has over 25 years of experience in oncology drug development as senior executive or corporate officer, clinician and researcher. During this time, he has held various senior positions on projects for clinical and pre-clinical development of oxaliplatin, rasburicase, IL-2, tirapazamine, immunotoxins, bexarotine, ONTAK, AVINZA, and thrombopoietin. Prior to joining Quintiles, he held senior oncology development positions at Ligand Pharmaceuticals and Sanofi.

**Chris Learn, Ph.D., PMP**
Senior Clinical Program Manager, Oncology, Quintiles
Dr. Learn has over 10 years of experience leading investigator led oncology trials in academic settings and in industry. His expertise includes the development of molecular immunotherapies for malignant glioma. Prior to joining Quintiles, he held senior positions in clinical research at Surgical Review Corporation, The Hamner Institutes for Health Sciences and Duke University Medical Center.

**Acknowledgement**
The authors would like to acknowledge Jill Dawson, Ph.D. for her assistance in crafting and editing this document.