# Prophylactic Corticosteroid Use with Axicabtagene Ciloleucel in Patients with Relapsed/Refractory Large B-Cell Lymphoma: One-Year Follow-Up of ZUMA-1 Cohort 6

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# BACKGROUND

• ZUMA-1 is the registrational Phase 1/2 study of axicabtagene ciloleucel (axi-cel), an autologous anti-CD19 chimeric antigen receptor (CAR) T-cell therapy, in patients with refractory large B-cell lymphoma (LBCL)<sup>1,2</sup>

- In ZUMA-1 pivotal Cohorts 1+2
- 83% objective response rate (ORR); 58% complete response (CR) rate<sup>2</sup>
- With 63.1 months median follow-up: 25.8 months median overall survival (OS); 43% 5-year OS rate<sup>3</sup>
- 13% Grade  $\geq$ 3 cytokine release syndrome (CRS); 28% Grade  $\geq$ 3 neurologic events (NEs)<sup>1</sup> • Management of CRS and NEs has been under evaluation to optimize safety outcomes
- In safety management Cohort 4, earlier corticosteroid and/or tocilizumab use appeared to reduce Grade  $\geq$ 3 CRS and NE rates, without affecting CAR T-cell expansion or ongoing response rates<sup>4</sup> - Cohort 6 evaluated the addition of prophylactic corticosteroids to the Cohort 4 toxicity management regimen in further reducing
- the incidence and severity of CRS and NEs<sup>5</sup> • At a median follow-up of 8.9 months in Cohort 6 (n=40), no Grade ≥3 CRS was observed, a low rate of Grade ≥3 NEs (13%) was present, and response rates were high (95% ORR, 80% CR rate)<sup>5</sup>

# OBJECTIVE

• To present a 1-year updated analysis of Cohort 6 supported by a propensity score-based comparison of outcomes in Cohort 6 and Cohorts 1+2 to enable an accurate comparison of patients with highly similar characteristics across cohorts

# **METHODS**

### Figure 1. ZUMA-1 Study Design

Original AE	Management	Revised AE Management			
Phase 2 (n=101)		Phase 2 (n=40)			
<u>Cohort 1</u> Refractory DLBCL (n=77)	<u>Cohort 2</u> Refractory PMBCL/TFL (n=24)	<u>Cohort 6</u> R/R LBCLª (n=40)			
<ul> <li>Key eligibility criteria</li> <li>Cohorts 1+2: No responses</li> <li>≤12 months post-ASCT</li> </ul>	e to last chemotherapy or relapse	<ul> <li>Conditioning regimen (all cohorts)</li> <li>Cyclophosphamide 500 mg/m<sup>2</sup> + fludarabine 30 mg/r for 3 days</li> </ul>			

- $\leq$  IZ months post-ASCI
- Cohort 6: R/R LBCL after  $\geq 2$  lines of therapy

rituximab,<sup>c</sup> or bendamustine + rituximab<sup>d</sup>

**Optional bridging therapy allowed in Cohort 6 only** 

Dexamethasone,<sup>b</sup> high-dose methylprednisolone +

- **Axi-cel (all cohorts)**
- 2×10<sup>6</sup> CAR+ T cells/kg<sup>e</sup>
- Cohort 6 primary endpoint
- Incidence and severity of CRS and NEs

Methylprednisolone 1 g twice daily

Includes adult patients with DLBCL, PMBCL, TFL, and high-grade B-cell lymphoma after ≥2 systemic lines of therapy. b 20 to 40 mg/d or equivalent daily for 1 to 4 days, completed before conditioning chemotherapy. Methylprednisolone 1 g/m<sup>2</sup> daily for 3 days + rituximab (375 mg/m<sup>2</sup> weekly), completed at least 7 days before conditioning chemotherapy. <sup>d</sup> Bendamustine 90 mg/m<sup>2</sup> daily for 2 days + rituximab (375 mg/m<sup>2</sup> for 1 day), completed at least 14 days before conditioning chemotherapy. • Flat dose of 2×10<sup>8</sup> CAR+ T cells/kg for patients with body weight >100 kg. AE, adverse event; ASCT, autologous stem cell transplantation; axi-cel, axicabtagene ciloleucel; CAR, chimeric antigen receptor; CRS, cytokine release syndrome; DLBCL, diffuse large B-cell lymphoma; LBCL, large B-cell lymphoma; NE, neurologic event; PMBCL, primary mediastinal B-cell lymphoma; R/R, relapsed/refractory; TFL, transformed follicular lymphoma.

