

# AUTOMATED TESTING FOR WEB APP

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Type to search

This is part of the wreckage of Ethiopian Airlines Flight ET302, a Boeing 737 Max airliner that crashed on 11 March in Bishoftu, Ethiopia, killing all 157 passengers and crew.

FEATURE AEROSPACE

# HOW THE BOEING 737 MAX DISASTER LOOKS TO A SOFTWARE DEVELOPER

Design shortcuts meant to make a new plane seem like an old, familiar one are to blame

Source: <https://spectrum.ieee.org/how-the-boeing-737-max-disaster-looks-to-a-software-developer>



# AGENDA

- What is software testing and why it is important?
- Types of software testing
- How to apply Test Pyramid for a Web App
- Questions



# WHAT IS SOFTWARE TESTING AND WHY?

- **Software testing** is an investigation conducted to provide stakeholders with information about **the quality of the software product or service under test**.
  - Software testing can also provide an objective, independent view of the software to allow the business to appreciate and understand the risks of software implementation.
- Test techniques include the process of executing a program or application with **the intent of finding failures** and **verifying that the software product is fit for use**.

Resource: [https://en.wikipedia.org/wiki/Software\\_testing](https://en.wikipedia.org/wiki/Software_testing)



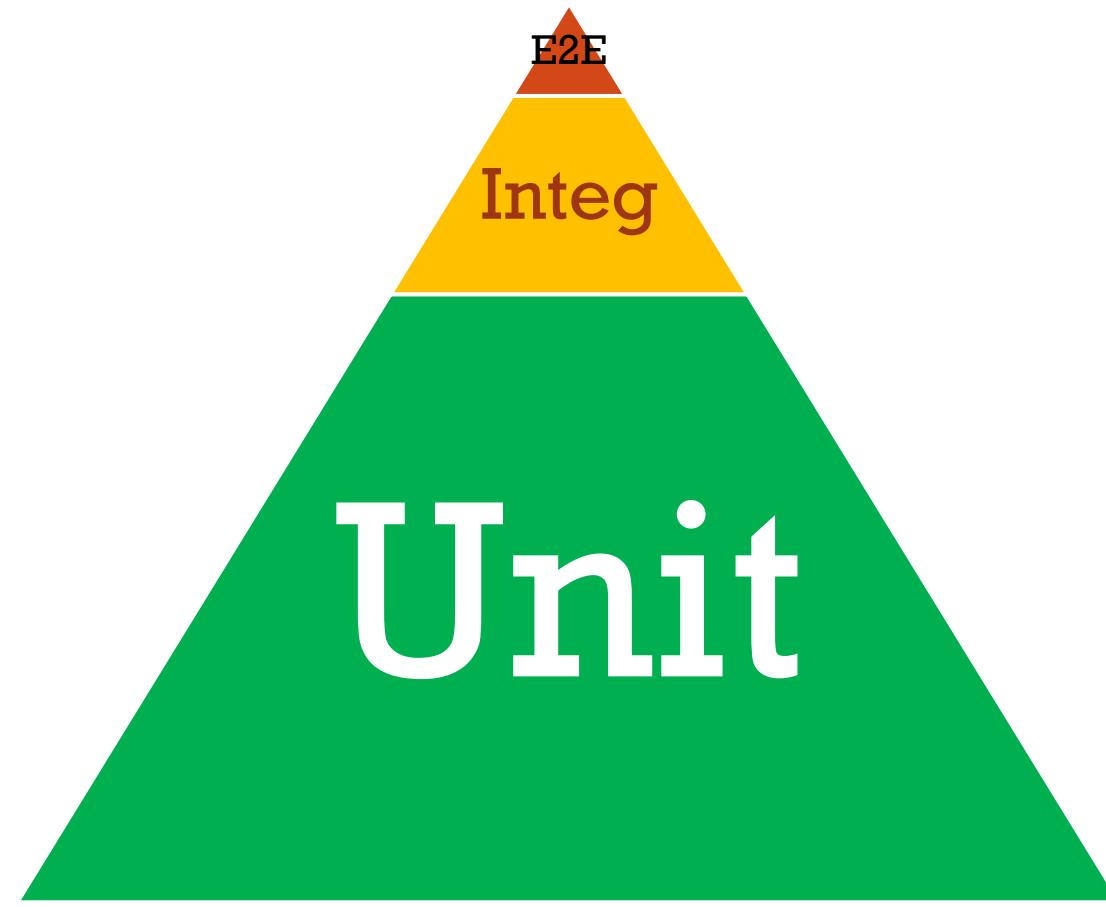


There are multiple types of software testing but ...

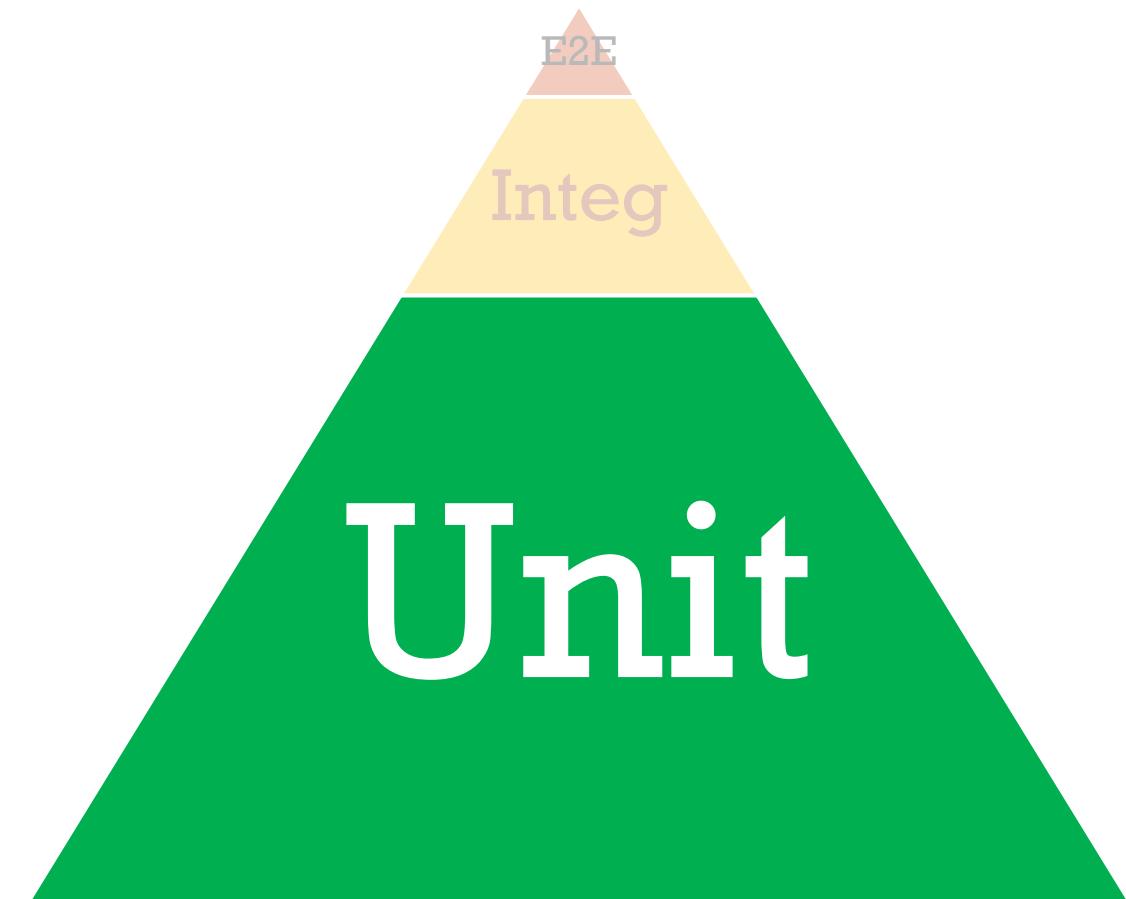
We will only cover  
**AUTOMATED  
TESTING**  
focusing on testing  
**WEB Applications**  
in this talk



