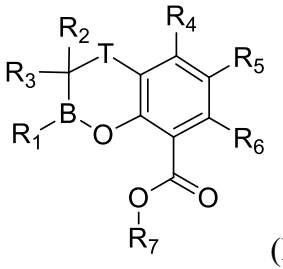
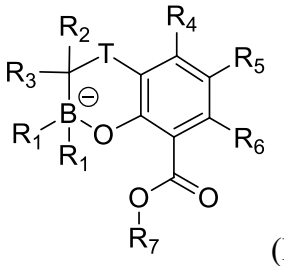
Claims

1. A compound represented by Formula (II) or (II') or a pharmaceutically acceptable salt thereof,


(II) or

(II'),

wherein B is boron;

T is -O-, -S-, or -Se-;

each R_1 is independently -OH or C_{1-3} alkoxy;

R_2 and R_3 are each independently H or C_{1-3} alkyl, wherein the C_{1-3} alkyl is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

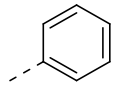
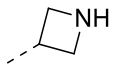
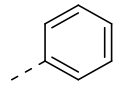
R_4 is H, F, Cl, Br, I, C_{1-3} alkyl, or C_{1-3} alkoxy, wherein the C_{1-3} alkyl and C_{1-3} alkoxy are each independently and optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

R_5 is H, F, Cl, Br, I, or C_{1-3} alkoxy;

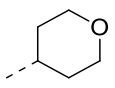
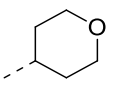
R_6 is H, F, Cl, Br, I, $-OR_a$, or C_{1-3} alkyl, wherein the C_{1-3} alkyl is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

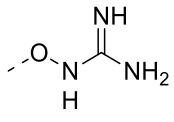
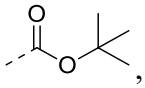
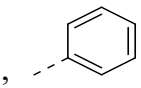
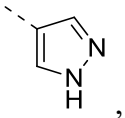
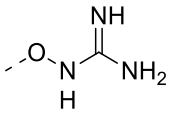
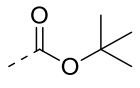
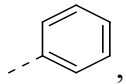
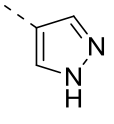
or R_5 and R_6 together with the carbon atom to which they are attached form a 5-6-membered oxygen-containing non-aromatic heterocyclic ring, wherein the 5-6-membered oxygen-containing non-aromatic heterocyclic ring is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

R_7 is H, C_{1-3} alkyl, $-C(R_b)_2OC(=O)R_c$, or $-C(R_b)_2OC(=O)OR_c$, wherein the C_{1-3} alkyl is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

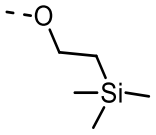
R_a is H, C_{1-6} alkyl, , , , or , wherein the C_{1-6} alkyl, , , , and  are each independently and optionally substituted with 1, 2, or 3 R_{a1};

each R_b is independently H or C_{1-3} alkyl;

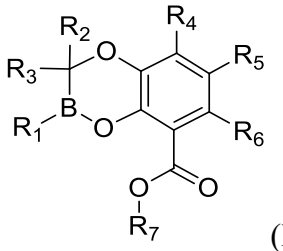
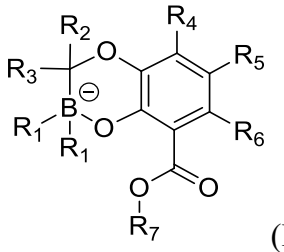
R_c is H, C_{1-3} alkyl, , or , wherein the C_{1-3} alkyl, , and  are each independently and optionally substituted with 1, 2, or 3 R_{c1};

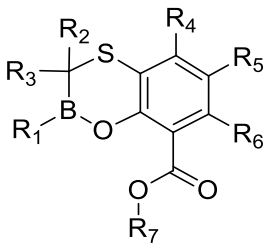
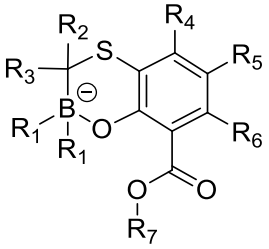
each R_{a1} is independently F, Cl, Br, I, C_{1-3} alkyl, C_{1-3} alkoxy, , , , , , or , wherein the C_{1-3} alkyl, C_{1-3} alkoxy, , , , , , and  are each independently and optionally substituted with 1, 2, or 3 R;

each R_{c1} is independently F, Cl, Br, I, -OH, C_{1-3} alkyl, or C_{1-3} alkoxy; and

each R is independently F, Cl, Br, I, -OH, or C_{1-3} alkyl, wherein the C_{1-3} alkyl is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, and .

2. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein the compound has a structure represented by Formula (II-1), (II'-1), (II-2), or (II'-2):

 (II-1),  (II'-1),

 (II-2), or  (II'-2),

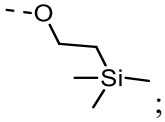
wherein R_1, R_2, R_3, R_4, R_5, R_6, and R_7 are as defined in claim 1.

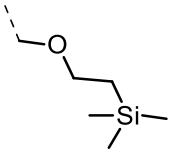
3. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein each R_1 is independently -OH or $-OCH_3$;

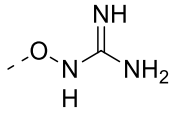
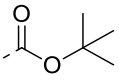
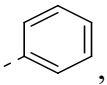
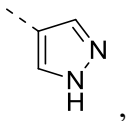
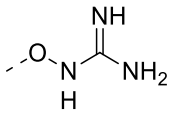
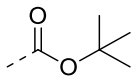
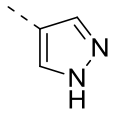
optionally, R_2 and R_3 are each independently H or $-CH_3$.

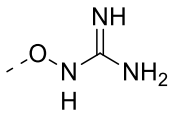
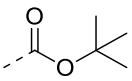
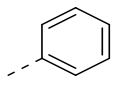
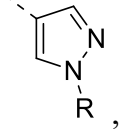
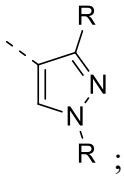
4. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein R_4 is H, F, Cl, $-CH_3$, or $-OCH_2CH_3$;

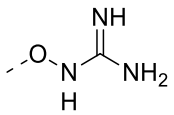
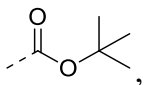
optionally, R_5 is H, F, Cl, or -OCH_3.

