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8.4 Pediatric Use 8.5 Geriatric Use

1 INDICATIONS AND USAGE

- 106 KEBILIDI (eladocagene exuparvovec-tneq) is an adeno-associated virus (AAV) vector-based
- gene therapy indicated for the treatment of adult and pediatric patients with aromatic L-amino
- acid decarboxylase (AADC) deficiency.

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- This indication is approved under accelerated approval based on the change from baseline in
- gross motor milestone achievement at 48 weeks post-treatment [see Clinical Studies (14)].
- 111 Continued approval for this indication may be contingent upon verification and description of
- clinical benefit in a confirmatory clinical trial.

113 2 DOSAGE AND ADMINISTRATION

114 For single-dose intraputaminal infusion only.

2.1 Important Dosing Information

- Confirm patient has AADC deficiency due to biallelic mutations in the *DDC* gene.
- Strictly observe aseptic technique during preparation and administration of KEBILIDI.
- KEBILIDI should be administered in a medical center which specializes in stereotactic neurosurgery.
 - Administer KEBILIDI only using an FDA-authorized cannula for intraparenchymal infusion (i.e., ClearPoint SmartFlow Neuro Cannula Part Number NGS-NC-01-EE or NGS-NC-02-EE).
 - Use of the syringe (i.e., connecting the syringe to the syringe pump and priming of the cannula) should begin within 6 hours of starting product thaw.
 - KEBILIDI is intended to be administered with an infusion pump capable of infusing at a rate of 0.003 mL/min.

127 2.2 Recommended Dose

- KEBILIDI is administered as four intraputaminal infusions in a single stereotactic neurosurgical
- procedure as per the recommended dose shown in Table 1.

130 Table 1: Recommended Dose of KEBILIDI

Total Recommended Dose	1.8x10 ¹¹ vg (0.32 mL)	
Total number of infusions	4	
Volume (dose) per infusion	0.08 mL (0.45x10 ¹¹ vg)	
Location of infusions	2 in anterior putamen, 2 in posterior putamen	
Infusion rate at each target point	0.003 mL/min	
Dose duration for infusion at each target point	27 minutes	

131 2.3 Preparation

132 Thawing KEBILIDI Vial

• Coordinate timing of KEBILIDI thaw and infusion. KEBILIDI should be used within 6 hours of starting product thaw. Infusion of KEBILIDI takes 4 hours. The maximum time from thaw to completion of infusion should be no more than 10 hours.

- Thaw the KEBILIDI vial upright at room temperature before use. The contents of the vial will thaw in approximately 15 minutes at room temperature. **Do not** thaw or warm the vial any other way. Gently invert the vial 3 times. **Do not** shake the vial.
 - Inspect the fully thawed KEBILIDI vial after mixing. KEBILIDI should be inspected visually for particulate matter, and discoloration prior to administration. KEBILIDI is clear to slightly opaque. The color of KEBILIDI should be a colorless to faint white suspension.
 - **Do not** use if particulates, or discoloration are visible in the suspension.

144 Preparing KEBILIDI in Syringe

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1. Gather supplies listed in Table 2 for preparation:

Table 2: Supplies for KEBILIDI Preparation

Component	Material of Construction	
1mL lubricated sterile Luer-lock syringe with elastomer plunger	Silicone, PC; Silicone, PP	
Or		
5mL lubricated sterile Luer-lock syringe with	Silicone, PP	
elastomer plunger		
18 or 19 G sterile needle with 5µm filter	Stainless steel, PC hub; Stainless steel, PP hub	
Sterile Luer-lock syringe cap	-	
Plastic bag for delivery into surgical unit	-	
Secondary container for delivery into surgical unit	-	

- 147 Abbreviations: PC=Polycarbonate; PP=Polypropylene
 - 2. Prepare KEBILIDI using sterile techniques under aseptic conditions, proper engineering controls (e.g., biological safety cabinets or isolator) as per the institutional policies.
 - 3. Open the syringe and label it as the product-filled syringe.
- 4. Attach the filter needle to the syringe.
 - 5. Draw the full volume of the vial of KEBILIDI into the syringe. Invert the vial and syringe and partially withdraw or angle the needle as necessary to maximize recovery of product.
 - 6. Draw air into the syringe so that the needle is emptied of product. Carefully remove the needle from syringe containing KEBILIDI. Purge the air from the syringe until there is no air bubble and then cap with a syringe cap.
 - 7. Place the syringe in a plastic bag and seal the bag.
 - 8. Place the plastic bag in an appropriate secondary container for delivery to the surgical suite at room temperature.
 - 9. The filled syringe prepared under aseptic conditions for delivery to the surgical site should be used immediately.

