

# Atidarsagene Autotemcel for Metachromatic Leukodystrophy: Response to Public Comments on Draft Evidence Report

# **September 14, 2023**

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Comment **ICER Response** Manufacturers **Orchard Therapeutics** Respectfully, we disagree with ICER's C++ comparative Thank you for the clarification about the progression of the two early symptomatic effectiveness assessment applied to arsa-cel for the EJ-MLD patients who subsequently died and treatment of early symptomatic early juvenile MLD based on the cognitive outcomes for the early ICER's justification that arsa-cel treatment may hasten motor symptomatic EJ-MLD patients. We agree and cognitive decline compared to natural history. The DER that the preponderance of the data suggest infers that the reason for the C++ rating is that treatment that early symptomatic EJ-MLD patients do could initially hasten progression of physical and cognitive gain at least a small net health benefit from decline before stabilizing and treated patients would have to treatment. Therefore, we have adjusted our evidence rating to B+ for this population. deal with the consequences of bone marrow conditioning with only partial benefit. However, this is inconsistent with what has been observed in the clinical trial data. The inference of accelerated disease progression was based 2. We heard from experts that the concern about accelerated disease progression with upon conclusions from the Beschle study in allogeneic HSCT allogeneic HSCT may also apply to arsa-cel which is not applicable to arsa-cel. treatment, since the treatment regimen with arsa-cel also includes chemotherapy for bone marrow conditioning, which is hypothesized to be a trigger for accelerated disease progression. 3. See comment above. Further this inference was based upon observations of the time from treatment to death of two symptomatic EJ patients whose baseline disease characteristics are outside of the scope of this appraisal. As a reminder, the families of the two treated symptomatic EJ patients both rejected insertion of a G-tube once the patients experienced dysphagia, after progressing to GMFC-MLD 5 and 6. Whilst, at first glance, these patients would seem to have progressed more rapidly in the later GMFC-MLD stages, the "time to death" metric used to illustrate this progression did not account for carer attitudes and decisions. The rapidly progressive phase of MLD is from GMFC-MLD 2 to 5. After GMFC-MLD 5, the duration of time spent in these stages is largely based on the degree of palliative care the carers are prepared to undertake to prolong life. The time taken to transition from GMFC-MLD 2 to 5 in the two treated symptomatic EJ patients that died was comparable to the time taken to transition from GMFC-MLD 2 to 5 in the natural history data, rather than a more rapid progression.

Regarding the cognitive decline of arsa-cel treated ES-EJ patients, the clinical data do not suggest that arsa-cel treatment hastens cognitive decline in ES-EJ before stabilizing that decline. One substantial benefit of arsa-cel treatment compared to standard of care is the preservation of cognitive function even if patients have incurred some motor dysfunction prior to arsa-cel treatment. Although some of the arsa-cel treated ES-EJ patients progressed to GMFC-MLD 3 or 4, these patients have retained normal cognitive function. Comparatively, in the natural history (NHx) cohort, the majority of patients at the same GMFC-MLD level had severe cognitive impairment. In fact, ICER also stated in the DER: "Of note, cognitive function did not decline in the majority of patients with EJ-MLD treated with arsa-cel even with some motor impairment (i.e., higher GMFC-MLD level) whereas it severely declined for those in the natural history cohort even at early stages of motor impairment." (Page D12). The implications of normal cognitive function in arsa-cel treated patients are the retention of independence, attendance at school/university and interaction with their peers and these individuals are all associated with a better quality of life than those who are severely mentally incapacitated. It is, therefore, surprising that the summary of benefit for the ES-EJ cohort doesn't recognize this aspect and instead infers that cognitive decline is hastened. Finally, a recent publication by Martin et al. evaluated meaningful changes in physical functioning and cognitive declines in MLD through caregiver interview. The authors reported that caregivers felt that GMFC-MLD and ELFC-MLD accurately described motor and language declines in their children, respectively. Most caregivers (10/12) reported that the idea of delaying disease progression would be meaningful. Further, a slowing of motor function decline in GMFC-MLD, from category 1 to category 3 or from category 2 to category 4 over 2 years, was seen as meaningful by all caregivers asked. Caregivers also reported that delaying expressive language decline at any level that did not indicate a complete loss of expressive language (indicated by categories 1–3) would be meaningful.

4.

Thank you for this clarification about the cognitive outcomes in the trial. We have moved some discussion about the cognitive outcomes from the Supplement to the main report, and have expanded our discussion about the implications of maintaining normal cognitive function in the Summary section.

5. In summary, given the above evidence, we respectfully ask ICER to:

As stated above, we had expert clinicians share their concern that treatment with arsa-cel may lead to a rapid disease progression as seen in patients treated with

Remove the text suggesting that treatment with arsa-cel may allogeneic HSCT. Thus, we plan to keep this language in the report. lead to a rapid disease progression. We have adjusted our evidence rating for Re-assess the comparative effectiveness of arsa-cel in the ESthe early symptomatic EJ-MLD population as EJ population. discussed above. We find that ICER's assumption of a 20-year durability of There is considerable uncertainty regarding 6. the durability of effect of arsa-cel. effect for all full and stable partial responders treated with Considering the data and rationale provided arsa-cel is overly conservative and a gross underestimation of as well as assumptions that made in treatment benefit due to the mechanism of action, already 12 previous ICER reports for LentiGlobin gene years of clinical data, underlying biomarkers, and precedents therapies, we have altered our approach set in other disease areas would justify a proportion of regarding the durability of effect for arsa-cel in the base case. Specifically, the model patients to receive a lifetime durability of effect. now assumes that full responders stabilize for 12 years, after which there is small probability (0.02% per month) of transitioning to the unstable partial responder group in the same GMFC health state for the remaining time horizon. The 0.02% transition probability is based on previous ICER reports that evaluated gene therapies and reflects the cellular turnover that would be expected to occur over time. The same approach is applied to the stable partial responders after the period of stabilization. 7. A significant reason for the expectation of prolonged See above. durability of effect (i.e., greater than 20 years) is related to the mechanism of action of arsa-cel, Essentially, genecorrected CD34+ HSPCs contain one or more copies of the human ARSA cDNA sequence and after myeloablative conditioning, these infused gene-corrected cells engraft and repopulate the hematopoietic compartment. The myeloid progeny of these cells migrates across the blood brain barrier to reconstitute resident microglia in the brain and differentiate into endoneurial macrophages in the PNS. Gene corrected cells synthesize the functional ARSA enzyme at normal to supranormal levels and ARSA secreted into the extracellular matrix and taken up by surrounding cells leads to the breakdown of harmful sulfatides. This prevents or slows brain and PNS demyelination, neurodegeneration, and atrophy, processes that underlie the clinical manifestations of

