



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 1, 2026 – 09:48 AM UTC

PDB ID : 2HB0 / pdb_00002hb0
Title : Crystal Structure of CfaE, the Adhesive Subunit of CFA/I Fimbria of Enterotoxigenic Escherichia coli
Authors : Li, Y.F.; Xia, D.; Poole, S.; Rasulova, F.; Savarino, S.J.
Deposited on : 2006-06-13
Resolution : 2.30 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

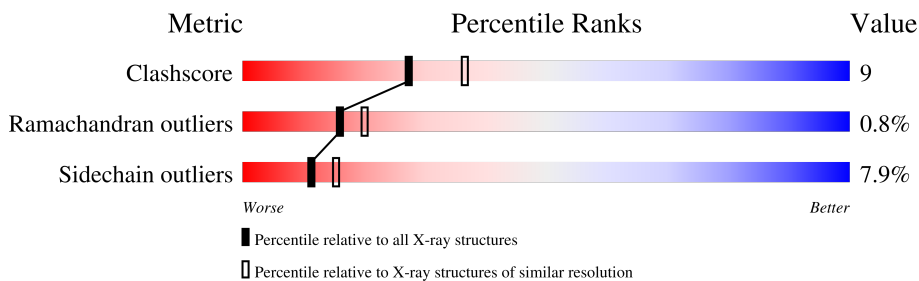
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	369	
1	B	369	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	MLI	A	901	-	X	-	-
2	MLI	A	902	-	-	X	-
3	PEG	A	801	-	-	X	-
3	PEG	A	802	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6230 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called CFA/I fimbrial subunit E.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	356	Total	C	N	O	S	0	0	0
			2763	1731	479	542	11			
1	B	355	Total	C	N	O	S	0	0	0
			2754	1724	478	541	11			

There are 62 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	361	ASP	-	expression tag	UNP P25734
A	362	ASN	-	expression tag	UNP P25734
A	363	LYS	-	expression tag	UNP P25734
A	364	GLN	-	expression tag	UNP P25734
A	365	VAL	-	expression tag	UNP P25734
A	366	GLU	-	expression tag	UNP P25734
A	367	LYS	-	expression tag	UNP P25734
A	368	ASN	-	expression tag	UNP P25734
A	369	ILE	-	expression tag	UNP P25734
A	370	THR	-	expression tag	UNP P25734
A	371	VAL	-	expression tag	UNP P25734
A	372	THR	-	expression tag	UNP P25734
A	373	ALA	-	expression tag	UNP P25734
A	374	SER	-	expression tag	UNP P25734
A	375	VAL	-	expression tag	UNP P25734
A	376	ASP	-	expression tag	UNP P25734
A	377	PRO	-	expression tag	UNP P25734
A	378	VAL	-	expression tag	UNP P25734
A	379	ILE	-	expression tag	UNP P25734
A	380	ASP	-	expression tag	UNP P25734
A	381	LEU	-	expression tag	UNP P25734
A	382	LEU	-	expression tag	UNP P25734
A	383	GLN	-	expression tag	UNP P25734
A	384	LEU	-	expression tag	UNP P25734
A	385	GLU	-	expression tag	UNP P25734