# TYPES OF AUTOMATED TESTING

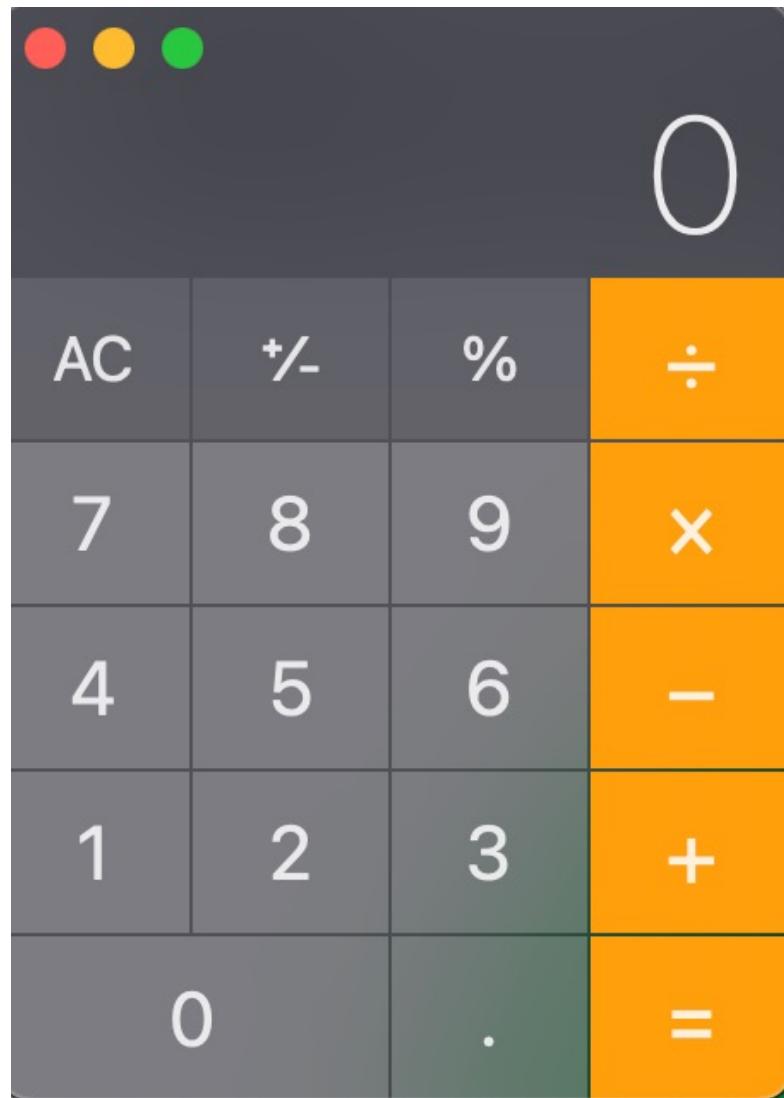


# UNIT TESTING



- Cover individual units of code
- Can be tested in isolation
- Typically performed by the developer during development
- **Fast and easy to debug**
  - Tests at this level should be maximized (~70%)





# EXAMPLE: UNIT TEST CASES FOR CALCULATOR APP

## Possible unit test cases

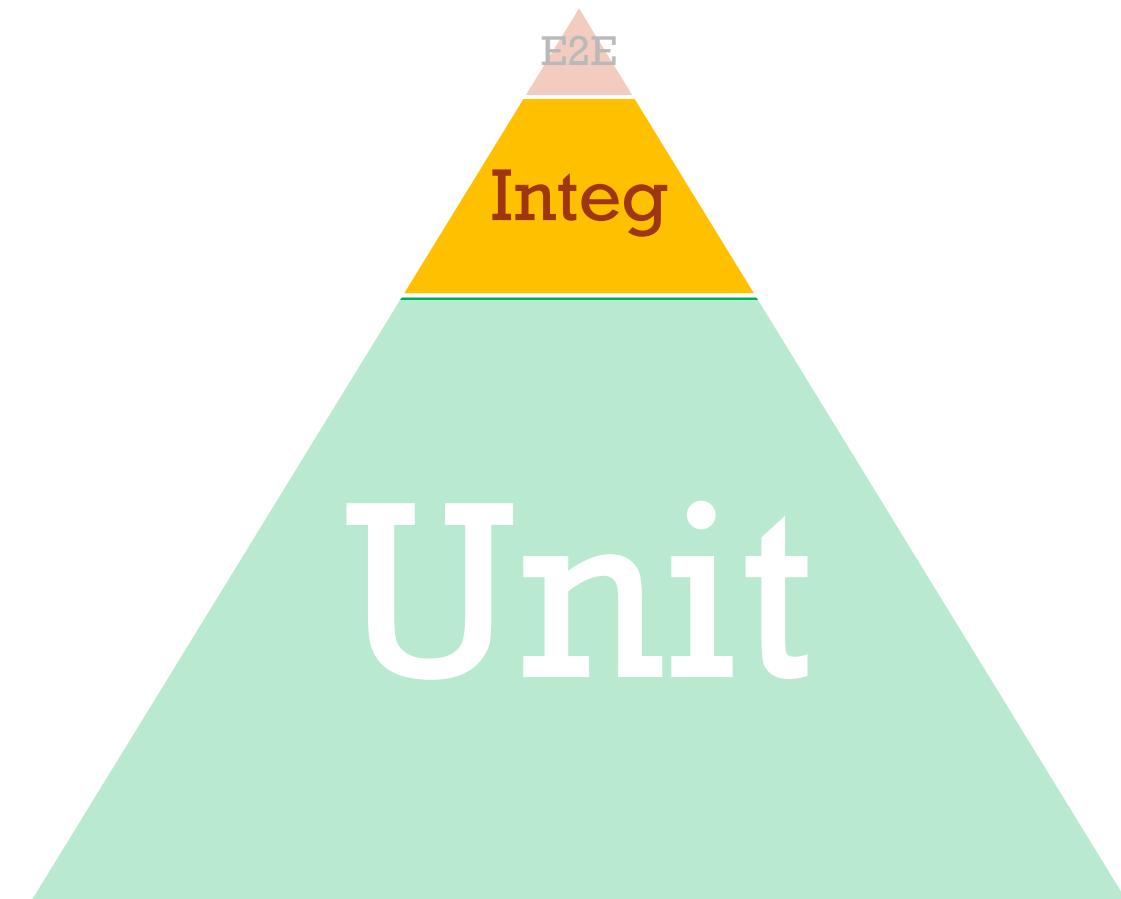
### no UI

- Test the math operations (+, -, x, /)
- Test the AC function
- Test the +/- function
- Test the % function

### UI Components

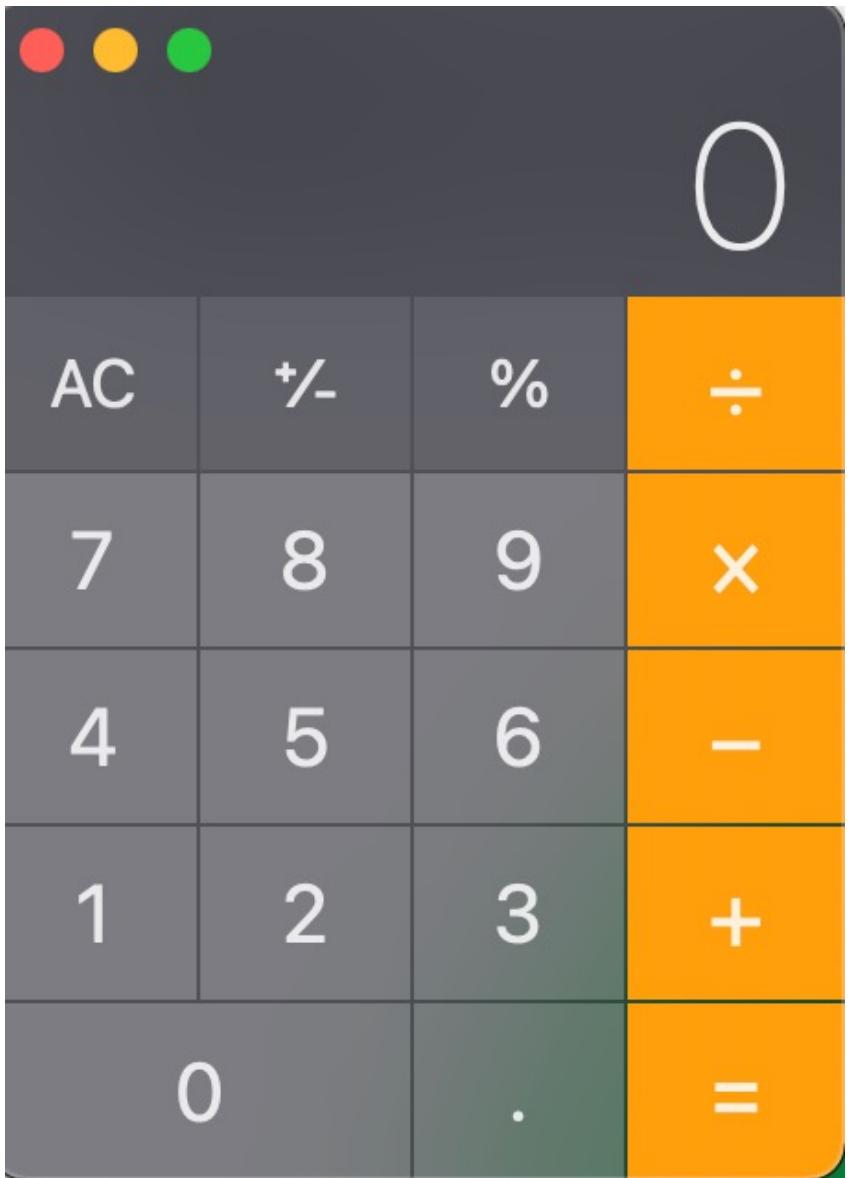
- Button component should render an appropriate symbol