MLD. In addition, replacing ARSA-deficient microglia with gene-corrected, ARSA-expressing microglia addresses the

	inflammatory and apoptotic aspects of MLD mediated by abnormal microglial activation and restores normal microglial function, including scavenging of excess extracellular sulfatides. Consequently, after successful and stable engraftment of gene-corrected HSCs the effects of arsa-cel are expected to be persistent, as progeny will continue to be generated indefinitely and all progeny have the corrected gene for ARSA enzyme production.	
8.	Reconstitution of ARSA activity in PBMCs to normal or supranormal levels and ARSA activity in CSF to normal levels was sustained throughout the length of follow-up, which was over 12 years in the earliest treated subject (PS-LI) and showed no trend to diminishing (Figure 1). Data from Scala et al. looking at the dynamics of genetically engineered hematopoietic stem and progenitor cells after autologous transplantation in humans showed similar results. Therefore, a stabilization period of 20 years, with an assumption that thereafter all patients progress, lacks biological plausibility. In other words, there is no biological reason to support the assumption that after 20 years, progeny cells carrying the corrected gene would suddenly stop producing the ARSA enzyme.	See above.
9.	We maintain that ICER's assumption of the 20-year durability of effect based on previous assessments of arsa-cel by NICE and FINOSE does not reflect the latest clinical data cut provided to ICER. Furthermore, it is important to appreciate that the context of these discussions was not fully captured in their assessment reports. At the time of the earliest assessment by NICE which commenced in 2020, NICE selected 20 years as their base case for the following reasons:	See above.
	Although recognizing the likelihood of durability of effect for over 20 years was high, there was still perceived uncertainty, given the lack of experience with HSC-based gene therapies with over 20 years of follow-up.	
	At the time of the NICE and FINOSE assessments, the clinical trial results available to these HTA bodies, were based on an average of only 2-3 years of follow-up with some of the later treated patients (classified as full responders) having less than 2 years of follow-up (note, although during the course of the HTA evaluation longer term data with follow-up of 5	

	years, were provided to NICE and FINOSE, this was for a limited group of patients and did not include data from patients in the expanded access programs (n=9 patients) some of whom had only 1-2 years of follow-up data).  At the time of the assessment, the additional n=10 patients treated with the cryo-preserved formulation had no clinical outcome data available.	
10.	However, since these assessments, each of the points highlighted above can be addressed with a greater level of certainty to support long-term durability due to augmentation of the evidence base.  The data from another autologous HSC gene therapy (Strimvelis) shows durability of effect beyond 20 years - nearly 25 years showing continued durability of effect.  Specifically, for arsa-cel, there are follow-up data for up to 12+ years (with an average of 8 years – an additional 3 years' worth of follow-up since the NICE and FINOSE HTAs) demonstrating preserved durability of effect for full responders. This length of follow-up is in excess of many gene therapies that have been approved in the US, of which some have been previously reviewed by ICER.  There are clinical outcomes for up to 4 years (average of 2.5 years) available for patients treated with the cryo-preserved formulation affirming the sustainability of the treatment effect.	See above.
11.	In addition, with specific reference to the comment in Table 4.1 of the DER, "However, updated data analyses submitted to other HTA agencies such as FINOSE and NICE report a decline in motor function after 2-3 years of stability," we would like to clarify that during the initial stages of these HTA appraisals, patients' response status was originally classified based on GMFC-MLD alone. Following feedback from NICE during the review process, we classified patient response using a more holistic and robust method through observing a multitude of outcomes (GMFM, MRI, DQp, PBMC ARSA and NCV) alongside GMFC-MLD to better determine stabilization. This is evidenced by comparing the previous proportions of	We have updated the text to reflect this information.

	unstable partial responders from the FINOSE assessment	
	(which was used prior to this reclassification) with the	
	WORLD 2023 data, which we provided for use in the ICER	
	health economic model.	
12.	The mechanism of action of arsa-cel is broadly based on the	See comment above.
	principle of allogenic haematopoietic stem cell transplants	
	(HSCT), which have shown ongoing durability of effect for	
	metabolic patients beyond 30 years. Arsa-cel leverages the	
	same HSCT platform to be able to self-propagate and renew	
	and involves the direct integration of the corrected gene into	
	the genome unlike <i>in vivo</i> gene therapies. This is supported	
	by experienced clinical experts in HSCT transplantation for	
	lysosomal storage diseases. Professor Rob Wynn indicated	
	that the demonstration of stable vector copy number (VCN)	
	and polyclonality in autologous HSC gene therapy is	
	analogous of stable donor cell engraftment and chimerism in	
	allogeneic transplantation. In the allogeneic setting, stable	
	initial engraftment is predictive of stable long-term	
	engraftment, which then translates to stable biochemical	
	correction, clinical outcomes, and survival. The observation of	
	stable VCN and polyclonality for arsa-cel in his opinion	
	indicates that the autologous cells will continue to remain	
	engrafted and correlate with long term clinical and disease	
	response. Conversely, if a patient is going to fail with	
	transplant, he/she will fail early, which gives confidence in	
	the data showing consistent response rates over a longer	
	period of time.	
13.	HSCT has been used for over 50 years to treat patients with	See comment above.
	several diseases such as cancers, thalassaemia and sickle cell	
	disease and has shown to be effective and life-long in	
	preventing disease progression in these patients. It is	
	important to note that conventional allogeneic stem cell	
	therapies carry the risk of graft failure due to immunological	
	rejection of the transplant. Orchard would like to point out	
	that the main reason why HSCT grafts fail is due to the body's	
	immunological rejection of a recognised foreign body, which	
	would not be the case with an autologous treatment such as	
	arsa-cel. Hence whilst HSCT convenes long-term durability in	
	several diseases, engraftment results with arsa-cel would be	
	expected to be superior to allogeneic HSCT.	