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Chain	Residue	Modelled	Actual	Comment	Reference
A	386	HIS	-	expression tag	UNP P25734
A	387	HIS	-	expression tag	UNP P25734
A	388	HIS	-	expression tag	UNP P25734
A	389	HIS	-	expression tag	UNP P25734
A	390	HIS	-	expression tag	UNP P25734
A	391	HIS	-	expression tag	UNP P25734
B	361	ASP	-	expression tag	UNP P25734
B	362	ASN	-	expression tag	UNP P25734
B	363	LYS	-	expression tag	UNP P25734
B	364	GLN	-	expression tag	UNP P25734
B	365	VAL	-	expression tag	UNP P25734
B	366	GLU	-	expression tag	UNP P25734
B	367	LYS	-	expression tag	UNP P25734
B	368	ASN	-	expression tag	UNP P25734
B	369	ILE	-	expression tag	UNP P25734
B	370	THR	-	expression tag	UNP P25734
B	371	VAL	-	expression tag	UNP P25734
B	372	THR	-	expression tag	UNP P25734
B	373	ALA	-	expression tag	UNP P25734
B	374	SER	-	expression tag	UNP P25734
B	375	VAL	-	expression tag	UNP P25734
B	376	ASP	-	expression tag	UNP P25734
B	377	PRO	-	expression tag	UNP P25734
B	378	VAL	-	expression tag	UNP P25734
B	379	ILE	-	expression tag	UNP P25734
B	380	ASP	-	expression tag	UNP P25734
B	381	LEU	-	expression tag	UNP P25734
B	382	LEU	-	expression tag	UNP P25734
B	383	GLN	-	expression tag	UNP P25734
B	384	LEU	-	expression tag	UNP P25734
B	385	GLU	-	expression tag	UNP P25734
B	386	HIS	-	expression tag	UNP P25734
B	387	HIS	-	expression tag	UNP P25734
B	388	HIS	-	expression tag	UNP P25734
B	389	HIS	-	expression tag	UNP P25734
B	390	HIS	-	expression tag	UNP P25734
B	391	HIS	-	expression tag	UNP P25734

- Molecule 2 is MALONATE ION (CCD ID: MLI) (formula: C₃H₂O₄).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			7	3	4		
2	A	1	Total	C	O	0	0
			7	3	4		
2	B	1	Total	C	O	0	0
			7	3	4		

- Molecule 3 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			7	4	3		

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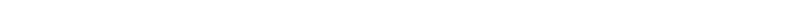
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			7	4	3		
3	B	1	Total	C	O	0	0
			7	4	3		
3	B	1	Total	C	O	0	0
			7	4	3		

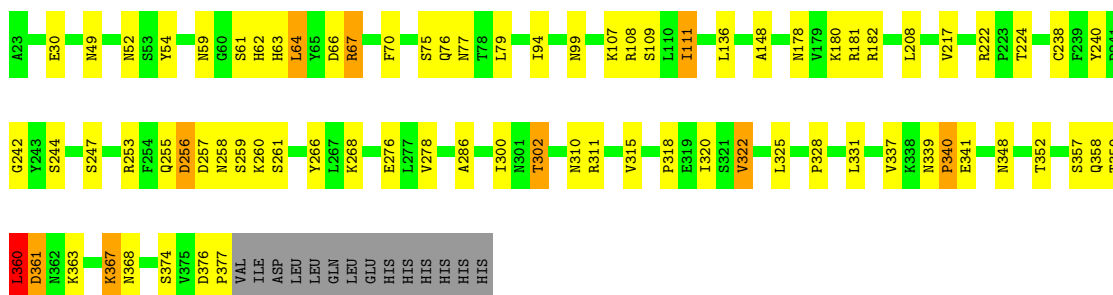
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	322	Total	O	0	0
			322	322		
4	B	342	Total	O	0	0
			342	342		

i

Note EDS was not executed.

- Chain A:  79% 13% ...



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 62 2 2	Depositor
Cell constants a, b, c, α , β , γ	143.35Å 143.35Å 231.43Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 2.30	Depositor
% Data completeness (in resolution range)	97.4 (20.00-2.30)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.178 , 0.201	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	6230	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PEG, MLI

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.88	3/2817 (0.1%)	1.07	17/3825 (0.4%)
1	B	0.85	0/2807	1.02	9/3810 (0.2%)
All	All	0.87	3/5624 (0.1%)	1.05	26/7635 (0.3%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	317	MET	SD-CE	-9.13	1.56	1.79
1	A	137	ASN	CB-CG	-5.31	1.38	1.52
1	A	32	MET	SD-CE	-5.29	1.66	1.79

The worst 5 of 26 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	358	GLN	CB-CA-C	12.51	130.40	109.75
1	A	359	THR	N-CA-C	10.03	132.16	110.80
1	A	358	GLN	OE1-CD-NE2	-9.35	113.25	122.60
1	B	340	PRO	N-CA-C	-8.21	99.72	111.22
1	B	107	LYS	N-CA-C	7.12	119.66	111.11

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	358	GLN	Peptide

5.2 Too-close contacts ⓘ

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2763	0	2730	55	0
1	B	2754	0	2715	41	0
2	A	14	0	4	6	0
2	B	7	0	2	0	0
3	A	14	0	20	13	0
3	B	14	0	20	1	0
4	A	322	0	0	13	1
4	B	342	0	0	5	1
All	All	6230	0	5491	101	1

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 9.