# INTEGRATION TESTING



- Process of testing the interface between two software units or modules
- Focus on determining the correctness of the interface
  - The purpose of the integration testing is to expose faults in the interaction between integrated units
- **More costly than unit testing** but less expensive than E2E testing
  - There should be around 20% of tests added to this level



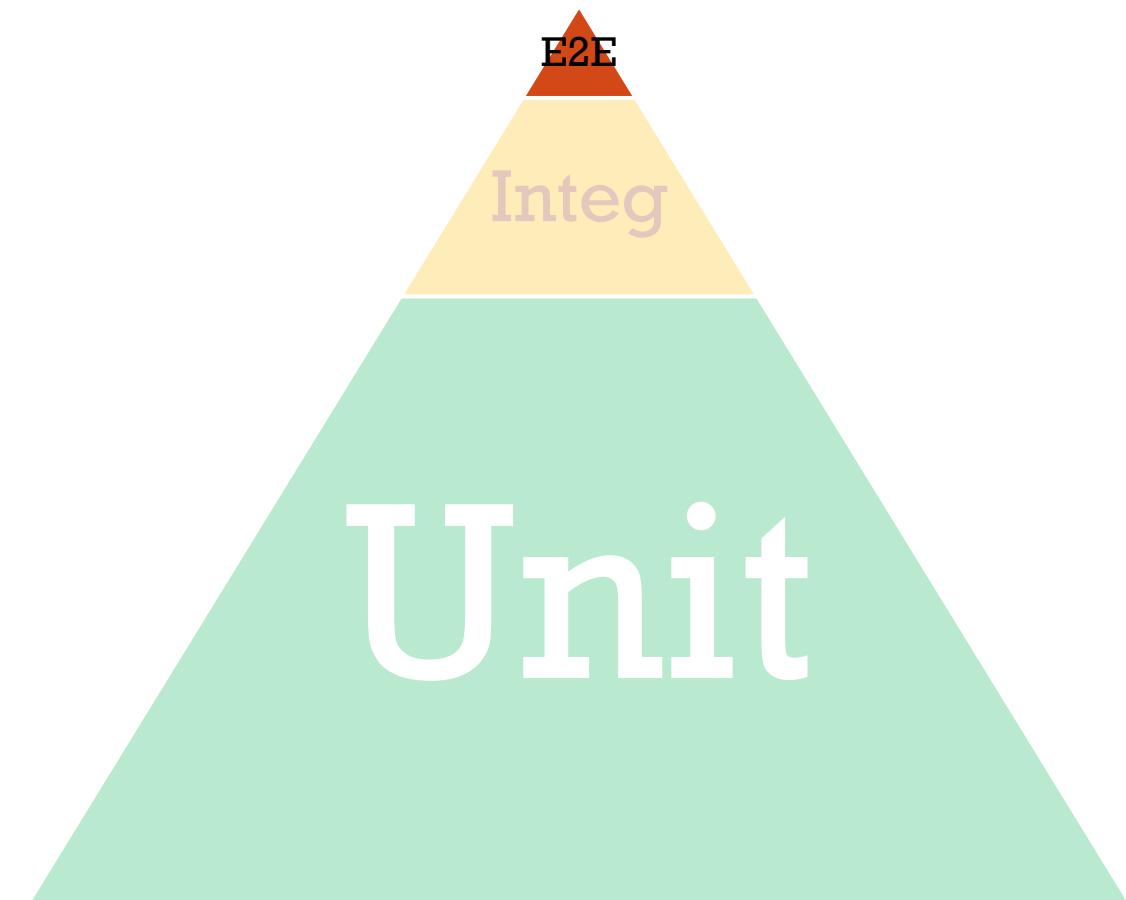


## EXAMPLE: INTEG TEST CASES

Possible integ test cases

- Clicking '7', '+', '8', '=' and verify that the display shows '15'
- Clicking the 'AC' button should reset the display

# END-TO-END (E2E) TESTING



- Simulate a user level experience across the full stack of a software product
  - These tests are highly valuable to implement as they offer assurance that real users are having a smooth bug free experience, even when new commits are pushed
- E2E tests can be expensive up front to capture and record the user flow sequence
  - Tests at this level should saved to capture design cases and requirements
  - They can be used to replace manual testing



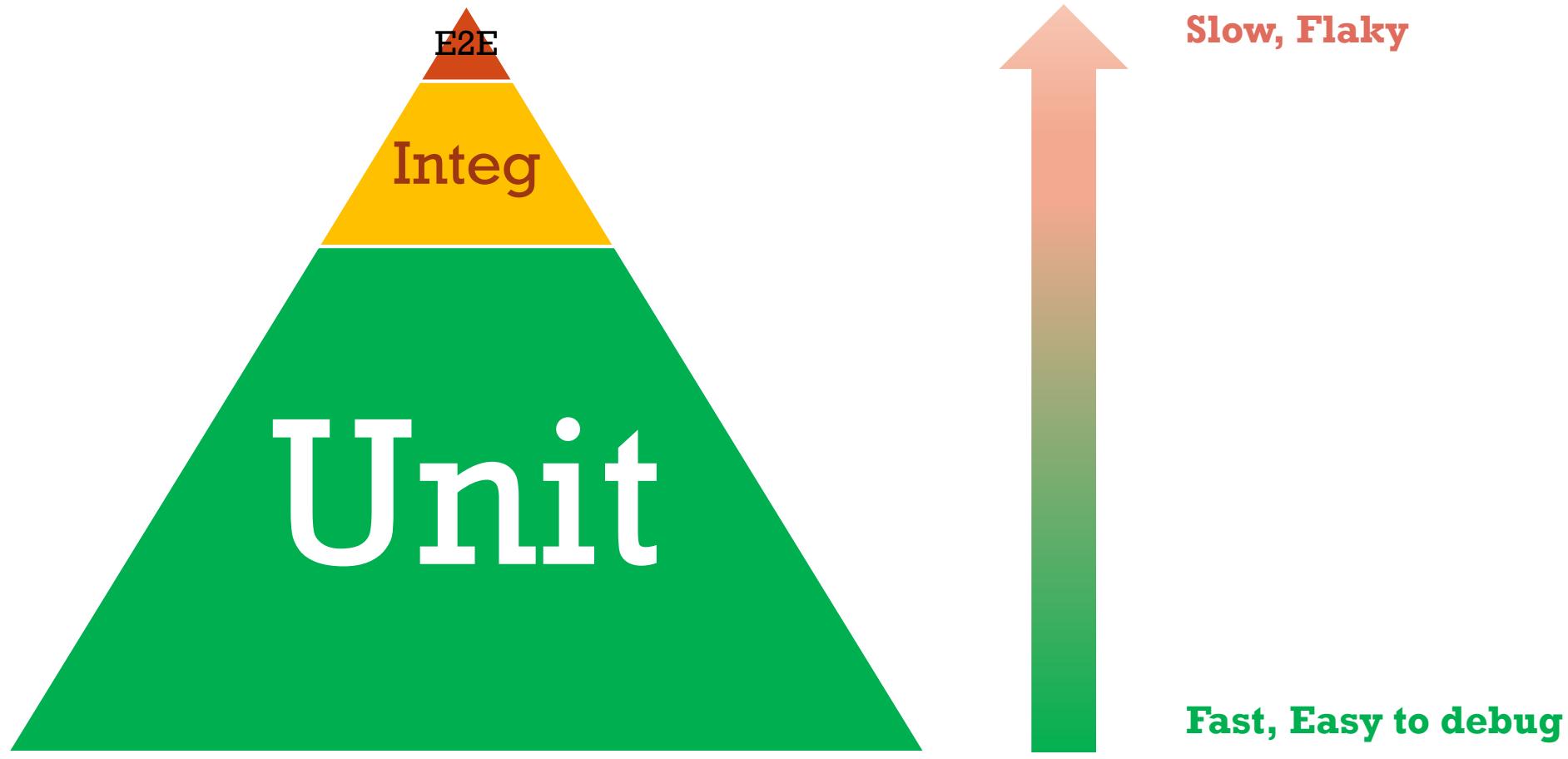


# EXAMPLE: E2E TEST CASES

## Possible E2E test cases

- Select a restaurant should show up menu of the selected restaurant
- Click the 'Order NOW' button should place an order in the cart to the server and return an appropriate response to the user