In the January 2023 periodic benefit: risk evaluation report (PBRER) for Strimvelis, for the treatment of ADA-SCID, Strimvelis was found to have 100% long-term survival for subjects in the study based on 2 to 23 years of follow-up data. The majority of subjects demonstrated evidence of engrafted gene-modified cells with sustained and maintained treatment benefits suggesting a lifetime durability of effect.

In the case of Hurler's Syndrome (MPS1-H), where patients receive similar HSC transplants as children, Prof. Robert Wynn confirmed that treated patients are above the age of 20 with maintained clinical response and cognitive function and no observation of waning of effect. In fact, for some of the earliest metabolic patients who were transplanted, they are now associated with follow-up of more than 30 years demonstrating long-term stabilisation. This observation is supported by data from Gardin et al. who followed MPS-1H patients treated with HSCT for up to 16.5 years and found that there were no signs of neurocognitive regression during follow-up (Figure 2).

Lastly, HSCT data from two long-term follow-up studies, both show that if graft failure is to occur, it occurs soon after treatment administration. For the remainder of patients who do not experience graft failure, there is expected to be long term stabilization, which again supports the longer-term time horizon for arsa-cel.

14. The above evidence supports the potential for a lifetime durability of effect. Which we believe that a lifetime durability of effect should be assumed for all full and stable partial responders, we do recognise uncertainty in this parameter. Therefore, we propose that ICER in their basecase apply a lifetime durability of effect to the proportion of responder patients with at least 5 years of follow-up data (as evidence of sustained durability of effect) and the remaining full and stable and partial responders with the current 20year durability of effect. A similar follow-up period of 5 years is also generally accepted and used in mixture-cure models for some cancer types, whereby a proportion of patients are considered "cured" (i.e., receive sustained lifetime durability of treatment effect) and are expected to have a survival benefit equal to the general population. This alternative is a

See above comment.

similar methodology to what was used in ICER's assessment of beti-cel for beta-thalassemia. This approach could be conducted using the clinical data reported in Table 1 documenting the percentage of patients classified as full or stable partial responders that have: (i) > 5 years of follow-up data; (ii) >8 years of follow-up data and (iii) >10 years of follow-up data. To implement this proposal in the current ICER model, ICER could run their model first using the 20-year duration of stabilization and next using a lifetime duration of stabilization and then calculated a weighted average of these results based upon the proportions referenced in Table 1. e.g., If lifetime durability is assumed for all full or stable partial responders that have > 5 years of follow-up, then the overall ICER would be weighted 59% lifetime to 41% having a 20-year stabilization period. 15. In summary, given the above evidence, we respectfully ask See above. The scenarios have also been updated to reflect a 5 year and 50 year ICER to: stabilization period. Reassess the durability of a lifetime horizon and at a minimum consider the implementation for a proportion of patients. Report the results of the 10-year and 50-year durability of effect scenarios in the main body of the evidence report and by MLD subtype (i.e., PS-LI, PS-EJ and ES-EJ) in addition to the currently reported aggregated result because of the large impact the durability of effect has on the cost-effectiveness results. 16. When reviewing ICER's we identified that natural history We have revised the model accordingly. transition probabilities were used for the 12-month prestabilization period for stable partial responders. This led to a misalignment of the model GMFC-MLD stabilization stages and the clinical trial data (Table 2). To aid with correcting this issue while accommodating ICER's model design, we have calculated the following transition probabilities that would be more closely aligned with the clinical trial results (see the stable partial responder transition probabilities in Tables 3

and 4). These pre-stabilization transition probabilities can be readily inserted into the existing ICER model for stable partial responders in the first 12 months. The transition probabilities were calculated (or "calibrated") through an iterative process using the ICER model by triangulating the modelled number of stable partial responders at 12 months post-treatment (i.e., the start of the stabilization period) across the GMFC-MLD stages with the clinical trial results for stable partial responders. We do recognize this approach does not perfectly align with the clinical trial data, but as seen in Tables 3 and 4, these adjustments result in a very close and clinically plausible approximation of the expected number of patients stabilizing across GMFC-MLD stages when using the ICER model design.

We respectfully request that ICER update their implementation of the pre-stabilization period for stable partial responders to align with the clinical trial data.

17. In the ICER health economic model base case, ICER used an adjusted (i.e., "recalibrated") version of the utility set provided by Orchard that did not allow for negative utility values. We appreciate that there is continued debate on the use of negative utilities, however, not allowing for negative health states requires deviation from the reported preferences of the US general population in valuing certain health states.

The concept of negative utility scores (i.e., health states worse than death) is supported by published literature, as studies in the US among healthy outpatients and those with serious illnesses show that a significant minority, and sometimes a majority, rate health states with severe cognitive impairment, such as severe dementia, as worse than death. For example, quotes from carer's the PFDD for MLD submitted to the FDA provide a vivid picture of what it is like living with an untreated patient with MLD

Our value set retains face validity when compared to other utility value set for similar severe progressive neuromuscular diseases and is comparable across all GMFC-MLD health states (Table 5). This is corroborated further by a recent study by Lo et al. estimating utility values for health states in MLD

Despite our concerns regarding the face validity of the magnitude of the negative utilities provided, we acknowledge that negative utilities are plausible for this disease. We further acknowledge potential issues with the face validity of the rescaled utilities using the draft report. We have therefore altered our approach to handling utilities and now use the original utilities provided by Orchard, which include negative values. Results based on the rescaled utilities are now provided in a scenario.

with TTO and EQ-5D utility values for GMFC-MLD 6 of -0.356 and -0.418, respectively.