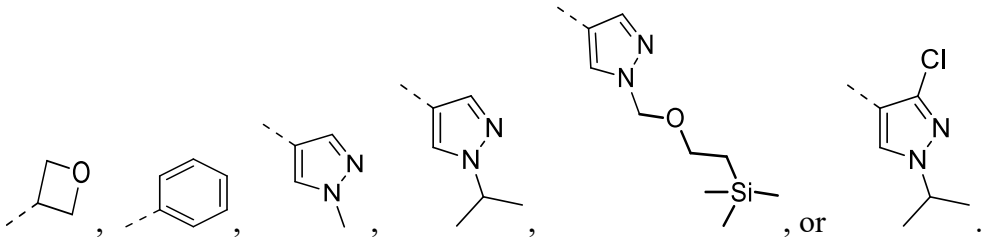
5. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein each R is independently F, Cl, Br, I, -CH_3, or , wherein the -CH_3 or  is each independently and optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, and ;

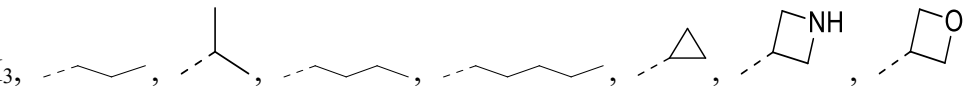
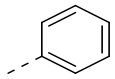
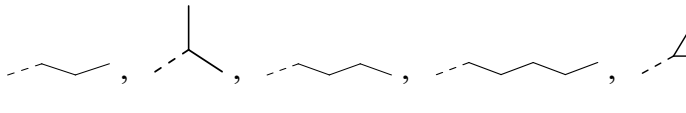
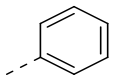
preferably, each R is independently F, Cl, Br, I, -CH_3, , or .

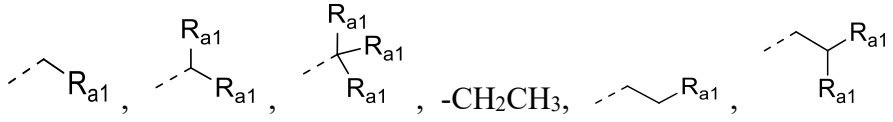
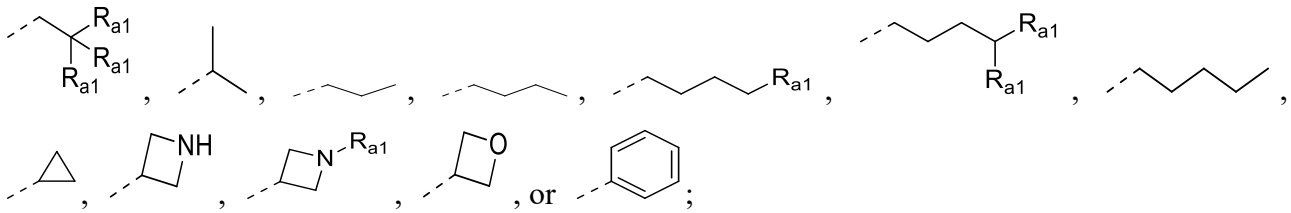
6. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein each R_{a1} is independently F, Cl, Br, I, -OCH_3, , , , , , or , wherein the -OCH_3, , , , , , and  are each independently and optionally substituted with 1, 2, or 3 R;

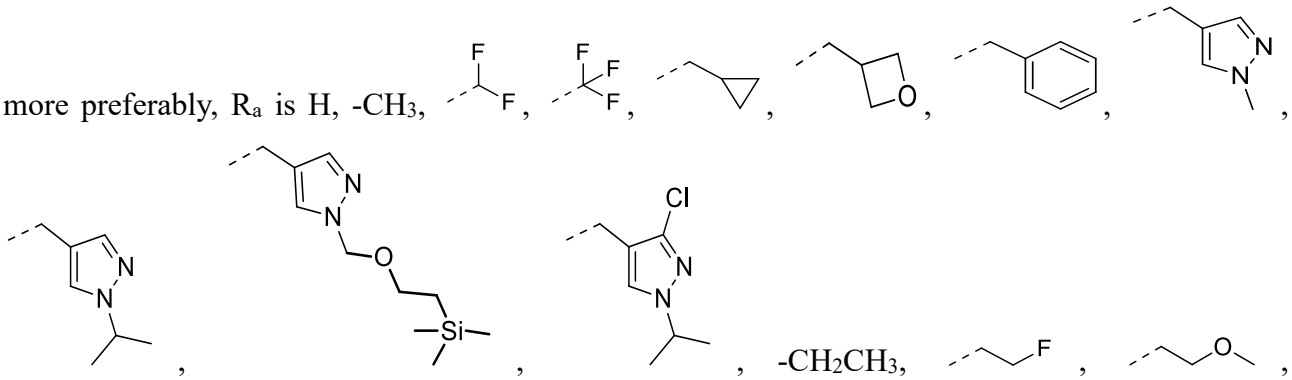
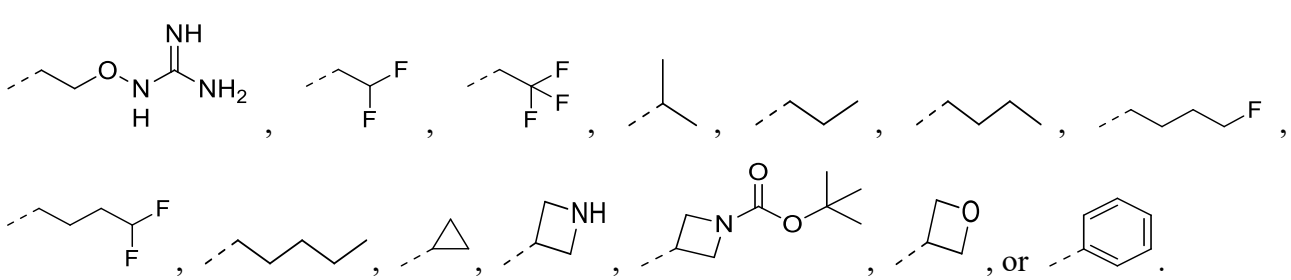
preferably, each R_{a1} is independently F, Cl, Br, I, -OCH_3, , , , , , , or ;

more preferably, each R_{a1} is independently F, Cl, Br, I, -OCH_3, , , ,

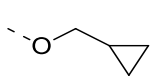
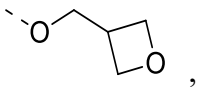
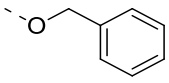
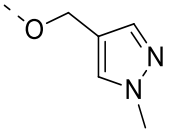
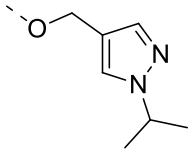
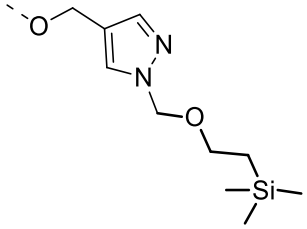
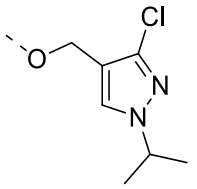
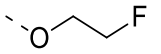
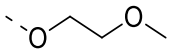
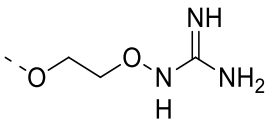
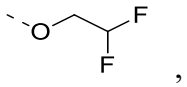
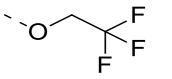
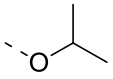
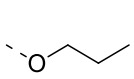
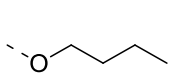
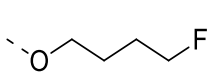
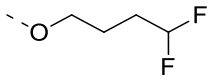
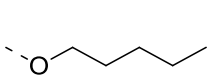
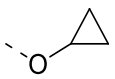
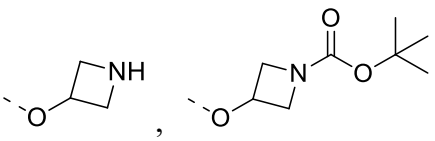
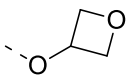
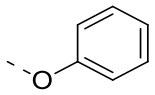