163 Notes:

- **Do not** refreeze thawed product.
- Dispose any remaining KEBILIDI or disposable material in compliance with institutional policy.

2.4 Administration

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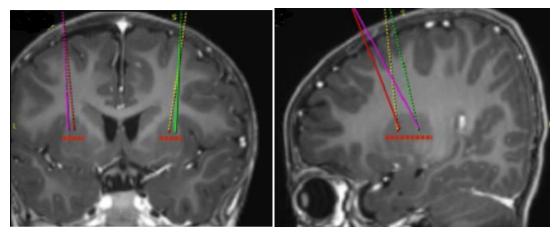
Gather supplies for administration:

- KEBILIDI [see How Supplied/Storage and Handling (16)]
- SmartFlow Neuro Cannula
- Syringe pump, capable of an infusion rate of 0.003 mL/min and compatible with 1 mL or 5 mL syringe sizes
- Stereotactic system

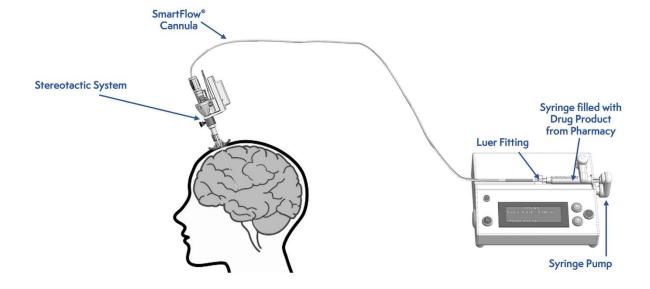
174 <u>Identification of the Target Points Within the Putamen</u>

• Using standard neurosurgical stereotactic procedure, brain imaging for stereotactic planning and intraoperative navigation should be done prior to the procedure (see Figure 1).

Figure 1: Four Target Points within the Putamen for Infusion Sites



• After stereotactic registration is complete, mark the entry point on the skull. Surgical access through the skull bone and dura should be performed.



Intraputaminal Administration of KEBILIDI

Administer KEBILIDI by bilateral intraputaminal infusion using a single infusion cannula in one surgical session at two sites (anterior and posterior) per putamen. The infusion cannula is placed and infusion performed separately for each target point (see Figure 2).

- 1. Tightly connect the syringe containing the prepared KEBILIDI to Luer Lock connector at the proximal end of the infusion cannula.
- 2. Load syringe onto the infusion pump and secure appropriately.
- 3. Set infusion pump occlusion limit to the highest level to prevent pump from alarming or disrupting the infusion.
- 4. Prime KEBILIDI at the rate of up to 0.003 mL/minute (0.18 mL/hour) until the first drop of the product can be seen at the tip of the needle.
- 5. Place sterile absorbent pad or gauze under the tip of the cannula to contain drops of the prepared product that might emerge during priming.
- 6. Run the infusion pump prior to insertion of the cannula to ensure the prepared product is flowing from the tip immediately before insertion.
- 7. Place the infusion SmartFlow Neuro Cannula at the designation point in the putamen using stereotactic tools based on pre-planned stereotactic trajectories.
- 8. Starting with the first target site, insert the cannula through a burr hole into the putamen and then incrementally withdraw cannula along the intraputaminal infusion track, distributing the 0.08 mL (infused at a rate of 0.003 mL/min) of KEBILIDI per putamen across the planned trajectory to optimize distribution across the target site. The pump should run continuously throughout the 27-minute infusion, including during the repositioning to the designated sites along the infusion track.
- 9. Once the infusion is complete, stop the pump and leave the cannula in place for 5 minutes before withdrawing. Re-zero the total delivered volume setting on the infusion pump as soon as the cannula is inserted to the target and perform infusion. Reinsert at the next target point, repeating the same procedure for the other 3 target points.