# ADHERE TO TEST PYRAMID FOR QUALITY AND TESTABILITY



**THERE ARE SO  
MANY JS  
TESTING  
LIBRARIES.**

**WHICH ONE  
SHOULD I USE?**

## **Frameworks**

- Jest, Mocha, Protractor, Jasmine, QUnit, etc.

## **Browser Controller Libraries**

(for E2E Testing)

- Playwright, Puppeteer, FuncUnit etc.

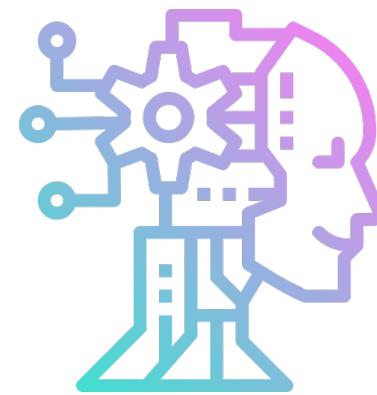
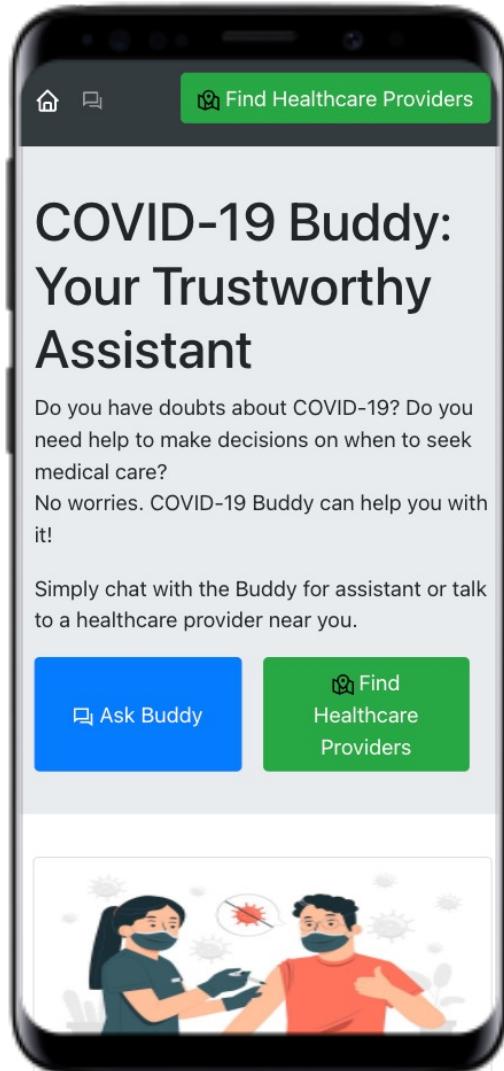
Above are available JS testing libraries (nodejs) as of August 12<sup>th</sup>, 2021