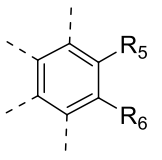
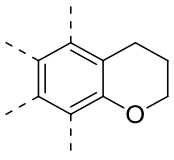
7. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein R_a is H, -CH_3, -CH_2CH_3, , or , wherein the -CH_3, -CH_2CH_3, , and  are each independently and optionally substituted with 1, 2, or 3 R_{a1};

preferably, R_a is H, -CH_3, , -CH_2CH_3, ;

more preferably, R_a is H, -CH_3, , -CH_2CH_3, .

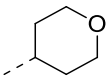
8. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein R_6 is H, F, Cl, Br, I, $-OR_a$, or $-CH_3$, wherein the $-CH_3$ is optionally substituted with 1, 2, or 3 substituents independently selected from F, Cl, Br, I, -OH, and $-OCH_3$;

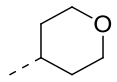
preferably, R_6 is H, F, Cl, Br, I, -OH, $-OCH_3$, $-OCH_2CH_3$, $-CH_3$, $-CH_2OH$, $-CH_2OCH_3$, , , , , , , , , , , , , , , , , , , , , , , , or .

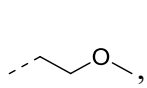
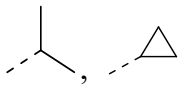
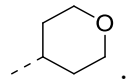
9. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein the structural unit  is .

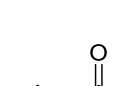
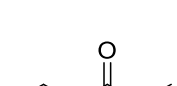
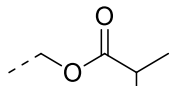
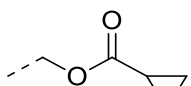
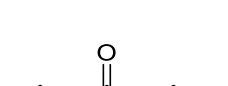
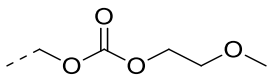
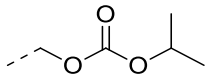
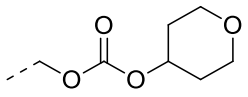
10. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein each R_b is independently H;

optionally, each R_{c1} is independently $-OCH_3$.

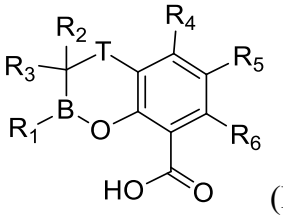
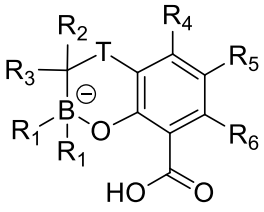
11. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein R_c is H, $-CH_3$, $-CH_2CH_3$, , , or , wherein the $-CH_3$, $-CH_2CH_3$, , ,

and  are each independently and optionally substituted with 1, 2, or $3R_{c1}$;

preferably, R_c is H, $-CH_3$, $-CH_2CH_3$, , , or .

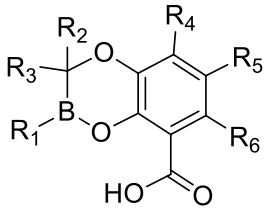
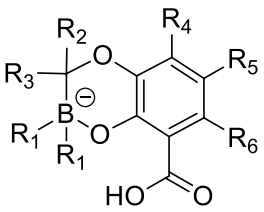
12. The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein R_7 is H, , , , , , , , or .

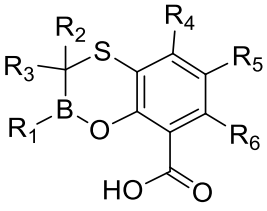
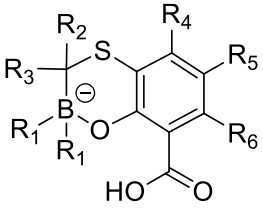
13. The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein the compound has a structure represented by Formula (I) or (I'):

 (I) or  (I'),

wherein T, R_1, R_2, R_3, R_4, R_5, and R_6 are as defined in claim 1;

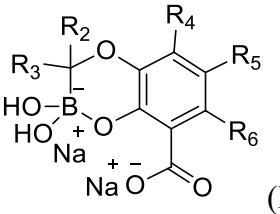
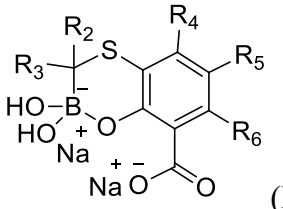
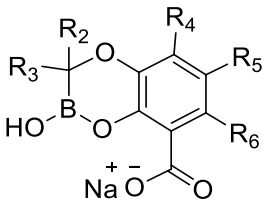
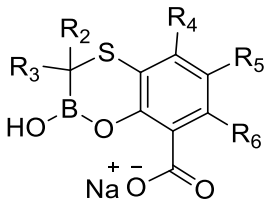
preferably, the compound has a structure represented by Formula (I-1), (I'-1), (I-2), or (I'-2):

 (I-1),  (I'-1),

 (I-2), or  (I'-2),

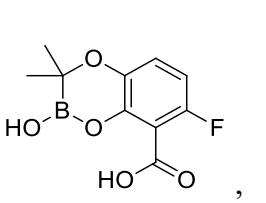
wherein R_1, R_2, R_3, R_4, R_5, and R_6 are as defined above;

more preferably, the pharmaceutically acceptable salt thereof has a structure represented by Formula (I-3), (I-4), (I-5), or (I-6):


(I-3),

(I-4),

(I-5), or

(I-6),

wherein R_2, R_3, R_4, R_5, and R_6 are as defined above.