# Figure 2. AE Management in ZUMA-1

ts 1+2 Igmt	CRS Tocilizumab: No Corticosteroid: No	Tocilizumab: <b>Yes</b> ª Corticosteroid: <b>Yes</b> ª	Tocilizumab: <b>Yes</b> Corticosteroid: <b>Yes</b>	Tocilizumab: <b>Yes</b> Corticosteroid: <b>Yes</b>
Cohorts 1+2 AE Mgmt	NE Tocilizumab: No Corticosteroid: No	Tocilizumab: <b>Yes</b> Corticosteroid: <b>No</b>	Tocilizumab: <b>Yes</b> Corticosteroid: <b>Yes</b> <sup>b</sup>	Tocilizumab: <b>Yes</b> Corticosteroid: <b>Yes</b>
	1	2 AE (	Grade 3	4
		<b>↑</b>	1	1
۲ د	Tocilizumab: <b>Yes</b> <sup>c</sup>	Tocilizumab: <b>Yes</b>	Tocilizumab: <b>Yes</b>	Tocilizumab: <b>Yes</b>
Cohort 6 AE Mgmt	CRS Corticosteroid: Yes <sup>d</sup>	Corticosteroid: Yes	Corticosteroid: Yes	Corticosteroid: Yes, HD

Only in case of comorbidities or older age. <sup>b</sup> Only if no improvement with tocilizumab; use standard dose. <sup>c</sup> If no improvement after 24 hours of supportive care in Cohort 6. <sup>d</sup> If no improvement after 3 days. <sup>e</sup> Only for Grade  $\geq$ 2 NEs with concurrent CRS in Cohort 6. AE, adverse event; CRS, cytokine release syndrome; HD, high dose; Mgmt, management; NE, neurologic event.

• Patients in Cohort 6 received once-daily oral dexamethasone 10 mg on days 0 (before axi-cel infusion), 1, and 2

• Corticosteroids and tocilizumab were started earlier in Cohort 6 than in Cohorts 1+2 for toxicity management<sup>1,5</sup>

### Table 1 Tacilizumah and Carticoctoroid Guidalinas for AE Managament in Cahart 6

Table 1. Tocilizumab and Corticosteroid Guidelines for AE Management in Cohort 6						
CRS Grade	Tocilizumab Dose <sup>a</sup>	Corticosteroid Dose <sup>a</sup>				
1	If no improvement after 24 hours of supportive care, 8 mg/kg over 1 hour <sup>b</sup> ; repeat every 4-6 hours as needed	If no improvement after 3 days, dexamethasone 10 mg ×1				
2	8 mg/kg over 1 hour <sup>b</sup> ; repeat every 4-6 hours as needed	Dexamethasone 10 mg ×1				
3	Per Grade 2	Methylprednisolone 1 mg/kg IV twice daily or equivalent dexamethasone dose				
4	Per Grade 2	Methylprednisolone 1000 mg/d IV for 3 days				
NE Grade	Tocilizumab Dose	Corticosteroid Dose				
1	N/A	Dexamethasone 10 mg ×1				
2	Only in the case of concurrent CRS; 8 mg/kg over 1 hour; repeat every 4-6 hours as needed	Dexamethasone 10 mg 4 times/day				
3	Per Grade 2	Methylprednisolone 1 g once daily				

Per Grade 2 Therapy to be tapered on improvement of symptoms at investigator's discretion. <sup>b</sup> Not to exceed 800 mg. AE, adverse event; CRS, cytokine release syndrome; IV, intravenous; N/A, not applicable; NE, neurologic event.