**LET'S APPLY WHAT WE  
LEARNED TOGETHER!**





**Website:** <https://covid-buddy.herokuapp.com/>  
**Github:** <https://github.com/nongnoochr/covid-buddy>

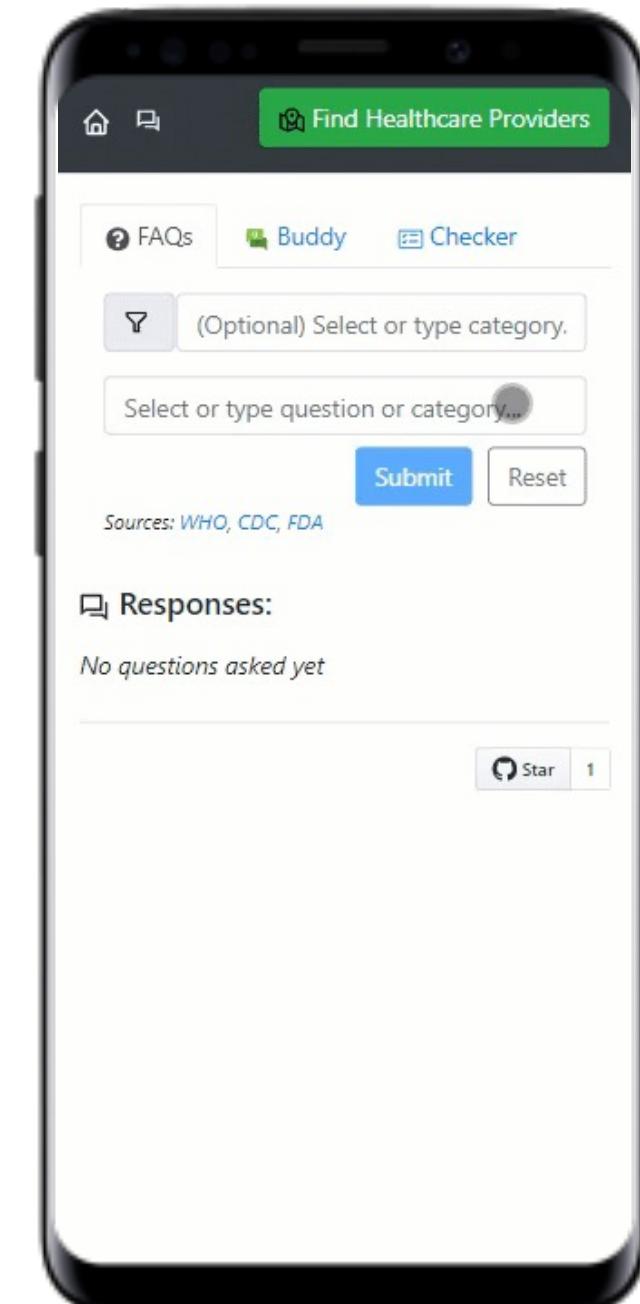


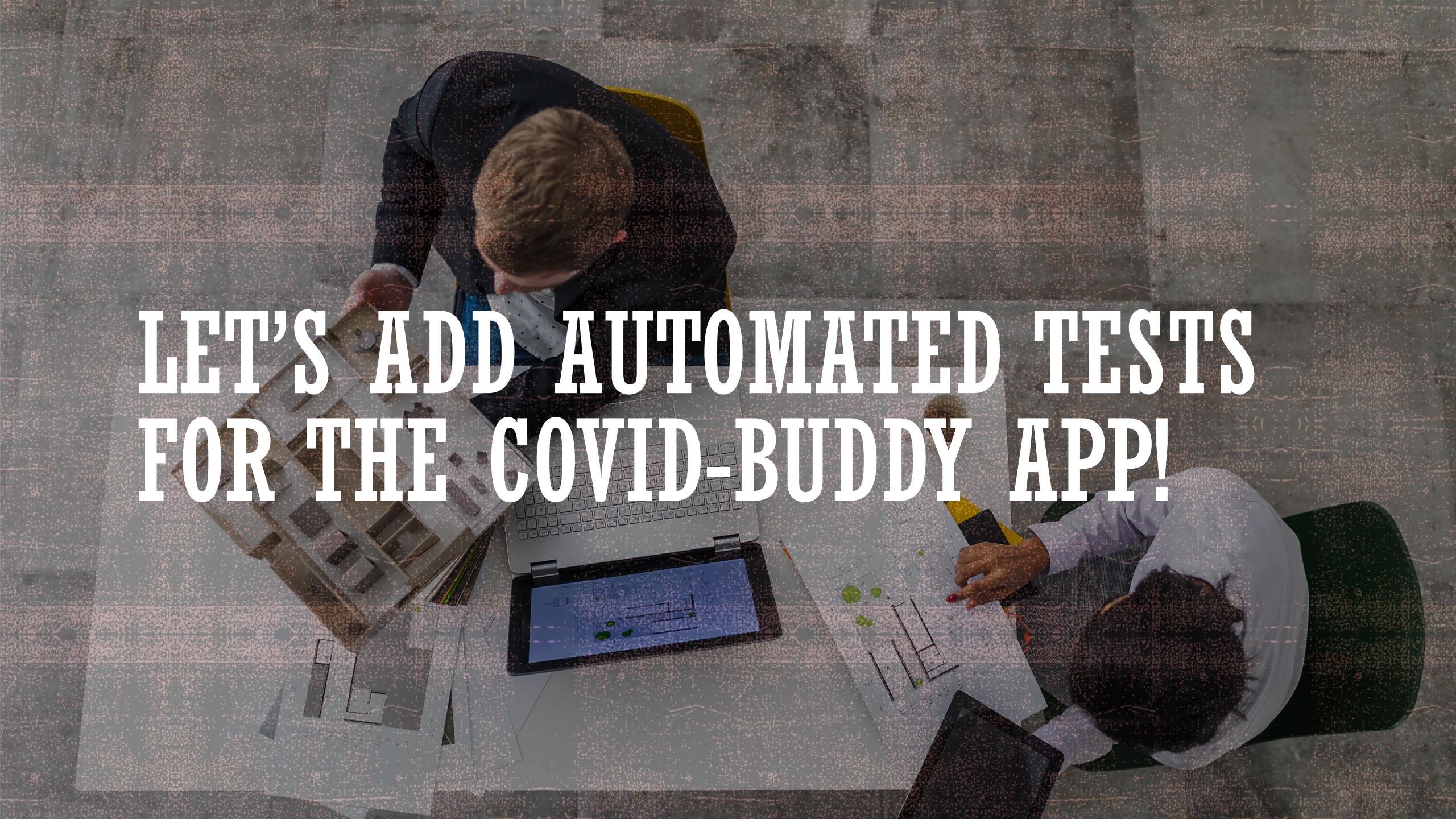
[Project in devpost](#)





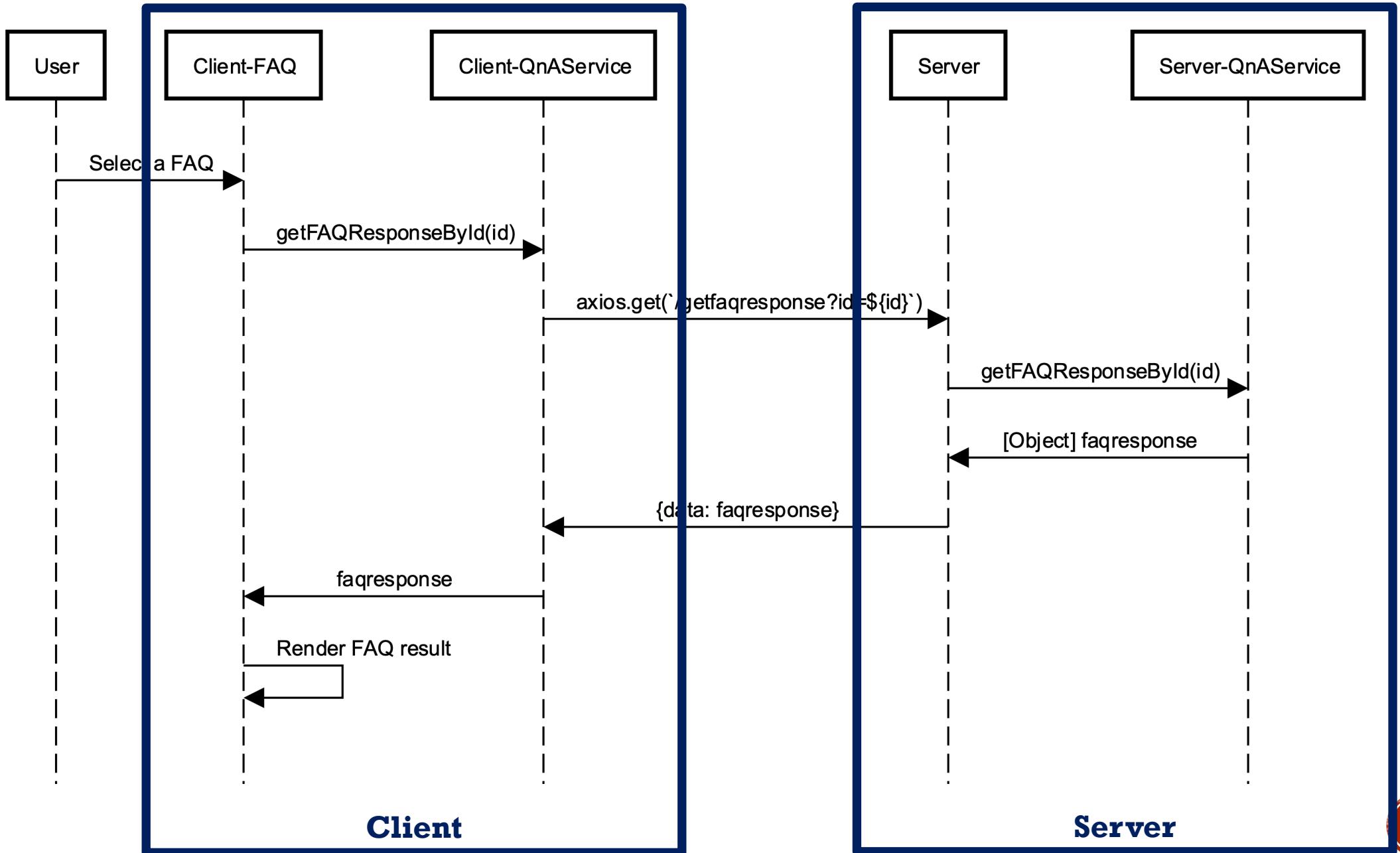
- **794 FAQs** collected from **WHO, CDC, FDA** websites
- **AI + IQVIA HealthCare Locator SDK** are integrated to suggest specialists nearby