14. A compound of the following formula or a pharmaceutically acceptable salt thereof: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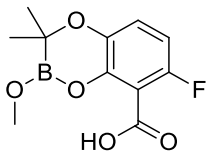
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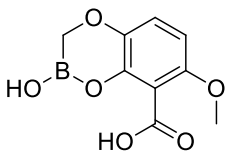
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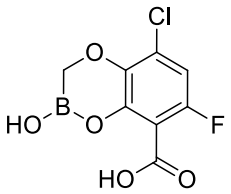
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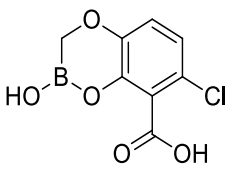
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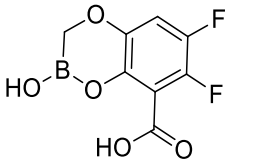
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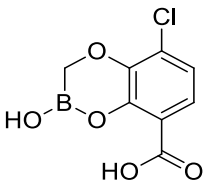
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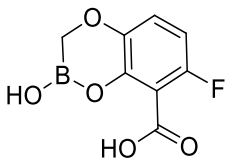
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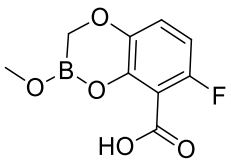
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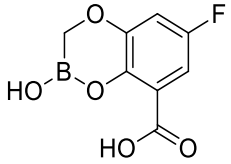
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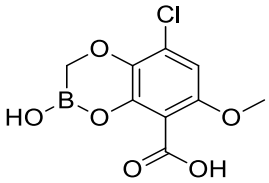
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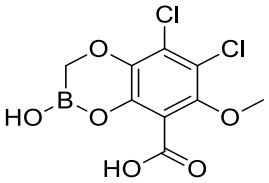
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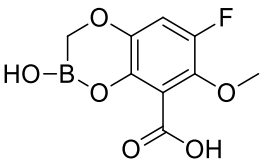
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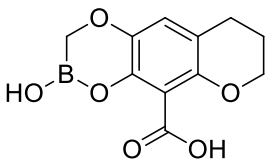
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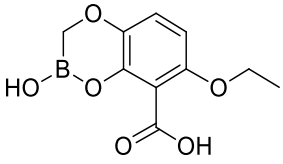
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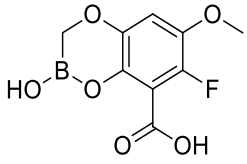
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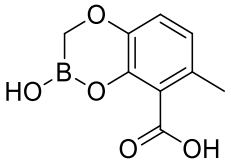
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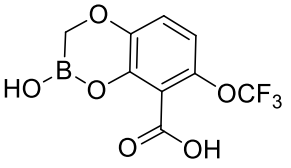
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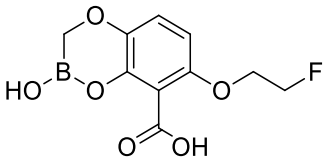
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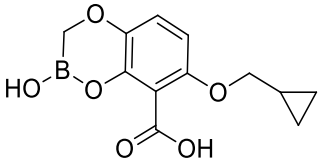
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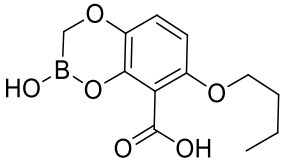
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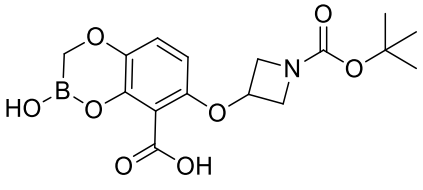
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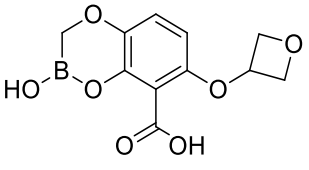
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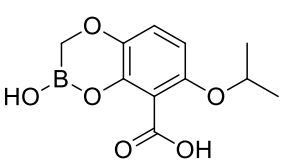
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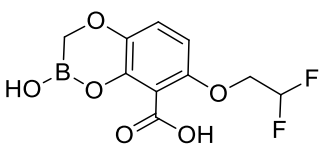
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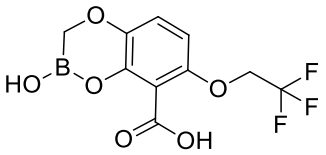
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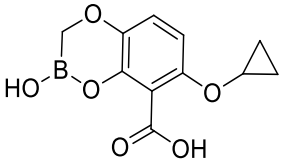
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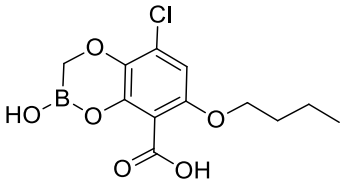
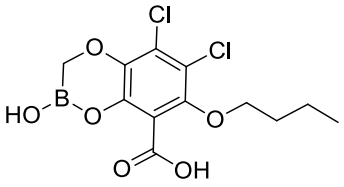
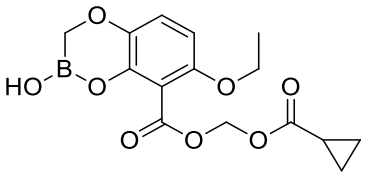
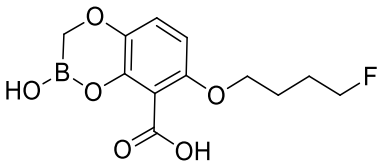
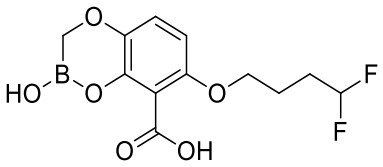
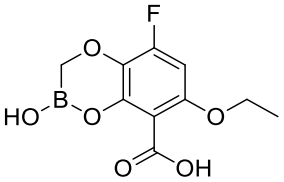
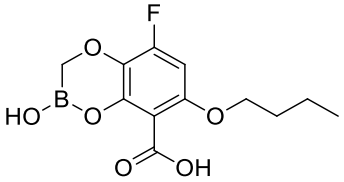
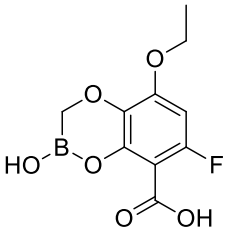
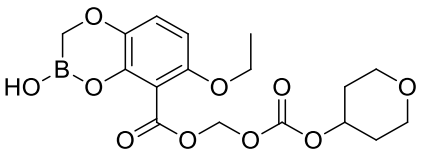
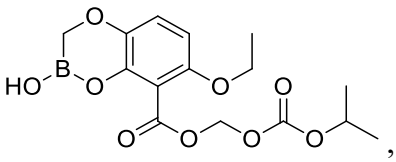
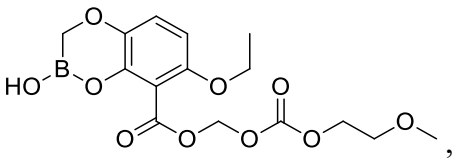
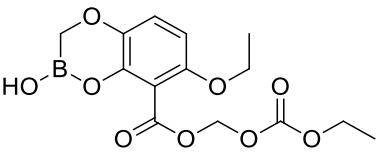
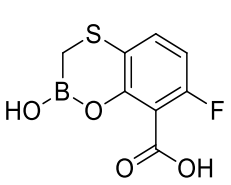
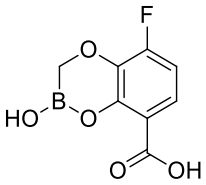
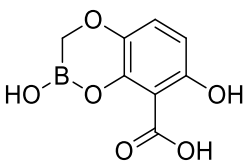
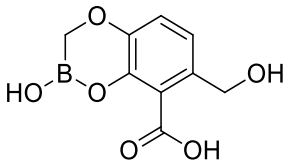
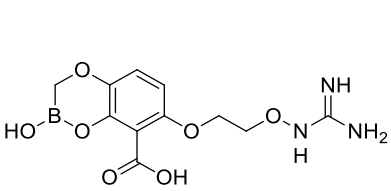
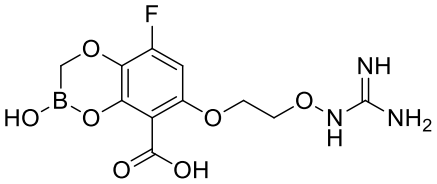
, , ,