# **METHODS** (continued)

#### Figure 3. Analyses and Follow-Up Time **Data Cutoff Dates** Median Follow-Up Times • Cohorts 1+2<sup>1</sup>: Aug 11, 2017 • Cohorts 1+2<sup>1</sup>: 15.4 months **1-Year Analysis** • Cohort 6: Dec 16, 2020 • Cohort 6: 14.9 months Propensity score–matched comparisons<sup>6</sup> were performed to compare clinical safety, efficacy, and PK profiles of patients in Cohort 6 and Cohorts 1+2 after balancing for known baseline disease characteristics – Tumor burden Exploratory IPI score opensity - No. of prior lines of chemotherapy Score Analys – Disease stage – LDH level • Propensity score matching was used to select matching patient subgroups from Cohorts 1+2 and Cohort 6

# RESULTS

### **Cohort 6: 1-Year Analysis**

IPI, International Prognostic Index; LDH, lactate dehydrogenase; PK, pharmacokinetic.

- As of December 16, 2020, 40 patients with relapsed/refractory LBCL were treated with axi-cel and all 40 were eligible for efficacy and safety analyses
- The median patient age was 64.5 years (range, 37–85 years; ≥65 years, 50%); 55% of patients had Eastern Cooperative Oncology Group performance status score of 1, 65% had stage III or IV disease, and 38% had received  $\geq$ 3 prior therapies

### Table 2. Primary Endpoint: Incidence and Severity of CRS and **Neurologic Events**

	Cohort 6 (N=40)
CRS, n (%)	(11=40) 32 (80)
Worst Grade 1	14 (35)
Worst Grade 2	18 (45)
Worst Grade ≥3	0 (0)
Median time to onset (range), days	5 (1–15)
Median duration (range), days	4 (1–11)
Neurologic event, n (%)	23 (58)
Worst Grade 1	10 (25)
Worst Grade 2	7 (18)
Worst Grade ≥3	6 (15)
Median time to onset (range), days	6 (2–162)
Median duration (range), days	19 (1–438ª)

Duration is defined as the end date of the last neurologic event minus the onset date of the first neurologic event +1. The maximum value is due to a late onset neurologic event that occurred on Day 441 and resolved on Day 442; if not for this late event, the maximum duration would be 79 days as the patient's second to last neurologic event ended on Day 83 (lasted 3 days). Severity of CRS and neurologic events were graded per Lee et al criteria<sup>7</sup> and Common Terminology Criteria for Adverse Events version 4.03, respectively. CRS, cytokine release syndrome.

• No Grade ≥3 CRS occurred in Cohort 6

- Grade  $\geq$ 3 NEs were reported in 15% of patients
- Since the previous analysis<sup>5</sup>
- No new cases of CRS
- Four new axi-cel-related NEs in 2 patients
- Patient 1: Grade 2 mental status changes and seizure-like phenomena both on Day 441 (duration, 2 days and 1 day, respectively)
- Patient 2: Grade 1 dementia (occurred on Day 93 but was reported late; duration, 277 days) and Grade 5 toxic encephalopathy on Day 369 (resultant from a Grade 4 event that started
- on Day 351) - Investigator believed that a mild case of dementia may have predated the study - Workup was limited on the Grade 5 adverse event (AE) due to family refusal for diagnostic testing and autopsy; however, magnetic resonance imaging showed leukoencephalopathy but was not confirmed with lumbar puncture. The investigator suspected that the outcome may have resulted from an opportunistic infection due to
- prolonged immunosuppression - Two new infections of Grade 2 pneumonia on Day 474 (resolved on Day 479; unrelated to axi-cel) and Grade 1 bronchitis on Day 459 (resolved on Day 459; related to axi-cel)
- One death due to progressive disease