In addition, ICER's recalibration method to adjust negative utility scores introduces a floor effect, such that there is very little difference (i.e. 0.01) in the HRQL of a patient in GMFC-MLD 4 with moderate cognitive function who still has some motor function (i.e. able to sit or crawl and roll, and has head control), and is able to maintain awareness, communicate, recognize loved ones; as compared to a patient in GMFC-MLD 6 (bedridden, with no motor function) and has severe cognitive impairment and who is unable to do the aforementioned activities. Indeed, health states described as worse than death by patients in the US with one or more chronic illnesses included lack of awareness or inability to think, inability to communicate, inability to recognize loved ones, inability to make own decisions and progressive cognitive decline, particularly Alzheimer dementia. Therefore, to have so little difference (0.01) in the HRQL of patients between these two health states makes the recalibration approach overall unreliable and lacking face validity.

ICER's rationale for not permitting negative utilities was because it considered that "there are face validity concerns that as early as GMFC 3, where patients are still sitting without support, crawling, and rolling, participants rated this health state below 0." We would like to point out that patients in GMFC-MLD 3 with normal cognitive function and moderate cognitive function both have positive utility values of 0.38 and 0.10, respectively. It is the loss of cognitive function that leads to negative utilities, the impact of which has been validated in the literature mentioned above. Furthermore, whilst patients in GMFC-MLD 3 can crawl or roll, they cannot walk and require a wheelchair which was described in the vignette for GMFC-MLD 3. It is common knowledge that the loss of ambulation is perceived by the general public to have a significant impact on HRQL. Indeed, in the NICE appraisal of Elosulfase alfa for treating mucopolysaccharidosis type IVa, the accepted utility value for patients with normal cognitive function but who were wheelchair dependent was 0.08, which is lower than the 0.38 and 0.10 reported for GMFC-MLD 3 patients who are wheelchair dependent with normal cognitive function or moderate cognitive impairment. In addition, Hendriksz et al. showed that children with MPS IVa who were confined to wheelchair reported utility values of -0.180, further supporting the plausibility of MLD patients in GMFC-MLD 3 and 4 having negative utility values.

We respectfully request that ICER use our "unadjusted" utility value set, including negative utility values, in the base case of the model or as a scenario in the main body of the report. Whilst we appreciate that ICER had included these utility values in a sensitivity analysis in the supplemental information, Orchard considers that the utility value set it provided is a more accurate reflection of the HRQL in MLD.

18. In the ICER model base case, the same caregiver disutility (-0.068), for one carer, was applied to patients in GMFC-MLD 2 through to GMFC-MLD 6; such that carers of patients with MLD who are still able to walk with support and have no cognitive impairment have the same disutility as those caregivers of children who are completely immobile and in a vegetative state. This conflicts with the description of the caregiver burden in the DER, which describes an increasing caregiving requirement as MLD patient's progress. Section 2 of the DER states that, "As MLD progresses and children lose motor and cognitive skills, the caregiving impact increases." It also states that often one or both parents need to leave work to care for their affected children. And therefore, this omission underestimates the total caregiver burden further by only applying the disutility to one caregiver.

Caregiver disutility scaling is further supported by the Lo et al. who reported that TTO-based and EQ-5D-5L-based caregiver state utility values decreased from 0.928 and 0.864 (caring for patients at GMFC-MLD 1) to 0.454 and 0.246 (caring for patients at GMFC-MLD 6), respectively.

We respectfully request that ICER use the GMFC-MLD-scaled caregiver disutility set as the base case to be more accurately reflect the caregiver disutility based on disease severity by GMFC-MLD stage.

We appreciate the data and rationale provided for the caregiver disutilities. We have altered our approach and now use the caregiver disutility estimates provided, which scale with the severity of disease.

stabilization than the 12 to 24 months of HSCT. Perhaps this is

	why some of the early symptomatic EJ patients return to an almost normal state.	
3.	Table 3.3 shows ES-EJ-MLD as GMFM median of 48.36 with arsa-cel contrasted with 2.29 for natural history. That is a dramatic improvement.	See above comment.
	Any treatment for MLD carries risks and unknowns. The partial benefits of GT are still better than the partial benefits of HSCT. We would like the rating for early symptomatic EJ returned to a B+. Ultimately, informed parents will weigh the potential risks/benefit of any treatment for their child based on the data available at the time and their own personal circumstances.	
4.	Table 4.1, row 1 and Table 4.2 We find it confusing that "full response" patients are defined as having a period of stabilization followed by a decline similar to natural history. It is not at all clear to us why the decline would be the same as natural history. We would expect either no decline or a significantly slower decline than natural history. The rate of decline assumption will dramatically affect the modeled results. Further, the "stable partial responders" are defined as some decline then stability. This is inconsistent with "full response " patients, where the therapy is assumed to lose its efficacy after some period of time. Why would the stability for partial responders be permanent when the therapy for full responders is not? And to further reinforce the concern that full responders do not decline at the rate of natural history, the "unstable partial responders" are described as having a slower than natural history progression. We request that these definitions and the derived models be carefully reconsidered.	See above comment regarding our new modeling approach. Briefly, for full responders after the period of stabilization, a small proportion (0.02% per month) will transition to the unstable partial responder group in the same GMFC health state for the remaining time horizon. Stable partial responders do not have a permanent treatment effect and will also transition to the unstable partial reponse group at 0.02% per month after the period of stabilization ends.
5.	Table 4.1, row 2 While there clearly is no observed proof of 50, 30, or even 20-year therapeutic stability, it is important to note that most patients retain full or significant mobility and that only a small handful of patients received therapy at the earliest stages of development where non-observable progression is minimized. We suspect, and perhaps a reanalysis of the data will show, that the further the progression, observable or not, i.e., age at the time of	See above comment.