, , ,

, , ,

, , ,

, , , ,

, , or .

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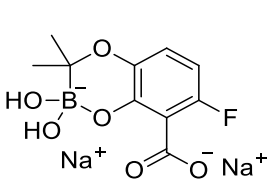
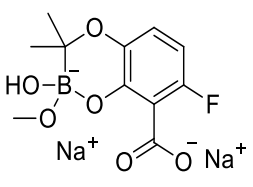
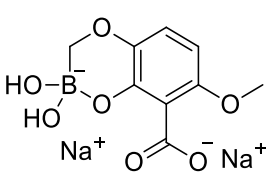
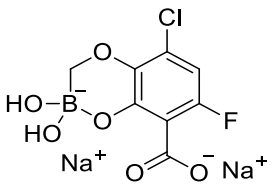
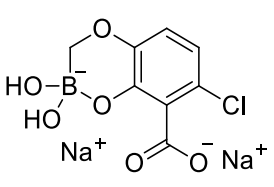
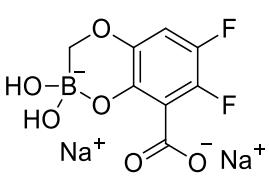
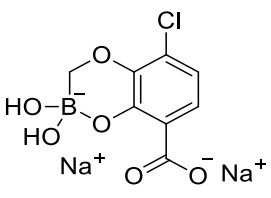
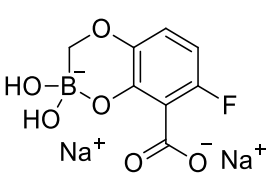
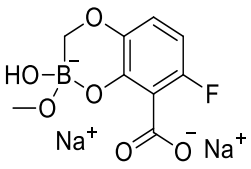
, , , ,