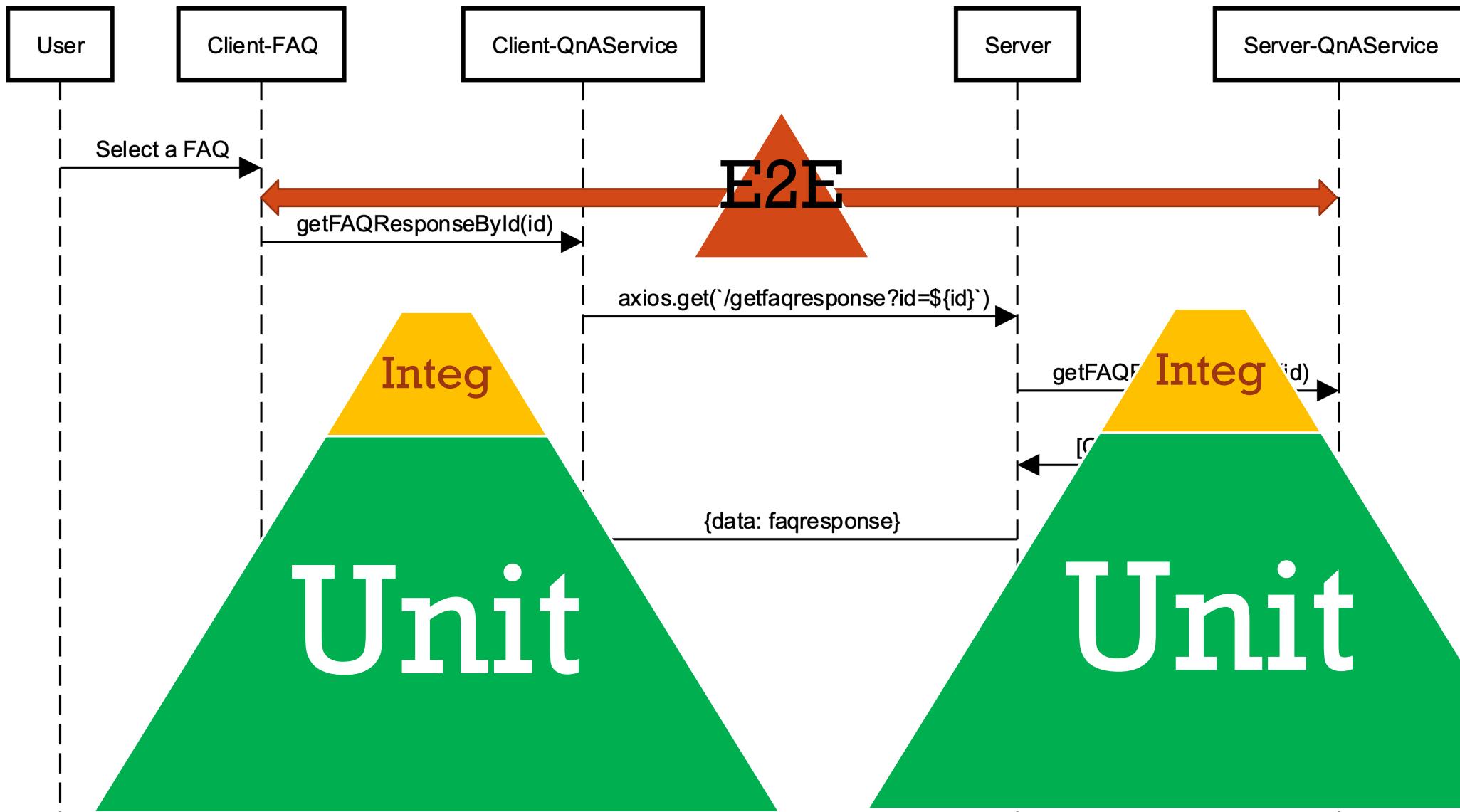


LET'S ADD AUTOMATED TESTS  
FOR THE COVID-BUDDY APP!

## FAQ Workflow



## FAQ Workflow



# BEFORE WE START...

Get this [\*\*repo\*\*](#) if you'd like to follow along:

```
% git clone https://github.com/nongnoochr/covid-buddy.git
% cd covid-buddy
% yarn install      (OR % npm install)
% cd client
% yarn install
% yarn build
```

*\* Note that the 'Find Healthcare Provider' feature won't work out-of-the-box without specifying a valid apiKey for the IQVIA SDK. For more details, see instructions in [README](#)*

If you'd like to run the app in dev mode

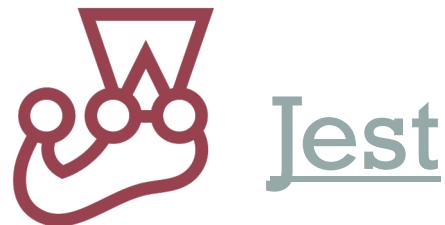
```
# Start server
% cd <path/to/covid-buddy>
% node index.js

# Start client app in dev mode – do this in a new tab
# Then, navigate to http://localhost:3000 in your browser
% cd client
% yarn start
```



# WHAT WE WILL BE USING TO DEVELOP AUTOMATED TESTS?

**JS Testing Framework:**



**Browser Controller Library (for E2E testing):**

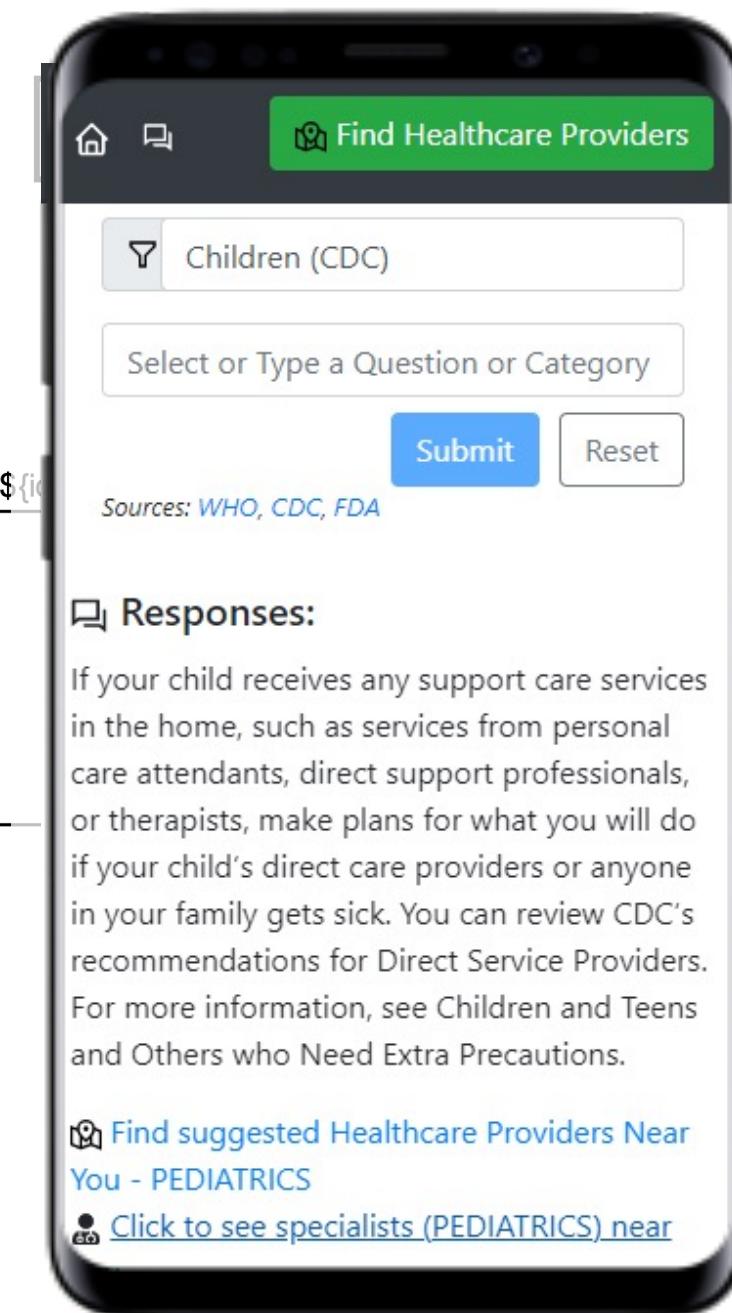
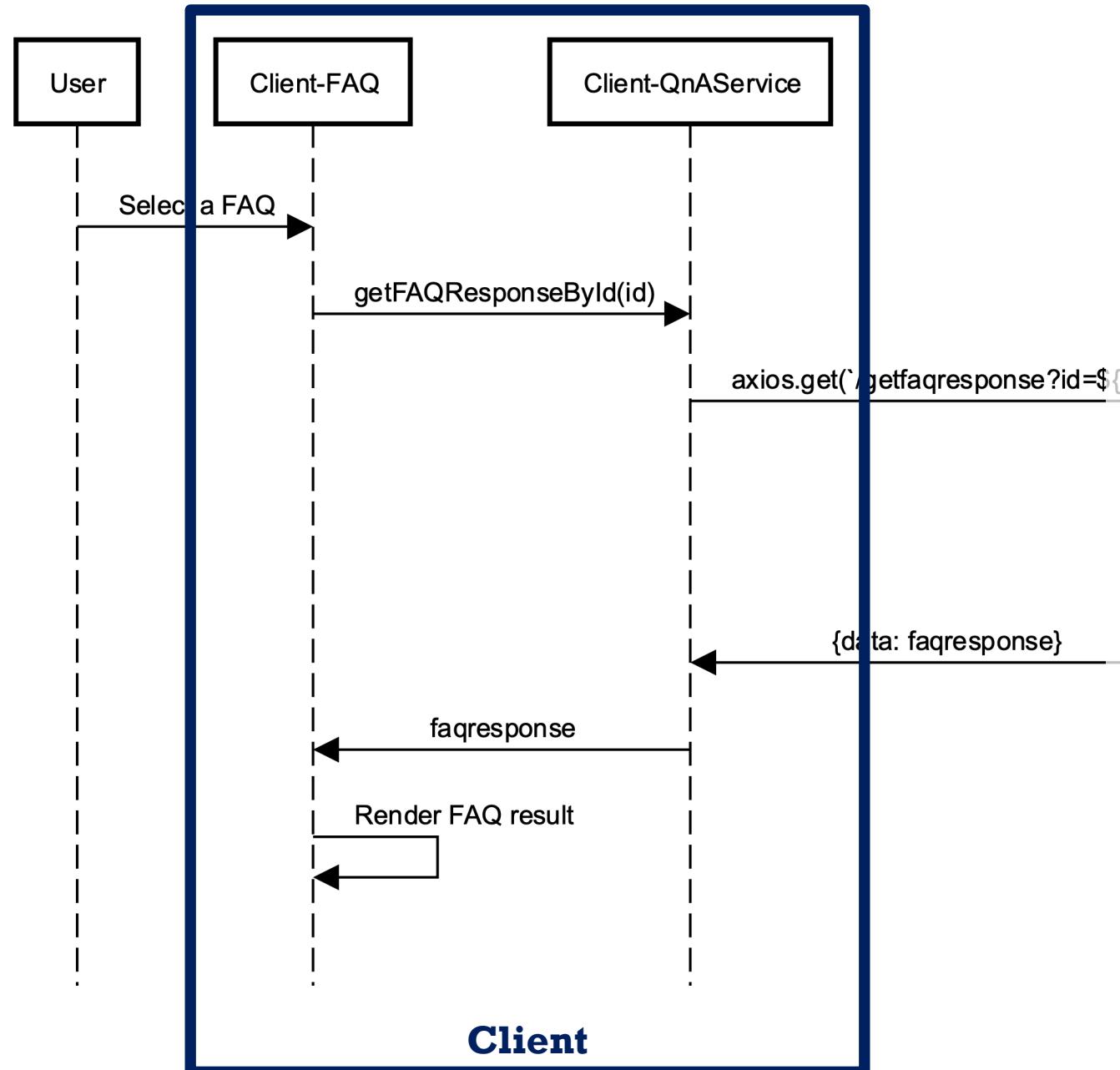