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212 10. After standard neurosurgical closure procedures, carry out a postoperative brain imaging examination of the patient to ensure there are no complications (e.g., bleeding).

214 3 DOSAGE FORMS AND STRENGTHS

- 215 KEBILIDI is a sterile suspension for intraputaminal infusion. Each single-dose vial contains
- 2.8×10¹¹ vg/0.5 mL (nominal concentration of 5.6×10¹¹ vg/mL) of KEBILIDI and each 2 mL
- vial contains an extractable volume of 0.5 mL.
- Following product thaw, the suspension for infusion is a clear to slightly opaque, colorless to
- faint white liquid, free of visible particulates [see How Supplied/Storage and Handling (16)].

220 4 CONTRAINDICATIONS

- 221 KEBILIDI is contraindicated in patients who have not achieved skull maturity assessed by
- 222 neuroimaging. Skull maturity is needed for stereotactic neurosurgical administration of
- 223 KEBILIDI.

224 5 WARNINGS AND PRECAUTIONS

225 **5.1 Procedural Complications**

- 226 Procedural complications have been reported after neurosurgery required for KEBILIDI
- administration. These events included respiratory and cardiac arrest which occurred within 24
- 228 hours of the neurosurgical procedure and during post-surgical care [see Adverse Reactions (6)].
- KEBILIDI administration has the potential risk for additional procedure related adverse events
- 230 including cerebrospinal fluid (CSF) leak, intracranial bleeding, neuroinflammation, acute
- 231 infarction, and infection.
- 232 Monitor patients for procedure related adverse events with KEBILIDI administration, including
- 233 continuous cardiorespiratory monitoring during hospitalization.

234 5.2 Dyskinesia

- Dyskinesia was reported after administration of KEBILIDI. All events were reported within 3
- months of administration and 2 events required hospitalization [see Adverse Reactions (6)].
- 237 Monitor patients for signs and symptoms of dyskinesia after KEBILIDI treatment which may
- include involuntary movements of face, arm, leg, or entire body. These may present as fidgeting,
- writhing, wriggling, head bobbing or body swaying. The use of dopamine antagonists may be
- 240 considered to control dyskinesia symptoms.

241 6 ADVERSE REACTIONS

242 6.1 Clinical Trials Experience

- 243 Because clinical trials are conducted under widely varying conditions, adverse reaction rates
- observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials
- of another drug and may not reflect the rates observed in practice.

- The safety data described in this section reflects exposure to KEBILIDI in 13 pediatric patients
- with genetically confirmed AADC deficiency who received a single dose of 1.8×10^{11} vg. The
- median duration of follow-up was 72 weeks (range 23 to 109 weeks) [see Clinical Studies (14)].
- The most common adverse reactions (incidence $\geq 15\%$) are summarized in Table 3.

Table 3: Adverse Reactions in ≥15% of Patients in Study 1

Adverse Reaction	Patients Treated with KEBILIDI N=13 (%)	
Dyskinesia	10 (77%)	
Pyrexia	5 (38%)	
Hypotension	4 (31%)	
Anemia	4 (31%)	
Salivary hypersecretion	3 (23%)	
Hypokalemia	3 (23%)	
Hypophosphatemia	3 (23%)	
Insomnia	3 (23%)	
Hypomagnesemia	2 (15%)	
Procedural complications*	2 (15%)	

- 251 *Procedural complications included respiratory and cardiac arrest.
- Other clinically significant adverse reaction includes worsening in duration and frequency of
- oculogyric crises during hospitalization following administration of KEBILIDI reported in one
- 254 patient.

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255 8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

- 257 Risk Summary
- 258 There are no clinical data from the use of KEBILIDI in pregnant women. Animal reproductive
- and developmental toxicity studies have not been conducted with KEBILIDI.
- In the US general population, the estimated background risk of major birth defects and
- miscarriage in clinically recognized pregnancies is 2% to 4% and 15% to 20%, respectively.

262 **8.2** Lactation

- 263 Risk Summary
- There is no data on the presence of KEBILIDI in human milk, the effects on the breastfed infant,
- or the effects on milk production.

8.3 Females and Males of Reproductive Potential

- 267 Pregnancy Testing
- 268 Pregnancy status of females with reproductive potential should be verified. Sexually active
- 269 females of reproductive potential should have a negative pregnancy test before administering
- 270 KEBILIDI.