, , , ,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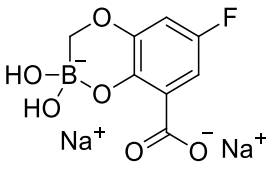
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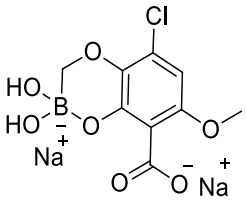
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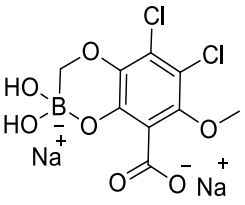
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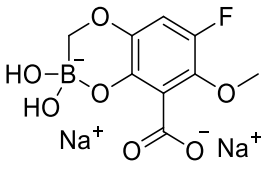
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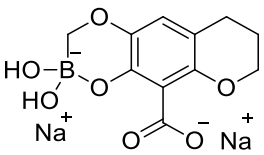
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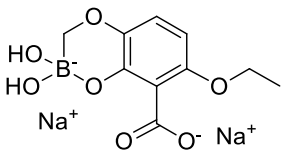
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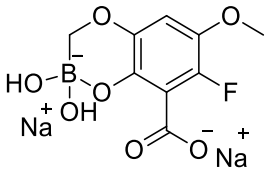
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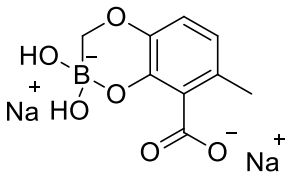
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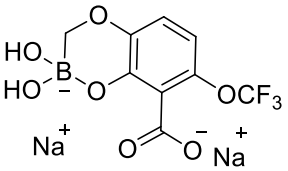
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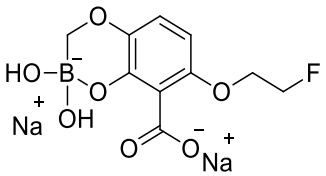
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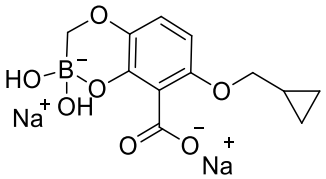
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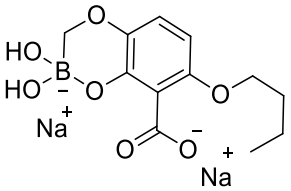
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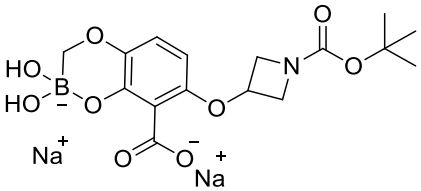
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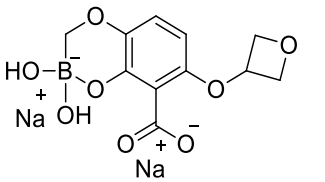
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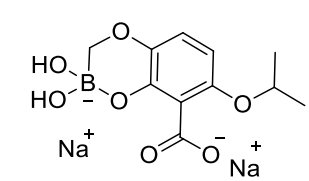
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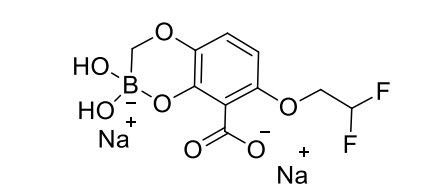
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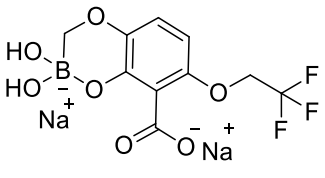
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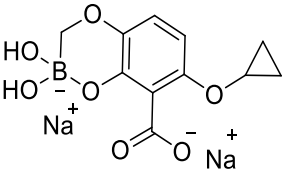
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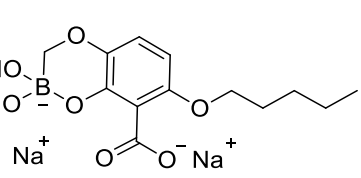
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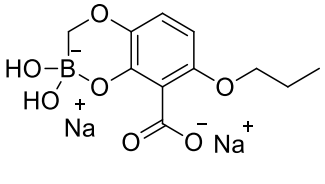
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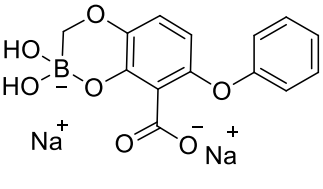
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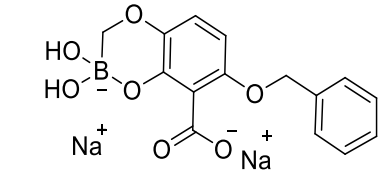
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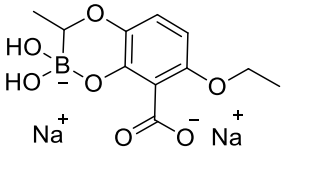
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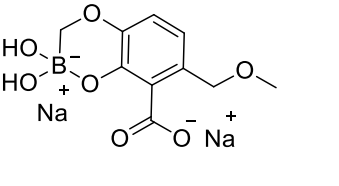
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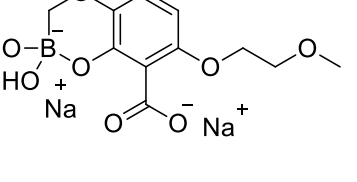
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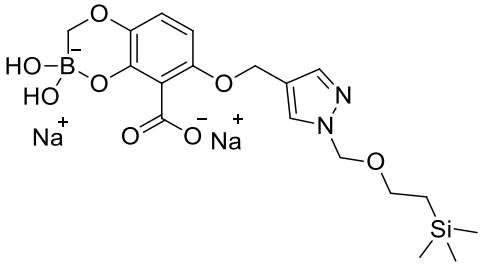
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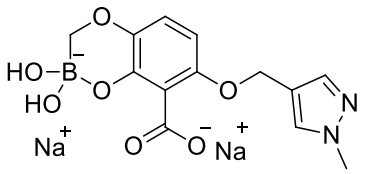
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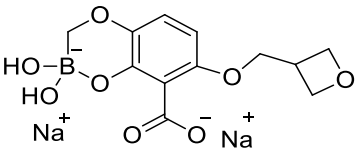
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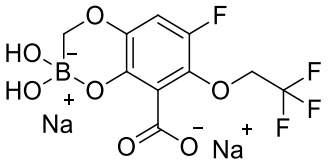
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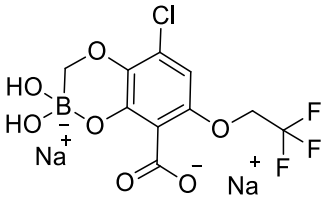
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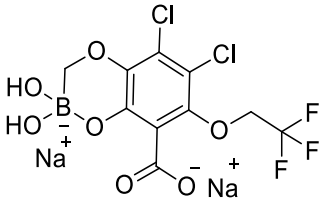
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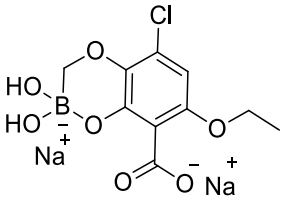
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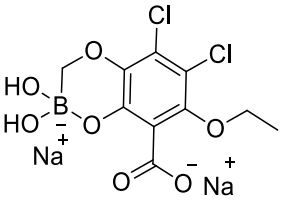
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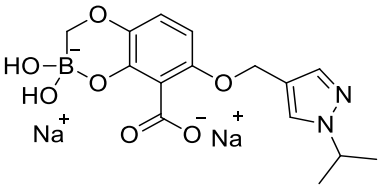
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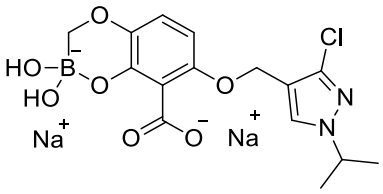
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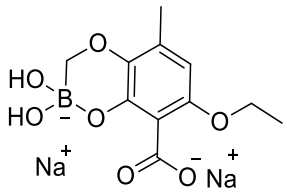
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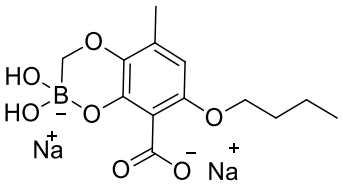
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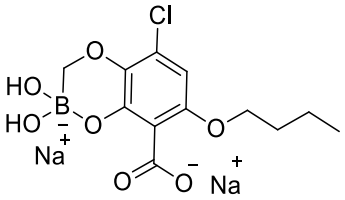
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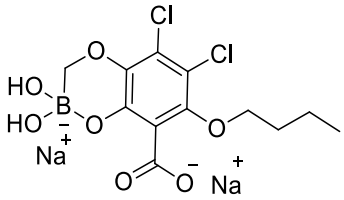
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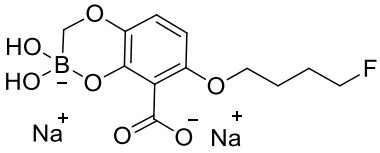
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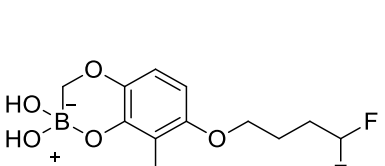
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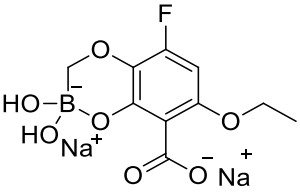
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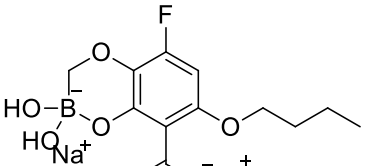
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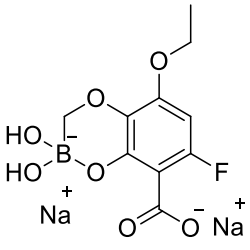
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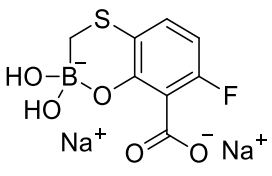
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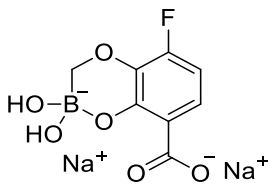
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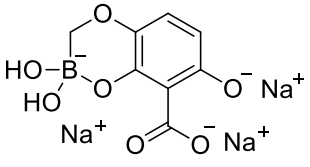
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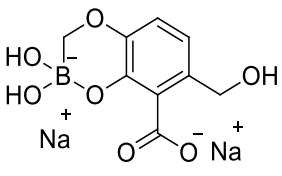
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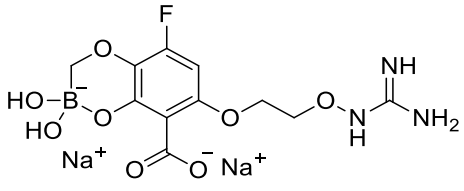
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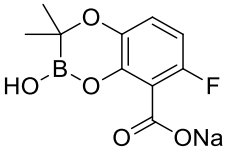
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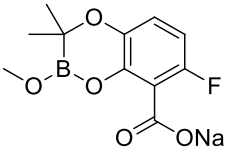
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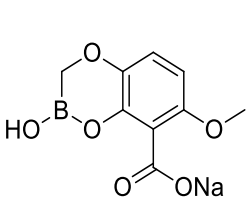
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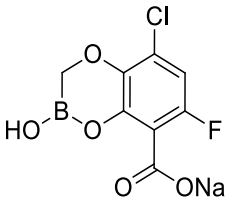
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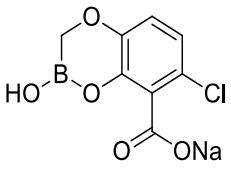