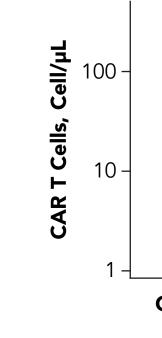
### Figure 4. Duration of Response 100-Median DOR (95% CI), mo Not reached (7.8-NE) 10 12 14 16 18 Time, Months Patients at risk (Patients censored) (4) (12) (18) (21) (23) DOR, duration of response; NE, not estimable

Figure 5.	Prog
()	100-
Progression-Free Survival, %	80-
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#### Patients at risk (Patients censore

### Patients at (Patients ce

# 12 Months



# CAR, chimeric antigen receptor.

### **Propensity Score Matching Analysis**

- score matching analysis Cohorts 1+2

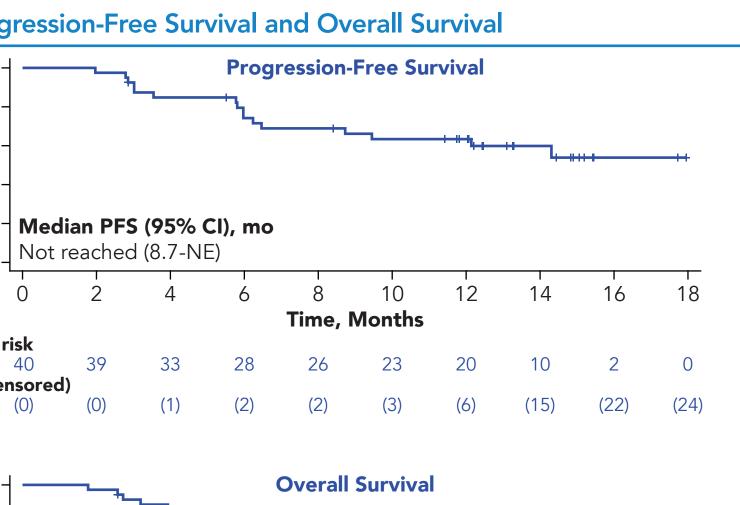
### Table 3. Propensity Score Comparison of CAR T-Cell and Cytokine Levels

Median (Q1, Q3)	Cohorts 1+2	Cohort 6	Cohorts 1+2	Cohort 6
	Overall	Overall	After Matching	After Matching
	(N=101)	(N=40)	(n=32)	(n=32ª)
Peak CAR T-cell levels				
CAR T-cell expansion,	38	64	43	65
cells/µL	(15, 83)	(6, 131)	(14, 107)	(18, 146)
Peak cytokine levels				
IFN-γ, pg/mL	477	208	481	227
	(196, 1097)	(87, 446)	(120, 1096)	(103, 424)
IL-2, pg/mL	22	8	23	8
	(10, 38)	(3, 23)	(10, 58)	(3, 16)
GM-CSF, pg/mL	7	2	9	2
	(2, 16)	(2, 5)	(2, 21)	(2, 4)
Ferritin, ng/mL	3001	904	2312	809
	(1326, 6683)	(489, 1529)	(1225, 4777)	(489, 1529)
CRP, mg/L	214	76	175	78
	(141, 353)	(39, 136)	(124, 345)	(44, 131)

CAR, chimeric antigen receptor; CRP, C-reactive protein; GM-CSF, granulocyte-macrophage colony-stimulating factor; IFN, interferon, IL, interleukin; Q, quartile.

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# **RESULTS** (continued)



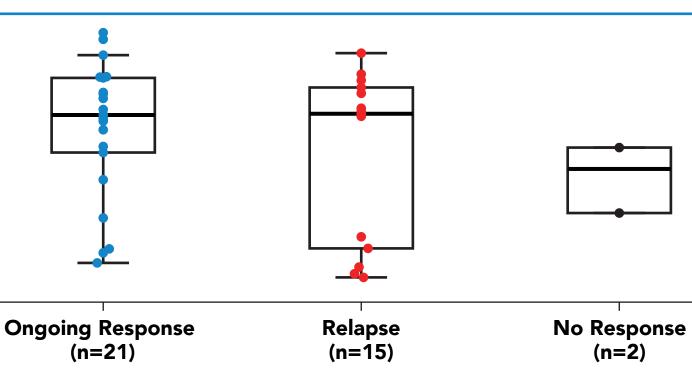
# Median OS (95% CI), mo

) –	Not re	eached (NE-NE)									
- 1	0	2	4	6	8	10	12	14	16	18	20
					Time,	Mont	hs				
t ri	i <b>sk</b> 40	39	35	34	32	32	32	24	10	3	0
er	(0)	(0)	(1)	(1)	(1)	(1)	(1)	(7)	(21)	(28)	(31)

NE, not estimable; OS, overall survival; PFS, progression-free survival.