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- 271 <u>Contraception</u>
- 272 There are insufficient exposure data to provide a recommendation concerning duration of
- 273 contraception following treatment with KEBILIDI.
- 274 <u>Infertility</u>
- There is no data on the effects of KEBILIDI on fertility.
- 276 **8.4 Pediatric Use**
- 277 The safety and effectiveness of KEBILIDI have been established in pediatric patients. The use of
- 278 KEBILIDI was evaluated in a single-arm, open-label study that enrolled 13 pediatric patients
- aged 16 months to 10 years who had achieved skull maturity [see Adverse Reactions (6) and
- 280 Clinical Studies (14)].
- The safety and effectiveness of KEBILIDI have not been studied in pediatric patients younger
- than 16 months.
- 283 8.5 Geriatric Use
- KEBILIDI has not been studied in patients 65 years of age and older.
- 285 11 **DESCRIPTION**
- KEBILIDI (eladocagene exuparvovec-tneq) is a gene therapy product that expresses the human
- aromatic L-amino acid decarboxylase enzyme (hAADC). It is a recombinant adeno-associated
- virus serotype 2 (rAAV2) based vector containing the complementary DNA of the human *DDC*
- gene under the control of the cytomegalovirus immediate-early promoter. Eladocagene
- 290 exuparvovec-tneq is produced in human embryonic kidney cells by recombinant DNA
- 291 technology.
- KEBILIDI is a sterile suspension administered by bilateral intraputaminal infusion in one
- surgical session at two sites (anterior and posterior) per putamen. Each single-dose 2 mL vial
- 294 contains 2.8×10¹¹ vg in an extractable volume of 0.5 mL of suspension. Each mL of suspension
- contains 5.6×10¹¹ vg. Patients will receive a total dose of 1.8×10¹¹ vg delivered as four 0.08 mL
- 296 $(0.45 \times 10^{11} \text{ vg})$ infusions (two per putamen).
- 297 KEBILIDI is provided in a single-dose 2 mL vial containing a clear to slightly opaque, colorless
- 298 to faint white liquid, free of visible particulates following thaw from its frozen state. The
- excipients include potassium chloride (3 mM), sodium chloride (337 mM), potassium
- dihydrogen phosphate (2 mM), disodium hydrogen phosphate (8 mM), and poloxamer 188
- (0.001%).

302 12 CLINICAL PHARMACOLOGY

303 **12.1 Mechanism of Action**

- 304 KEBILIDI is a recombinant adeno-associated virus serotype 2 (rAAV2) based gene therapy
- designed to deliver a copy of the DDC gene which encodes the AADC enzyme. Intraputaminal
- infusion of KEBILIDI results in AADC enzyme expression and subsequent production of
- dopamine in the putamen.

12.2 Pharmacodynamics

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Homovanillic Acid in Cerebrospinal Fluid

- In Study 1, homovanillic acid (HVA), a downstream metabolite of dopamine, in cerebrospinal
- fluid (CSF) was measured at baseline, Week 8, and Week 48 using a high-performance liquid
- 312 chromatography with tandem mass spectrometry (HPLC-MS/MS). In all patients of Study 1, an
- increase in CSF HVA levels from baseline was observed at Week 8 and Week 48 (Table 4).

314 Table 4: HVA Levels in CSF (Study 1)

Timepoint	Observed Values (nmol/L)	Change from Baseline (nmol/L)	Percent Change from Baseline (%)
Baseline		,	, ,
N	13	-	-
Median (Min, Max)	3.34 (1.00, 93.73)	-	-
Week 8			
N	12	12	12
Median (Min, Max)	35.09 (15.09, 150.48)	26.62 (12.49, 56.75)	534.7 (57.4, 2810.0)
Week 48			
N	9	9	9
Median (Min, Max)	29.16 (14.21, 125.84)	24.7 (13.21, 58.02)	773.1 (33.9, 3991.0)

- Note: Lower limit of quantification (LLOQ) was 2 nmol/L, and values reported as <LLOQ were imputed as 0.5*LLOQ.
- 316 Abbreviations: CSF=cerebrospinal fluid: HVA=homovanillic acid; N=number of subjects: Max=maximum;
- 317 Min=minimum