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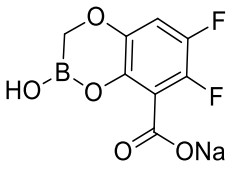
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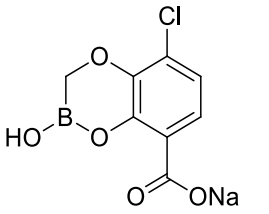
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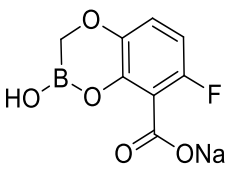
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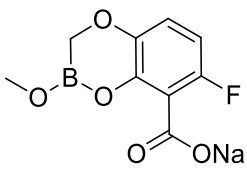
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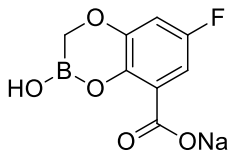
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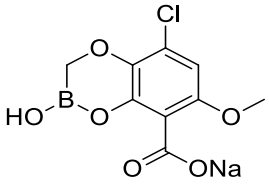
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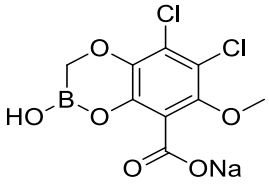
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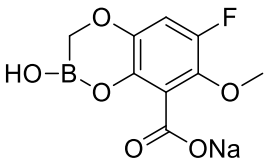
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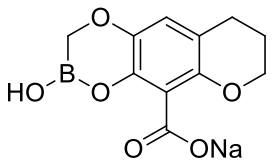
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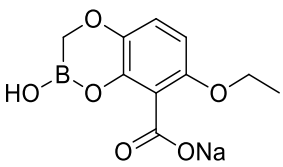
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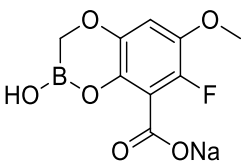
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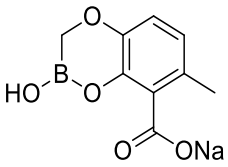
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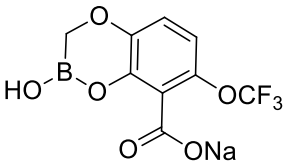
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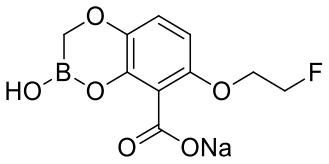
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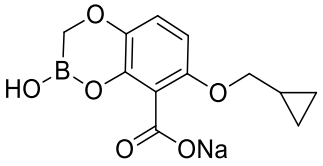
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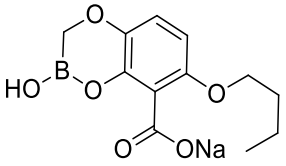
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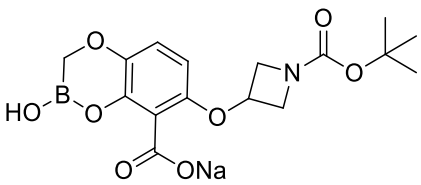
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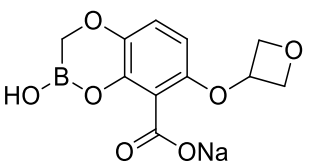
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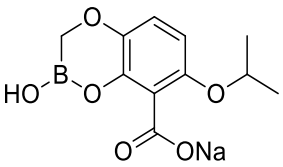
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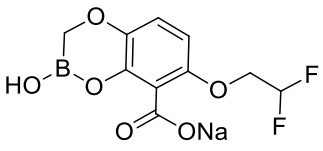
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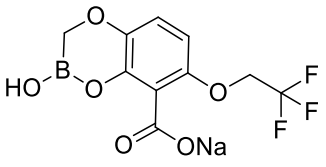
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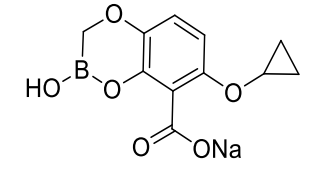
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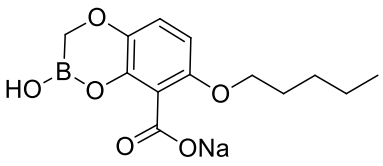
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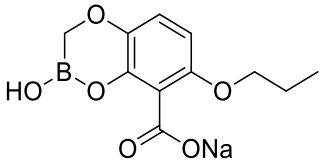
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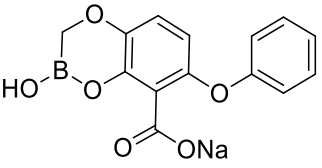
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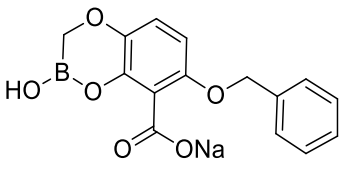
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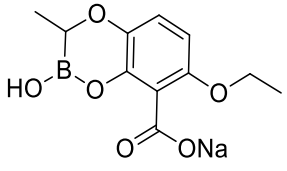
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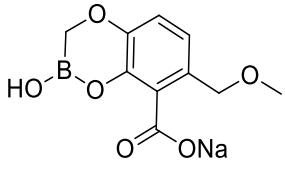
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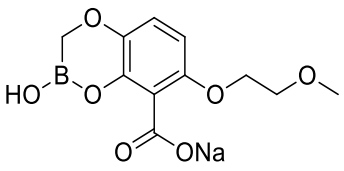
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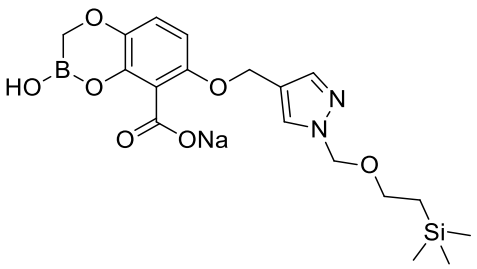
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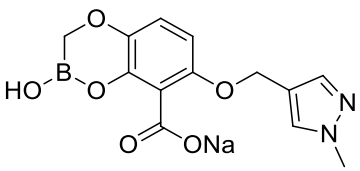
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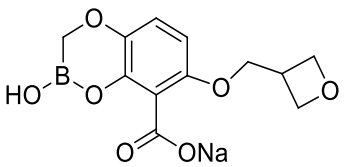
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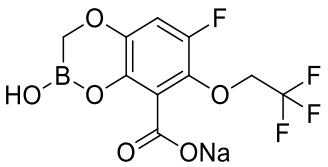
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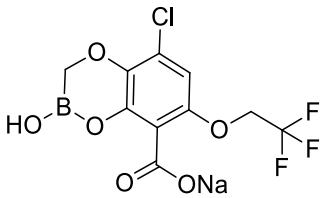
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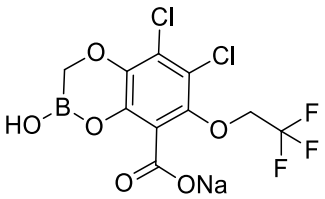
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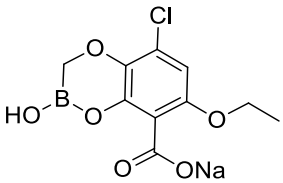
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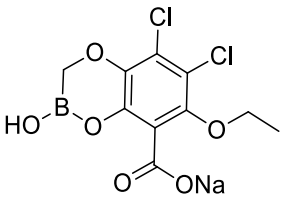
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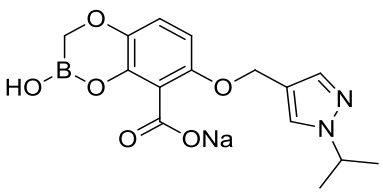
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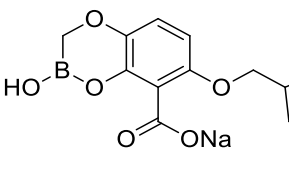
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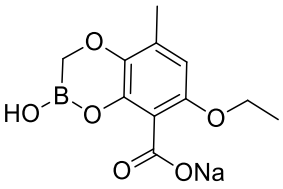
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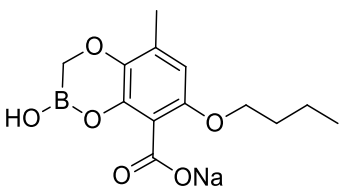
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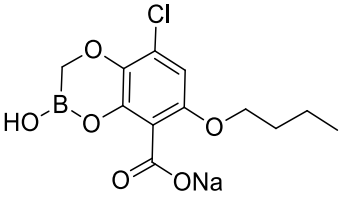
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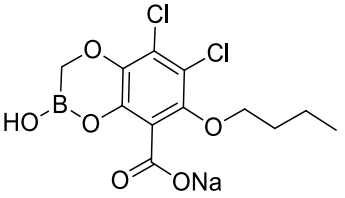
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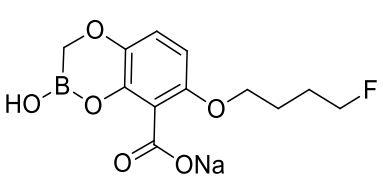
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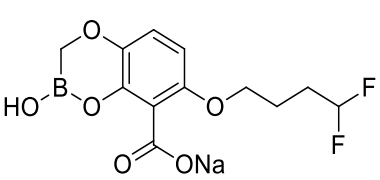
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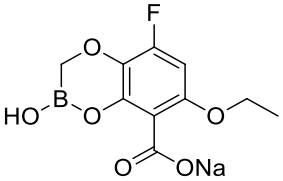
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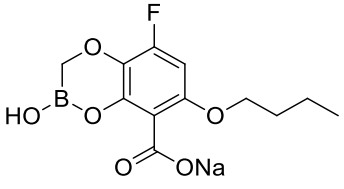
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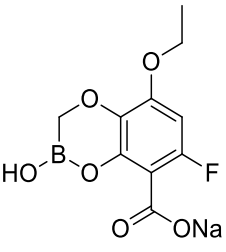
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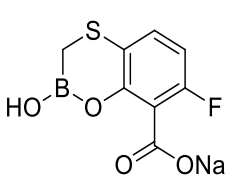
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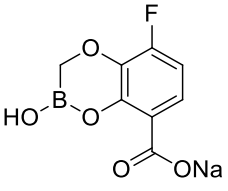
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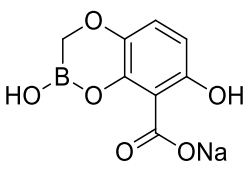
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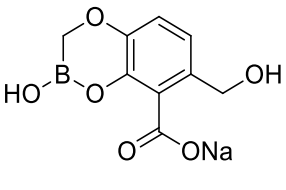
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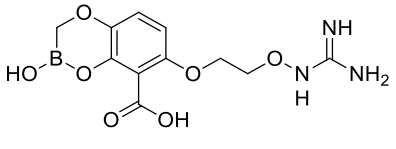
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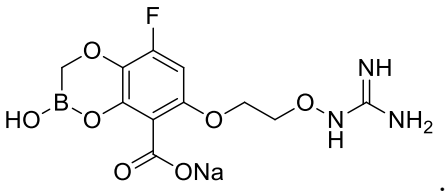