• Median duration of response (DOR), progression-free survival (PFS), and OS were not reached • KM estimates of the 12-mo DOR, PFS, and OS rates were 60%, 63%, and 82%, respectively • The investigator-assessed ORR remained 95% (80% CR rate) with a median follow-up of 14.9 months - At data cutoff, 21 patients (53%) were in ongoing response

### Figure 6. Associations Between Peak CAR T-Cell Levels and Response at



CAR T cells were quantified using quantitative polymerase chain reaction.

• Median peak CAR T-cell levels were comparably high in patients with ongoing response and relapse (64 cells/ $\mu$ L [n=21] and 66 cells/ $\mu$ L [n=15], respectively) at 12 months and considerably lower in nonresponders (18 cells/µL [n=2]) - A similar trend was observed with CAR T-cell expansion by area under the curve from Day 0 to 28

• In total, 32 matched patients each in Cohort 6 and Cohorts 1+2 were identified in propensity

- Eight patients from Cohort 6 were not included due to nonavailability of matched patients in

• Baseline characteristics (as noted in **Figure 3**) were comparable between the 32 matched patients<sup>5</sup>

# Table 4. Propensity Score Comparison of Outcomes

	Cohorts 1+2 Overall (N=101)	Cohort 6 Overall (N=40)	Cohorts 1+2 After Matching (n=32)	Cohort 6 After Matching (n=32ª)
Efficacy				
Objective response, n (%)	84 (83)	38 (95)	30 (94)	30 (94)
Complete response, n (%)	59 (58)	32 (80)	25 (78)	24 (75)
Ongoing response at data cutoff date, <sup>b</sup> n (%)	42 (42)	21 (53)	19 (59)	15 (47)
Median duration of response (95% CI), mo	11.1 (3.9, NE)	NR (7.8, NE)	NR (8.1, NE)	13.1 (5.5, NE)
KM 12-month (95% CI), %	49 (37, 59)	60 (41, 74)	65 (45, 80)	56 (36, 72)
Median progression-free survival (95% CI), mo	5.9 (3.3, NE)	NR (8.7, NE)	NR (5.6, NE)	14.3 (6.5, NE)
KM 12-month (95% CI), %	44 (34, 54)	63 (46, 77)	61 (42, 76)	61 (41, 76)
Median overall survival (95% CI), mo	NR (12.8, NE)	NR (NE, NE)	NR (15.4, NE)	NR (NE, NE)
KM 12-month (95% CI), %	60 (50, 69)	82 (66, 91)	81 (63, 91)	78 (59, 89)
Safety				
CRS				
Worst Grade ≥2, n (%)	57 (56)	18 (45)	19 (59)	15 (47)
Worst Grade ≥3, n (%)	12 (12)	0	4 (13)	0
Median time to onset of any grade CRS (Q1, Q3), days	2 (2, 3)	5 (4, 6)	2 (2, 4)	5 (4, 6)
Neurologic events				
Worst Grade ≥2, n (%)	43 (43)	13 (33)	12 (38)	13 (41)
Worst Grade ≥3, n (%)	29 (29)	6 (15)	7 (22)	6 (19)
Median time to onset of any grade neurologic event (Q1, Q3), days	5 (3, 7)	6 (5, 9)	6 (3, 7)	6 (5, 8)
Median time to onset of Grade ≥3 neurologic event (Q1, Q3), days	7 (5, 7)	12 (6, 30)	7 (6, 11)	12 (6, 30)
Infections				
Worst any grade, n (%)	37 (37)	20 (50)	12 (38)	15 (47)
Worst Grade ≥3, n (%)	23 (23)	8 (20)	6 (19)	8 (25) <sup>c</sup>
Cumulative cortisone-equivalent corticosteroid dose (including prophylaxis), n	25	40	6	32
Median (Q1, Q3), mg	6390 (2817, 15,760)	1252 (939, 6291)	7418 (2504, 11,579)	1252 (939, 6604)
Cumulative tocilizumab use, n	43	23	11	19
Peak median (Q1, Q3), mg	1300 (800, 1800)	1000 (700, 1760)	1339 (772, 3310)	1000 (600, 1680)