318 ¹⁸F-DOPA Uptake in the Putamen

- 319 ¹⁸F-DOPA is a positron-emitting fluorine-labeled substrate of the AADC enzyme. Following
- administration of ¹⁸F-DOPA, its uptake into the putamen assessed by positron emission
- 321 tomography (PET) imaging reflects AADC enzyme activity of dopaminergic neurons in the
- putamen. In Study 1, ¹⁸F-DOPA uptake in the putamen was assessed at baseline and followed up
- at Week 8 in 12 out 13 patients and at Week 48 in 10 out 13 patients indicating increased AADC
- 324 ¹⁸F-DOPA uptake in all assessed patients. The median (range) percent increase from baseline
- 325 was 259% (65% to 620%) at Week 8 and 271% (25% to 760%) at Week 48.

326 **12.3** Pharmacokinetics

- Biodistribution (within the body) and Vector Shedding (excretion/secretion)
- 328 KEBILIDI vector DNA levels in various tissues and secretions were determined using a
- validated quantitative polymerase chain reaction (qPCR) assay.
- 330 Nonclinical data
- Biodistribution of eladocagene exuparvovec-tneq was evaluated in rats at Days 7, 30, 90, and
- 180 after single-dose intraputaminal infusion at dose levels up to 7.5×10^9 vg/animal (21-fold
- higher than the recommended human dose based on relative brain weight). At Day 7, vector
- DNA was observed in the putamen, cerebellum, cerebrum, and spinal cord. Vector DNA levels
- declined from Day 7 to Day 90, with DNA levels primarily sustained in the putamen at Day 180.
- 336 Clinical data
- Following administration of KEBILIDI at a total dose for each patient of 1.8×10¹¹ vg in Study 1,
- biodistribution and viral shedding in CSF, blood, and urine were evaluated in 13 patients. CSF
- was collected at Weeks 8 and 48, and blood and urine were collected from Day 3 up to Week 48.
- Five (38%) patients showed detectable vector DNA levels in blood at Day 3 ranging from
- 4.0×10^3 to 6.5×10^3 copies/mL, which became below the limit of detection ($<3.1 \times 10^3$ copies/mL)
- by Week 3. No vector was detected in CSF or urine.

343 **12.6** Immunogenicity

- 344 The observed incidence of anti-AAV2 antibodies is highly dependent on the sensitivity and
- specificity of the assay. Differences in assay methods preclude meaningful comparisons of the
- incidence of anti-AAV2 antibodies in the studies described below with the incidence of anti-
- 347 AAV2 antibodies in other studies.
- 348 There is no clinical experience with KEBILIDI in patients with pre-existing anti-AAV2
- neutralizing antibody at titers >1:1200.
- In Study 1, anti-AAV2 total binding antibodies and anti-AAV2 neutralizing antibodies were
- assessed from Day 3 up to Week 48 following administration of KEBILIDI. In all patients
- 352 (N=13), titers of total binding antibody and neutralizing antibody increased from Week 3 and
- remained elevated, as measured at Week 48 (N=9). The highest titers in each patient ranged from
- 1:800 to 1:204,800 for total binding antibodies and from 1:80 to 1:10,240 for neutralizing
- antibody. Because of the small sample size of Study 1, there is insufficient data to determine the
- effect of anti-AAV2 antibody on the pharmacokinetics, pharmacodynamics, safety, or
- 357 effectiveness.

13. NONCLINICAL TOXICOLOGY

359 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenicity, genotoxicity, and fertility studies have not been performed with KEBILIDI.

361 14 CLINICAL STUDIES

- The efficacy of KEBILIDI was evaluated in one open-label, single arm study (Study 1;
- NCT04903288). The study enrolled pediatric patients with genetically confirmed, severe AADC
- deficiency who had achieved skull maturity assessed with neuroimaging. The main efficacy
- outcome measure was gross motor milestone achievement evaluated at week 48 and assessed
- using the Peabody Developmental Motor Scale, Second Edition (PDMS-2). Patients treated with
- 367 KEBILIDI were compared to an external untreated natural history cohort of 43 pediatric patients
- with severe AADC deficiency who had at least one motor milestone assessment after 2 years of
- 369 age.