16. The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1-14, wherein the pharmaceutically acceptable salt is a sodium salt.

17. A pharmaceutical composition comprising a therapeutically effective amount of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1-16, a β-lactam antibacterial agent, and a pharmaceutically acceptable carrier.

18. The pharmaceutical composition according to claim 17, wherein the β-lactam antibacterial agent is based on penicillin, cephalosporin, cephamycin, oxacephem, carbapenem, or monocyclic lactam;

preferably, the β-lactam antibacterial agent is amoxicillin, piperacillin, ticarcillin, azlocillin, mezlocillin, cefazolin, cefradine, cefotaxime, cefuroxime, cefaclor, cefotiam, cefprozil, cefotaxime, ceftriaxone, ceftazidime, cefoperazone, ceftizoxime, cefmenoxime, cefodizime, cefpodoxime, cefixime, ceftibuten, cefpirome, cefepime, cefoxitin, cefmetazole, panipenem, aztreonam, carumonam, cefoxitin, cefmetazole, latamoxef, flomoxef, imipenem, meropenem, ceftolozane, or cefiderocol.

19. Application of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1-16 or the pharmaceutical composition according to either one of claims 17-18 in the preparation of a β-lactamase inhibitor medicament.

20. Application of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1-16 or the pharmaceutical composition according to any one of claims 17-18 in the preparation of a medicament for treating a disease associated with bacterial infection.