[Playwright](#)

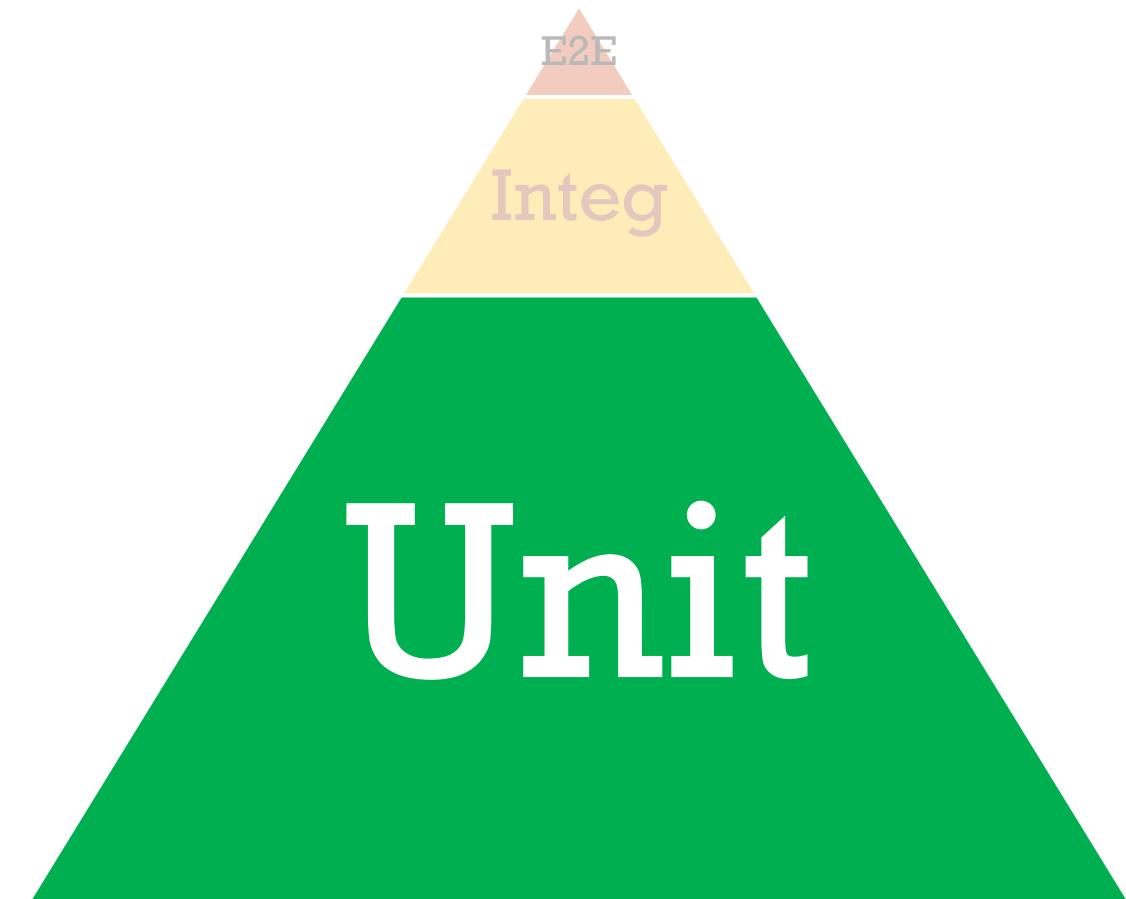


# CLIENT-SIDE TESTING

# FAQ Workflow



# RECAP: UNIT TESTING



- Cover individual units of code
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# UNIT TEST CASES – NO UI