	therapy, is the key factor influencing the rate of motor decline. The ideal time for therapy is as soon as practical after identification at birth. To date, with just a few patients falling into this category, therapy has been given at 6-9 months. MLD newborn screening is well-studied and will become universal over the next five years, so the trends will shift to earlier diagnosis and more effective outcomes.	
6.	Table 4.1, row 2 While the NICE and FINOSE models were adjusted from the manufacturer's 50-year stabilization to 20 and 15 years, respectively, we should not assume the purpose of those adjustments aligns with the purposes of the ICER analysis or that those adjustments reflect any change in actual expectations of outcome stability. Modeling with a shorter length of stability is more conservative in terms of outcome. However, it would be reasonable to additionally model at 30 or even 50 years to provide perspective.	See above comment.
7.	Harms page 15, page 19 2nd paragraph  Most of the harms are attributed to transplants, and the data shows these events are survivable without long-term harm. It is also not emphasized that arsa-cel is infused using an autologous transplant. This distinction is key when comparing arsa-cel transplant impacts to traditional HSCT impacts, especially in the peri-transplant period.	Thank you for this comment. We are not comparing gene therapy directly to HSCT; however we have added language throughout the report to make clear that arsa-cel involved autologous HSCT.
8.	We strongly request that an additional harm be considered that being the lack of access to arsa-cel (when eligible). Those patients will die (See E3.1 - E3.3). These patients not only die, they progress through all of the phases of GMFM, and they miss out on the life and life goals they would live even if gene therapy was sub-optimal, which frankly, the data refutes. In addition to the patient's death, the family suffers the progression and loss. We should include lack of therapy as a harm and incorporate it into the value aspects of the model.	We appreciate this perspective. While our Harms section focuses on direct harms of arsa-cel drawn from the clinical trials, we have included this concern in the Patient and Caregiver Perspectives section and also highlighted in the Potential Other Benefits and Contextual Considerations section the potential change in the "infrastructure" of care that may come about with having an effective treatment for MLD.
9.	Summary & Comment, page 18: "as reflected in the improvement in both primary and secondary endpoints,	Thank you for this comment. We have revised this paragraph to highlight that

	extending survival, and avoiding the reduced quality of life and much quicker death with no therapy.".	children treated with arsa-cel have higher quality of life and longer lives than untreated children.
10.	Page D7 this section should also reflect that no therapy leads to quicker progression into all of the levels of GMFM, i.e., poor quality of life, and to a certainty of earlier death than the comparatively much lower risk of harm from therapy.	In our Summary and Comment section, in the explanation about our evidence rating of A, we discuss that the benefits of arsacel likely outweigh the risks.
11.	Drug Costs page 26  It should be noted that many gene therapy companies, including Orchard Therapeutics, are lobbying for the ability to provide contractual guarantees with credits or rebates if the therapy does not work for a given patient (MVP Act). This sort of sales agreement moves risk to the drug company and puts them "in the boat" with the patient" as far as risk for a successful outcome goes. No other therapy class offers these sorts of risk management provisions. This needs to be reflected and incorporated into the ICER model.	We have not been provided information about any specific outcomes based contracts that Orchard uses or intends to use. In the absence of a specific contract, we are not in a position to include these arrangements into our modeling approach.
12.	re: Trinidad et al. Genome Biology (2023) 24:172 Predicting disease severity in metachromatic leukodystrophy using protein activity and a patient phenotype matrix  Patient-based data were used to develop a phenotype matrix that predicts MLD phenotype given ARSA alleles in a patient's genotype with 76% accuracy. We then employed a high-throughput enzyme activity assay using mass spectrometry to explore the function of ARSA variants from the curated patient data set and the Genome Aggregation Database (gnomAD). We observed evidence that 36% of variants of unknown significance (VUS) in ARSA may be pathogenic. By classifying functional effects for 251 VUS from gnomAD, we reduced the incidence of genotypes of unknown significance	We appreciate this comment and reference and have amended the statement in section A3 to reflect these new data.
	(GUS) by over 98.5% in the overall population.  The above reference should be reviewed for inclusion and updating of the conclusion in the last two sentences of A3, paragraph 1. There is a good genotype-phenotype correlation	

	for the great majority of variants seen in the general population. Additionally, MLD Foundation is validating the conclusions and academically/bench-derived geno-pheno correlation with real-world patient data.  Second paragraph " children with LI-MLD" should read " children with LI/EJ-MLD" and "The juvenile form often presents" should read "The late-juvenile (LJ) form often presents"	
13.	Table 5.2, block 1: "Substantial impact" is a severe understatement. As Figure E3.1 shows, PS-LI-MLD children are unable to experience any life goals by age 4 as they are at GMFM level 5.	We appreciate this comment and have revised our report to reflect that arsa-cel treatment may have a dramatic impact on patients with MLD and their families.
14.	Executive Summary, paragraph 2, page ES1: "Initial symptoms of LI/EJ MLD"	We have made this correction in the text.
15.	PSAP gene – Background page 1: It was correctly noted that PSAP/saposin B is an activator but it does not say that it activates ARSA – that should be noted. It should also be noted that PSAP problems are not resolved by arsa-cel.	We have made edits to reflect that PSAP codes for an activator.
16.	Newborn Screening – page 2, 2nd paragraph: might be clarified by " since there is no widely implemented newborn screening"	We have made edits in the text to reflect this sentiment.
17.	Autologous transplant – page 2, 2rd paragraph: It would be informative to enhance " cells are harvested from the patient (arsa-cel is an autologous transplant)."	Thank you for this suggestion, we have revised the wording in the Introduction to make clear that arsa-cel treatment utilizes autologous HSCT.
18.	Uncertainty and Controversies – page 16, 2nd paragraph: Are single-arm studies where the control is a sibling subject to the bias referred to in this paragraph? Many of the Clinical trial patients had older siblings as controls.	We appreciate that some MLD trials had older siblings as controls. However, in this instance, we were focused on the potential pitfalls for single-arm studies in general.