<sup>a</sup> Eight patients were excluded due to nonavailability of matched patients in the pivotal cohorts. <sup>b</sup> Represents the number of patients in response at the data cutoff date among all treated patients. <sup>c</sup> Worst Grade 4 or 5 infections occurred in 3 patients (patient 1: Grade 4 sepsis [unrelated to treatment]; patient 2: Grade 4 human herpesvirus 6 encephalitis [related to conditioning chemotherapy] and Grade 5 urosepsis [unrelated to treatment]; and patient 3: Grade 4 Aspergillus infection and respiratory tract infection [related to conditioning chemotherapy] and axi-cel]). CRS, cytokine release syndrome; KM, Kaplan-Meier; NE, not estimable; NR, not reached; Q, quartile.

### **Propensity Score Matching Analysis Summary**

- Incidence of Grade  $\geq$ 3 CRS was lower in Cohort 6 (0%) compared with Cohort 1+2 before and after propensity score-based matching
- Median time to onset of any-grade CRS was delayed in Cohort 6 (5 days) versus Cohorts 1+2 (2 days) before and after matching • Median time to onset of Grade  $\geq$ 3 NEs appeared to be delayed in Cohort 6 versus
- Cohorts 1+2 before and after matching (12 days versus 7 days, respectively) • Clinical efficacy remained comparable between patients in Cohort 6 and
- Cohorts 1+2 before and after propensity score–based matching
- Median cumulative corticosteroid dose including prophylaxis was ≈6-fold lower in Cohort 6 versus Cohorts 1+2 (1252 mg versus 7418 mg, respectively) after matching Although more patients in Cohort 6 versus Cohorts 1+2 required tocilizumab after matching, median peak cumulative tocilizumab dose was lower in Cohort 6 versus
- Cohorts 1+2 (1000 mg versus 1339 mg, respectively)
- Peak CAR T-cell levels were comparable and peak inflammatory biomarkers associated with CAR T-cell treatment-related AEs, including interferon-y, interleukin-2, GM-CSF, and ferritin, were lower in Cohort 6 versus Cohorts 1+2 before and after propensity score matching, supporting clinical outcomes

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### DISCLOSURES

Novartis, Miltenyi Biotech, Roche, and Bristol Myers Squibb/Celgene; consultancy or advisory role for Kite, a Gilead Company, Roche, Bristol Myers Squibb/Celgene, Novartis, and Miltenyi Biotech; research funding from Kite, a Gilead

support from Kite, a Gilead Company; and stock or other ownership in Gilead Sciences. **TvM:** honoraria from Kite, a Gilead Company; and consultancy or advisory role for Janssen.

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# CONCLUSIONS

- With ≥1-year follow-up for ZUMA-1 Cohort 6, prophylactic and earlier corticosteroid and/or tocilizumab intervention for toxicity management continued to demonstrate potential to improve the benefit/risk profile of axi-cel with no negative impact on pharmacokinetics and/or efficacy outcomes
- Although limited by retrospective and cross-cohort comparisons, findings were corroborated by propensity score-based matching analysis versus pivotal Cohorts 1+2
- Overall, these findings suggest that the Cohort 6 toxicity management strategy can improve long-term safety of axi-cel in relapsed/refractory LBCL without compromising its efficacy parameters, including the durability of responses

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