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- A total of 13 patients received a single total dose of 1.8×10^{11} vg of KEBILIDI given as four
- intraputaminal infusions in a single stereotactic neurosurgical procedure. The demographic
- characteristics of the population were as follows: the median age was 2.8 years (1.3 to 10.8
- years), 7 patients (54%) were female, 10 patients (77%) were Asian, 2 patients (15%) were
- White, and 1 patient was of "other" race. Twelve of the 13 patients had the severe phenotype of
- 375 AADC deficiency, defined as having no motor milestone achievement at baseline and no clinical
- 376 response to standard of care therapies. The one remaining patient had a "variant" of the severe
- disease phenotype, with the ability to sit with assistance but with lack of head control.
- 378 Gross motor milestone achievement at Week 48 was assessed in 12 of the 13 patients treated in
- 379 Study 1 (one patient dropped out of the study prior to Week 48).
- Eight (67%) of the 12 treated patients achieved a new gross motor milestone at week 48: 3
- patients achieved full head control, 2 patients achieved sitting with or without assistance, 2
- patients achieved walking backwards and the patient with the "variant" severe phenotype was
- able to sit unassisted. The two patients who achieved walking backwards at week 48 were treated
- before 2 years of age. The four patients who were unable to achieve new gross motor milestones
- at week 48 were treated between the ages of 2.8 and 10.8 years. In comparison, none of the 43
- untreated patients with the severe phenotype had documented motor milestone achievement at
- last assessment at a median age of 7.2 years (range 2 to 19 years).

16 HOW SUPPLIED/STORAGE AND HANDLING

389 How Supplied

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- 390 KEBILIDI is supplied in a single-dose 2 mL vial containing sterile, clear to slightly opaque,
- colorless to faint white liquid free of visible particulates, following thaw from its frozen state.
- Each KEBILIDI (eladocagene exuparvovec-tneq) vial contains 2.8×10¹¹ vg of eladocagene
- exuparvovec-tneg in an extractable volume of 0.5 mL of suspension. Each mL of suspension
- contains a nominal concentration of 5.6×10^{11} vg of eladocagene exuparvovec-tneq.
- 395 Package (carton): NDC Number 52856-601-01
- 396 Container (vial): NDC Number 52856-601-11

397 Storage and Handling

- Store and transport frozen at \leq -65°C (-85°F). Keep the vial in the supplied carton.
- Thaw KEBILIDI prior to administration. If not used immediately, store at room temperature (up
- 400 to 25°C [77°F]) and use within 6 hours of starting product thaw [see Dosage and Administration
- (2.3)]. **Do not** refreeze vial once thawed.

17 PATIENT COUNSELING INFORMATION

- Discuss the following with patients and caregivers:
 - Administration: Inform patients/caregivers that KEBILIDI administration involves an infusion into the brain that is administered during the neurosurgical procedure [see Administration 2.4)].
 - Procedural Complications: Inform patients/caregivers about the complications of the neurosurgical procedure required for administration of KEBILIDI, including respiratory and cardiac arrest, cerebrospinal fluid (CSF) leak, intracranial bleeding, neuroinflammation, acute infarction, and infection [see Warnings and Precautions (5.1)].
 - Dyskinesia: Inform patients/caregivers that they may experience dyskinesia within 3 months after treatment with KEBILIDI. Symptoms of dyskinesia may include involuntary movements of face, arm, leg, or entire body which may present as fidgeting, writhing, wriggling, head bobbing or body swaying. Advise patients and caregivers to contact their healthcare provider if these symptoms occur [see Warnings and Precautions (5.2)].
 - Vector Shedding: Inform patients/caregivers that temporary vector shedding of KEBILIDI may occur for 3 weeks after administration. Advise patients/caregivers on proper hand hygiene and appropriate handling of waste materials generated from dressings and/or any secretions (e.g., blood, nasal secretions, urine, stool, and CSF). Recommended procedures include storage of waste material in sealed bags prior to disposal and wearing gloves for dressings changes and waste disposal. Patients should not donate blood, organs, tissues, or cells for transplantation [see *Pharmacokinetics* (12.3)].
- 426 Manufactured by: PTC Therapeutics, Inc.
- 427 Warren, NJ 07059 USA

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