19.	Monthly Costs – page 27: We cannot argue with these numbers as we do not have concrete evidence to refute them, however, with regard to the care of Lindy, our 42 year old LJ-MLD daughter, her monthly drug costs are in excess of \$3,000 and her medical visit costs (cost, not out of pocket) are probably closer to \$2,000 per month (6-7 visits/mo). As a small offset for these higher expenses, we try not to go to the hospital more than once a year.	We appreciate this comment. Our cost estimates reflect the mean cost across the target population in accordance with standard methodology.

Comment **ICER Response** Clinicians Dr. Laura Adang, Dr. Adeline Vanderver, & Dr. Amy Waldman, The Children's Hospital of Philadelphia While rare, MLD is one of the most common We appreciate this comment and leukodystrophies (1, 2). Encompassing over half of the cases, perspective. We have tried to emphasize the late infantile form of MLD, which has its onset before 2.5 the devastating nature of LI- and EJ-MLD years of age, is characterized by a rapid motor and cognitive and have removed any reference to the regression and results in death years later (3). The juvenile condition being "mild". MLD (J-MLD) subtype is often divided into two categories: early and late juvenile. The duration and severity of the clinical course is thought to bridge the rapid decline found in the late infantile variant and the slower progression of the adult form, although once independent ambulation is lost, the rate of decline is rapid (4). The distinction between progression between early juvenile and late juvenile forms can be minor, with a difference in progression of months. After a rapid period of neurologic loss, affected children continue to live for years after having lost the ability to move. Cognitive skills are lost typically after motor skills are lost. Of importance, there is not a 'mild' form of MLD. This is a universally progressive and devastating disorder. 2. Even among the leukodystrophies, metachromatic Thank you for the details characterizing leukodystrophy is notable for its severe and rapid neurologic the severity of MLD. We agree and have decline (5-7). Overall, children with leukodystrophies have a tried to reflect this sentiment throughout low health-related quality of life (8-11), and hospitalizations the report. cost over \$59 million per year (9). Currently in the US, there is an unmet need for targeted therapies, and medical care is limited to palliation and support. Our affected patients require *many years* of intensive care beginning within months of diagnosis. The relentless loss of cognitive and motor functions, worsening tolerance for food/feedings, the diminishing quality of life, and the emotional toll on both patients and their caregivers underpin the daily struggle endured by our families. This report underscores the critical importance of evaluating novel treatments for rare diseases like MLD, where the impact on patients and their families is immeasurable. We would like to emphasize the profound burden that MLD places upon affected individuals and the urgent, unmet need for effective therapeutic options. Before gene therapy became a possibility, there was limited 3. We appreciate your input and comments. hope in the community. This report underscores the transformative and enduring impact of gene therapy,

especially when offered to presymptomatic children. Within the near future, we can envision a world in which children are diagnosed by newborn screen and treated *before* myelin and nerve injury occurs, dramatically changing the disease course with a single intervention.

As this report continues to shape discussions around MLD gene therapy, we urge ICER to recognize the gravity of the disease and the transformative impact that equitable access to gene therapy could have on our future patients' lives. Thank you for your commitment to advancing patient-centered analysis that guides the way towards better treatments and improved quality of life.

## Dr. Ashish Gupta, University of Minnesota

- 1. The report for MLD-gene therapy (Arsa-cel) with details several key findings and gives a detailed insight into the potential benefits and costs of this therapy. As the long term data for Arsa-cel continues to show stable neurocognition, it would be prudent to not limit the cognitive benefits to 10 years currently. As we continue to follow these children, especially those with the late-infantile and early juvenile cohorts, there is stable enzyme level of ARSA in these children. The comparative cohort in most of these instances is often deceased by 10 years of age. The survival as well neurocognitive and motor benefit of this therapy continues to be superior to the natural history.
- We appreciate the comment. We used a duration of benefit of 10 years only in a scenario analysis that assumed a conservative treatment benefit. We have now updated our approach.

- 2. One of the challenges of this report is the extrapolation of data from limited sample size, especially in cost comparison for loss of wages and out of pocket costs for caregivers. Some of these challenges are highlighted on page 32 of the repot under the section "Uncertainties and Controversies". In rare diseases, as reported by Project Alive, the indirect costs are a significant metric which often goes unnoticed. Objective assessment of GFMC based criteria are used to assess costs and benefits, but many of the indirect measures including caregiver burden on the family need to be further considered. There are several areas highlighted by the authors of this report which discusses the potential for longer term benefit of Arsa-cel compared to the current standard of care. As more data will potentially further strengthen the model in the
- Thank you for the comment regarding indirect costs. We agree as data accrue, the estimates used for indirect costs will become more precise. Currently, although limited, we have used the best available data to inform our estimates of indirect costs to caregivers.

next few years, this report can further discuss the scenarios and also consider perspectives from the families with children or adults living with MLD.

### Dr. Simon Jones, University of Manchester

I write to comment specifically on the question of durability of response. I note in the report you produce you limit the benefit of arsa-cel to 10 years, presumably based on the fact that follow up from the Milan trials does not extend much beyond this time and that a small minority of patients have shown clinical decline following treatment.