The worst 5 of 101 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:307:THR:OG1	3:A:801:PEG:O4	1.58	1.18
1:A:358:GLN:O	1:A:360:LEU:HD12	1.57	1.04
1:A:360:LEU:CD1	1:A:360:LEU:H	1.76	0.98
1:A:360:LEU:H	1:A:360:LEU:HD13	1.28	0.96
1:A:358:GLN:O	1:A:360:LEU:CD1	2.16	0.92

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:A:1223:HOH:O	4:B:1244:HOH:O[7_555]	1.33	0.87

5.3 Torsion angles

5.3.1 Protein backbone

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	354/369 (96%)	339 (96%)	11 (3%)	4 (1%)	11	13
1	B	353/369 (96%)	342 (97%)	9 (2%)	2 (1%)	21	27
All	All	707/738 (96%)	681 (96%)	20 (3%)	6 (1%)	16	20

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	258	ASN
1	A	359	THR
1	A	361	ASP
1	A	362	ASN
1	B	258	ASN

5.3.2 Protein sidechains

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	311/324 (96%)	287 (92%)	24 (8%)	12	16
1	B	309/324 (95%)	284 (92%)	25 (8%)	11	14
All	All	620/648 (96%)	571 (92%)	49 (8%)	11	15

5 of 49 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	111	ILE

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Mol	Chain	Res	Type
1	B	255	GLN
1	B	136	LEU
1	B	222	ARG
1	B	302	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 26 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	63	HIS
1	B	103	GLN
1	B	348	ASN
1	B	80	ASN
1	B	116	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

7 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	MLI	A	902	-	6,6,6	1.59	2 (33%)	7,7,7	1.40	2 (28%)
3	PEG	A	802	-	6,6,6	0.64	0	5,5,5	0.13	0
2	MLI	A	901	-	6,6,6	1.94	2 (33%)	7,7,7	1.60	3 (42%)
2	MLI	B	903	-	6,6,6	1.42	2 (33%)	7,7,7	1.22	0
3	PEG	B	803	-	6,6,6	0.44	0	5,5,5	0.45	0
3	PEG	A	801	-	6,6,6	0.46	0	5,5,5	0.35	0
3	PEG	B	804	-	6,6,6	0.60	0	5,5,5	0.32	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	MLI	A	902	-	-	2/4/4/4	-
3	PEG	A	802	-	-	3/4/4/4	-
2	MLI	A	901	-	-	4/4/4/4	-
2	MLI	B	903	-	-	4/4/4/4	-
3	PEG	B	803	-	-	2/4/4/4	-
3	PEG	A	801	-	-	2/4/4/4	-
3	PEG	B	804	-	-	3/4/4/4	-

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	901	MLI	O9-C3	-3.46	1.19	1.30
2	A	901	MLI	O7-C2	-2.65	1.22	1.30
2	B	903	MLI	O9-C3	-2.57	1.22	1.30
2	A	902	MLI	O7-C2	-2.51	1.22	1.30
2	A	902	MLI	O9-C3	-2.32	1.23	1.30

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	901	MLI	O9-C3-C1	2.21	121.36	114.51
2	A	902	MLI	O9-C3-C1	2.11	121.06	114.51
2	A	902	MLI	O9-C3-O8	-2.08	117.98	123.33
2	A	901	MLI	O7-C2-C1	2.06	120.88	114.51
2	A	901	MLI	O9-C3-O8	-2.04	118.10	123.33

There are no chirality outliers.

5 of 20 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	804	PEG	O2-C3-C4-O4
3	A	802	PEG	O2-C3-C4-O4
3	B	804	PEG	O1-C1-C2-O2
3	B	803	PEG	O2-C3-C4-O4
3	A	802	PEG	O1-C1-C2-O2

There are no ring outliers.

5 monomers are involved in 15 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	902	MLI	5	0
3	A	802	PEG	5	0
2	A	901	MLI	1	0
3	A	801	PEG	8	0
3	B	804	PEG	1	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.