I have clinical experience from 4 different ex vivo lentiviral vectors and following up over 100 allogeneic transplanted LSD children. Unlike in the AAV field (where I have also experience) there is no evidence thus far from long term clinical experience or on a biological basis to support a drop off in gene expression and therefore enzyme levels with this therapy approach. There is evidence for much longer than 10 years, especially in the primary immune deficiency world, showing continued expression for as long as follow up is continued. When I review the outcome data biologically there is excellent supraphysiological enzyme expression in all patients. The clinical data is more nuanced however which I understand can lead to concern. In my view the variability in the clinical data comes down in almost all cases to patient selection and this is a key reason why the license in Europe for Libmeldy is more restrictive than the original trial criteria. This is also why, in the UK, every case is discussed and assessed twice by a multi-disciplinary team to try and ensure the optimal patient selection and therefore outcome.

We have 35 year outcomes for both MPSI (Hurler) allogeneic transplants and in neuronopathic Gaucher disease (Lum et al 2017, Donald et al 2022). In all the long term cases enzyme expression by donor cells is stable, clinical outcomes change over time but in most cases related to inadequate enzyme secretion. We believe in ex vivo lentiviral stem cell gene therapy we have overcome the dosing question, we now need to focus on the age at diagnosis and newborn screening.

We appreciate the comment. We used a duration of benefit of 10 years only in a scenario analysis that assumed a conservative treatment benefit. We have now updated our approach.

### Dr. Stephanie Keller

1.

The report was a well put together analysis of the treatment and our gaps in knowledge. However, the numbers and reports fail to consider the real life impact of disease on the patient and their families. MLD is a horrible disease causing loss of skills, difficulty sleeping, seizures, spasticity, and systemic symptoms such as gallbladder disease, peripheral neuropathy, and GI symptoms. Although, this treatment may not completely cure MLD or prevent all future progress, the patients will have significant improvement from there natural disease course. The patients with early symptomatic disease may slow their progression and limit the severity of their disease with treatment. In the case of early juvenile MLD, their disease typically progresses more slowly but they may progress quickly for a few years and then stabilize with severe disabilities. Treatment with atidarsagene autotemcel will allow the patients to live a more enjoyable and productive life that without treatment. Transplant has not shown improvement/prevention of MLD Related peripheral neuropathy which this drug seems to help with prevention in MLD.

We appreciate your comments.

Throughout the Clinical Effectiveness sections of the report, we have attempted to discuss the clinical trial evidence on treating MLD patients with gene therapy. We have tried to capture the consequences of this devastating disease in the Patient and Caregiver Perspectives section.

2. In rare life-threatening diseases, the nature of the disease often limits knowledge and study design. Due to the severity of metachromatic leukodystrophy, waiting for additional studies to be completed prior to approval would allow more children to die waiting on a therapy. Leniency must be granted regarding these rare devastating diseases where there are no current effective treatments. Delaying or preventing disability is expected to make huge improvements in the qualify of life of patients. Please allow these children with MLD the opportunity lead longer and fuller life.

Although this is a common concern with ultra-rare devastating disorders like MLD, when therapies are developed they most often are brought forward because they generate very large improvements in patient outcomes. These sorts of improvements can typically be assessed quickly. ICER's "A" rating for arsa-cel reflects this sort of assessment in the face of enormous benefit.

### Dr. Sandhya Kharbanda, University of California, San Francisco

1. I am responding to the economic analysis that assume the duration of benefit with Arsa-cel to be 10 years.

In my professional opinion as a Bone Marrow Transplant physician with expertise in children with inherited metabolic

We appreciate the comment. We used a duration of benefit of 10 years only in a scenario analysis that assumed a conservative treatment benefit. We have now updated our approach.

disorders including metachromatic leukodystrophy, I am concerned about this assumption, even though stated in the document as conservative. Arsa-cel are gene corrected autologous hematopoietic stem cells that give rise to enzyme producing cells and the expected duration of benefit would be lifelong. This is the assumption with allogeneic hematopoietic cell transplant for various genetic disorders as well. Given that the follow up data is through 11 years, it is reasonable to state that though limiting the duration of benefit to 10 years seems very conservative and probably inaccurate.

#	Comment	ICER Response
Othe		
Parti	nership to Improve Patient Care	
1.	QALYs are discriminatory and should not be used in value	There are rare situations in which QALYs
	assessment.	can be discriminatory; in those rare
		situations, evLYs, which ICER also always
	Multiple studies have shown that cost-effectiveness models	reports, will not be discriminatory.
	that use the quality-adjusted life year (QALY) discriminate	
	against patients with chronic conditions <sup>1</sup> and people with	
	disabilities. <sup>2</sup> There is widespread recognition that the use of	
	the QALY is discriminatory. The QALY has historically been	
	opposed by the American public and policy makers. The	
	National Council on Disability (NCD), an independent federal	
	agency, concluded in a 2019 report that QALYs discriminate	
	by placing a lower value on treatments which extend the lives	
	of people with chronic illnesses and disabilities. NCD	
	recommended that policymakers and insurers reject QALYs as	
	a method of measuring value for medical treatments. <sup>3</sup>	
	Traditional cost utility methods, like those ICER uses, often	
	serve to undervalue treatments for highly severe illnesses. As	
	a result, such studies may lead payers to underpay for	
	treatment of severe illnesses, like MLD. ICER should be	
	evolving away from use of the QALY, and, instead, measuring	
	value based on the most up to date science and improved	
	health utilities reflecting the value to the patient. <sup>4</sup>	
2.	ICER should practice severity weighting, as is accepted by	We do not suggest one specific threshold
	many other HTA bodies. <sup>1</sup> As PIPC has stated in past	or one specific formula in estimating a fair
	comments to ICER, it is imperative that it follow the model of	price. Rather we present a range of
	other HTA organizations and incorporate severity weighting	threshold prices from \$50,000- \$200,000

in its assessments. Non-linear utility function in cost-utility analysis has been widely accepted with the discipline of health economics and has been incorporated into value assessment methods globally. European countries such as Norway, Sweden, the Netherlands,<sup>5</sup> and most recently the UK's NICE,<sup>6</sup> are actively using information on severity of the disease in the question to better inform approval decisions for new medicines. These countries are addressing the problem by developing multiple thresholds specific to each disease.

MLD is a devastating disease, and based on the utilities ICER chooses to use in its model, most other HTA bodies would consider it a severe condition and adjust their thresholds. In the Netherlands it would be granted a threshold four times that used for less severe conditions. In Norway it would be granted a threshold of three times that for less severe conditions. PIPC urges ICER to familiarize itself with the latest developments in value assessment instead of remaining wedded to a traditional CEA, which is dated in many ways. This will enable ICER to conduct more accurate, sensitive assessments for patients.

per outcome gained. We are aware of the literature suggesting higher thresholds for more severe illnesses with high unmet need and understand that this literature suggests lower thresholds for less severe illnesses with lower unmet need. Because you are recommending a higher threshold for MLD, we would be interested to know which specific conditions you feel we should evaluate using a lower threshold.

3. ICER continues to conduct premature assessments.

Once again, ICER is choosing to conduct this assessment at an early stage of our understanding of the treatment in question without all of the information available. Within this construct, ICER chooses to make overly conservative assumptions about the long-term value of the treatment in question and its impact on a specific set of outcomes. This type of premature and conservative assessment can be harmful to patients, painting a distorted picture of the relative value of a new technology.

ICER's premature assessment also leads it to raise questions about the durability of the treatment.

PIPC continues to claim that all ICER assessments are premature; we would be interested in knowing what therapies you feel are ready for review.

This therapy is approved in Europe making it particularly surprising that PIPC would claim it is premature to review now.

Additionally, the manufacturer requested that ICER undertake this review.

4. Questions of durability of treatment of any new technology are common, but these should not be used to restrict access to patients who will benefit today. ICER states that long-term durability is unknown for arsa-cel in MLD, but there is up to 11 years of follow-up data in the LI-MLD patients<sup>9</sup> and up to 9 years in the EJ-MLD patients.<sup>10</sup> In both cases the Kaplan-

It is unclear what in ICER's review leads PIPC to think that ICER suggests restricting access while awaiting longer-term data. ICER does believe in trying to make reasonable estimates about treatment durability. ICER further believes that Meier curves suggest quite considerable evidence for durability. It leaves us with the question as to what exactly is 'enough' evidence of durability in a novel drug that can reduce mortality by over 60% over ten years. The most problematic aspect of ICER's commentary on durability is that this reasoning assumes there is no downside to delaying access to new therapies, but this is far from true for patients waiting for treatments, especially those with few, if any, options. Every year this drug is not available for LI-MLD and EJ-MLD treatment, patient lives are lost. Patient lives should not be ignored in order to suit a conservative view of what constitutes enough evidence.<sup>11</sup>

when there are important uncertainties about durability, this should typically lead to a reduced price compared with a price assuming permanent cure in all patients.

5. ICER should use the societal perspective as the sole base case in this model.

MLD has an immense societal impact, including caregiver burden. Ignoring this reality has the potential to significantly exacerbate inequality within the disease state. The reality is that, given the immense caregiving needs of MLD, families are forced to make very difficult choices. Either the child's care and/or the family's earning potential may be compromised as a result. ICER has chosen to give equal weight to its healthcare perspective results that exclude caregiver utilities and indirect costs, which we believe is a mistake. For some diseases the burden on caregivers and the impact on social care costs make the societal perspective a more relevant choice than the health care perspective. NICE, which ICER leans heavily on for its approach to value assessment, has already included caregiver utility in its costeffectiveness models for diseases such as Alzheimer's, MS and Parkinson's disease. 12 It is also the recommended perspective for cost-effectiveness models of the 2nd panel on cost-effectiveness<sup>13</sup>, and ISPOR.<sup>14</sup>

The Second Panel on Cost-Effectiveness in Health and Medicine recommends reporting results from both the health care system perspective and the societal perspective in cost-effectiveness analyses.

In response to discussions with the patient and caregiver community, we have determined that the impact of MLD on caregiver productivity and quality of life is substantial and have elevated the societal perspective analysis to a co-base case. In doing so, the modified societal perspective threshold-based pricing estimates from both perspectives will be included in ICER's health benefit price benchmarks.

ICER reports are intended to inform population-based medical policy and pricing decisions within the US health care system which include employers, other plan sponsors, insurers, and risk-bearing provider groups in both private and public health insurance systems that are not responsible for making trade-off decisions that involve broader societal resources. Consequently, analyses from both the health care system and societal perspectives remain relevant.

from a source that evaluated a different disease, neuronal ceroid lipofuscinosis type 2,<sup>15</sup> and they show no gradation from GMFC health state 2 to GMFC health state 6. This is not an accurate source for these utilities as the level of care required, and the resulting impact on a caregivers' quality of life across these states of disease would be considerably different. ICER shares in the assessment that it was given a set of caregiver utilities directly by the manufacturer that does indeed vary by GMFC state. PIPC would recommend using that source for caregiver utilities.

See comment above.

7. ICER should factor system effects into its assessment.

The availability of a treatment for MLD changes the diagnostic and screening landscape for the disease. It means that patients are more likely to find an effective treatment, but it also triggers system effects. 16 In other words, the existence of the treatment leads to patients (and parents) having access to diagnostic certainty at an early stage of disease, cutting out the significant pathways of misdiagnosis and harmful and ineffective treatment strategies which can worsen the feelings of helplessness, anxiety and stress for patient and family. These effects are not incorporated into the value of new innovations in standard QALY-based costutility models. They have a huge impact on patients' and caregivers' quality of life and on the efficiency of healthcare resource use more generally. In cases like MLD, PIPC would recommend system effects be incorporated into ICER's modeling.

We agree that the development of an effective therapy for MLD may change the entire "infrastructure" of care. We have added this in the Potential Other Benefits section.