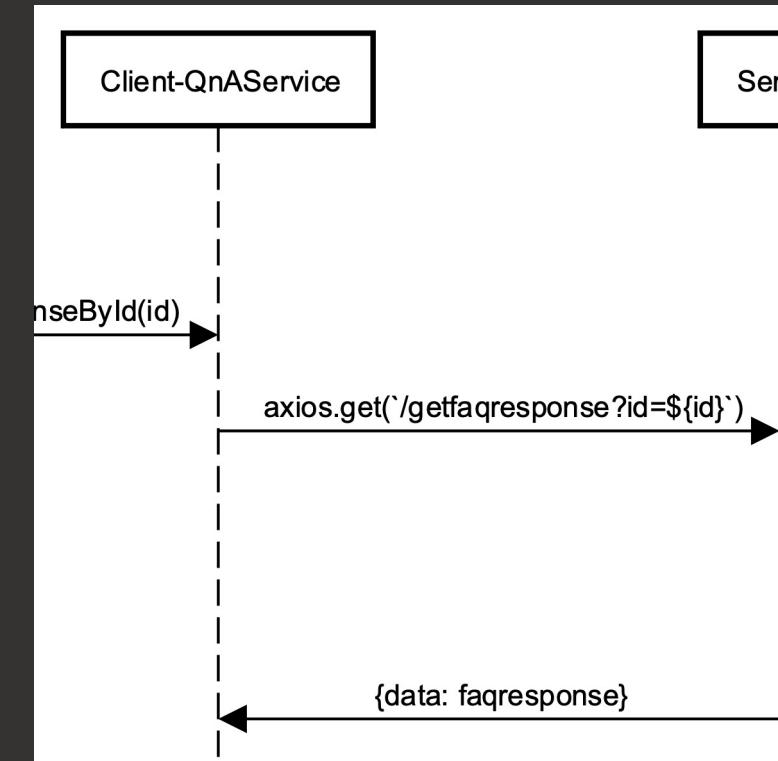
Ensure that the

**getFAQResponseById**

function of the **QnAService**

module make an

**appropriate request**



## Source: [services/OnAService.js](#)

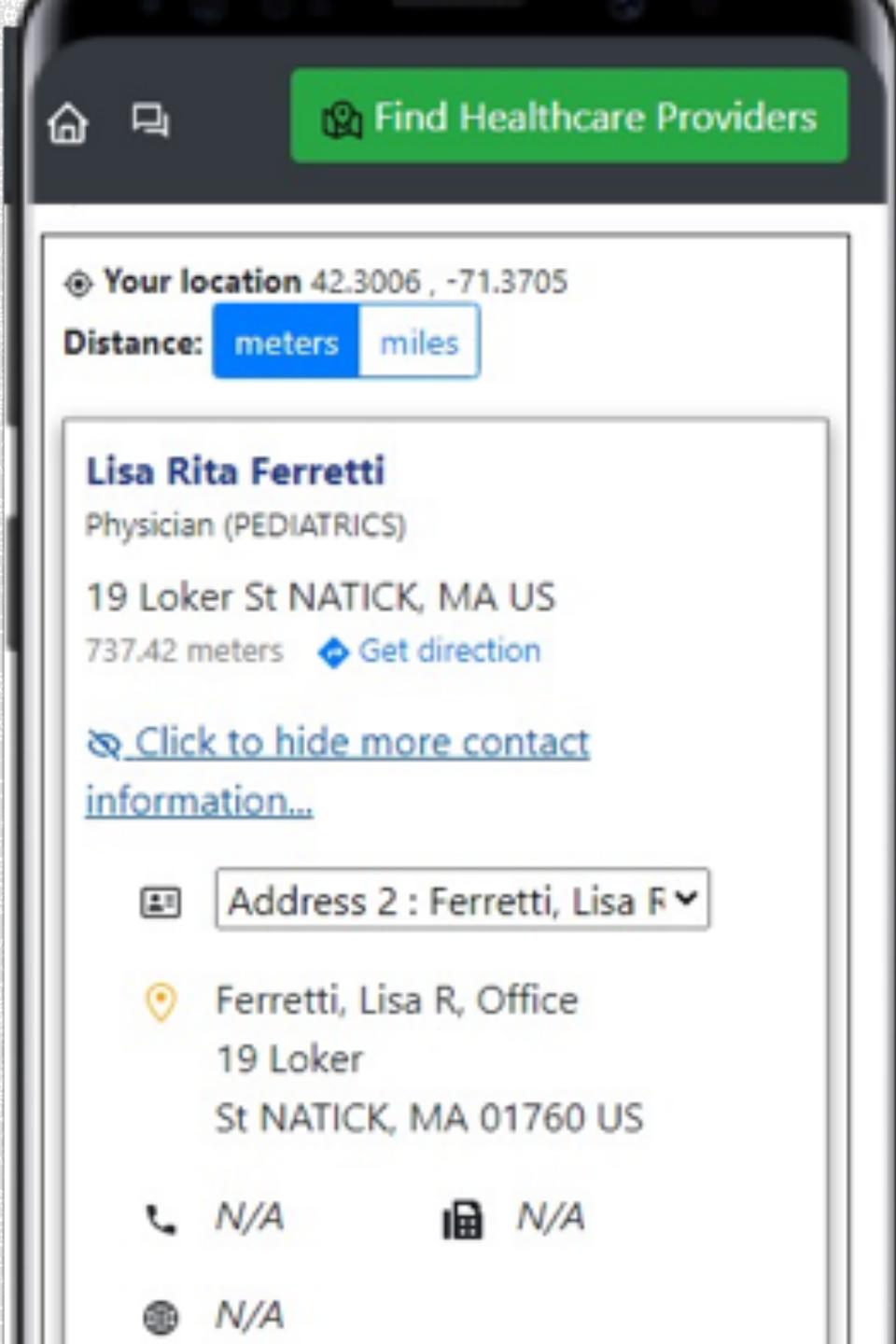
```
/**  
 * Request FAQ Response data for a particular FAQ  
 * @async  
 * @param {string} id Identifier of a requested FAQ  
 * @returns {[object]} FAQ Response data  
 */  
const getFAQResponseById = async (id) => {  
  const res = await axios.get(`/getfaqresponse?id=${id}`);  
  return res.data;  
}
```

To run test

% cd client  
% yarn test

## Test: [tests /services/OnAService.test.js](#)

```
it('getFAQResponseById should fetch an appropriate data', async () => {  
  
  const expRes = { data: 'mockedData' };  
  axios.get.mockResolvedValue(expRes);  
  
  const myId = 'myId';  
  const actRes = await getFAQResponseById(myId);  
  
  expect(actRes).toEqual(expRes.data);  
  expect(axios.get).toHaveBeenCalledWith(`/getfaqresponse?id=${myId}`);  
});
```



# UNIT TEST CASES –UI COMPONENT

Ensure that the **HCPIInfo** component **renders appropriate information** based on the **input data**

## Source: [components/OnA/HCPIInfo.js](#)

Lisa Rita Ferretti

Physician (PEDIATRICS)

19 Loker St NATICK, MA US

737.42 meters [Get direction](#)

[Click to hide more contact information...](#)

 Address 2 : Ferretti, Lisa R

 Ferretti, Lisa R, Office  
19 Loker  
St NATICK, MA 01760 US

 N/A  N/A

 N/A

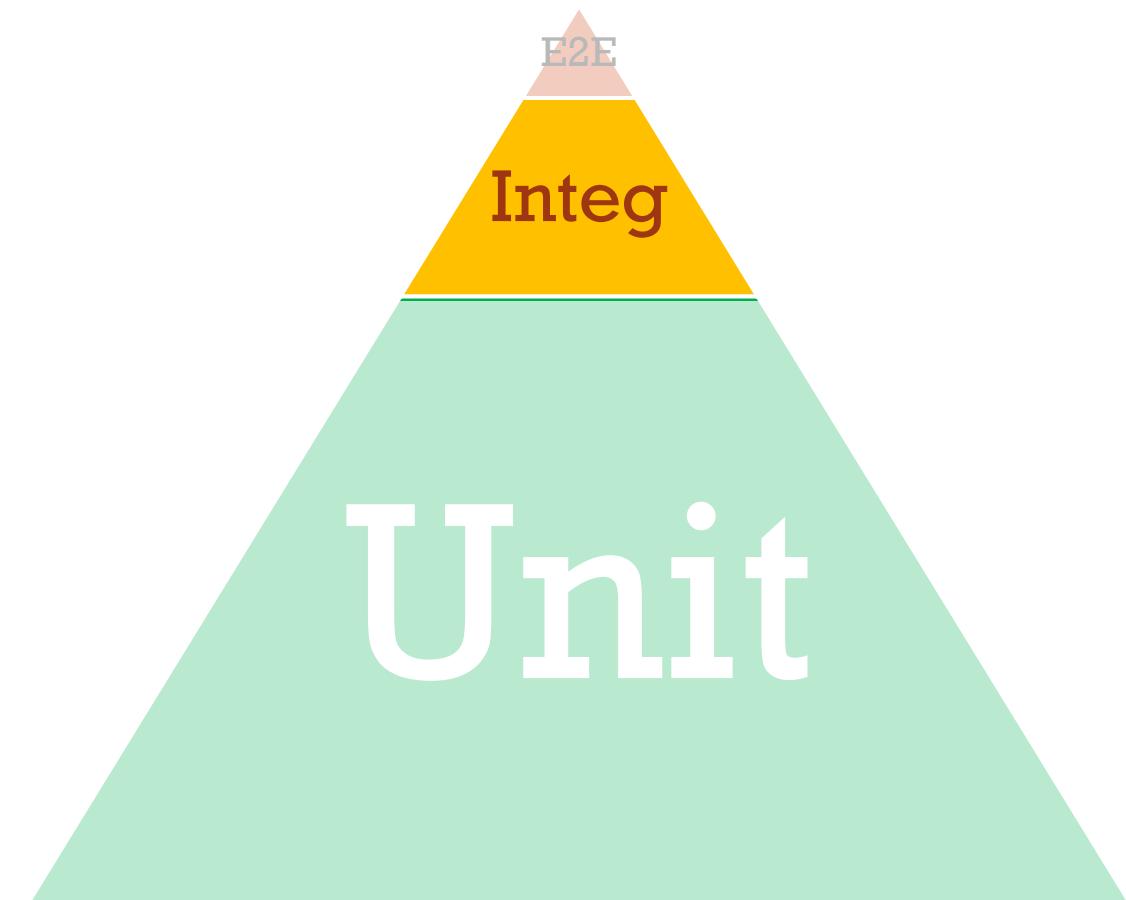
## Test: [tests /components/HCPIInfo.test.js](#)

```
describe('tHCPIInfo', () => {
  it('Workplace name should be visible', () => {
    const renderResult = render(<HCPIInfo data={data} cur-longLabel={longLabel} />);
    expect(renderResult.getByText(data.mainActivity.workplace.name))
      .toBeInTheDocument();
  });

  it.each([
    ...Object.entries(testAddressInfo),
    ['city', 'Natick'],
    ['county', 'MA']
  ]) ('Workplace address should contain appropriate information "%s"', (key, expected) => {
    render(<HCPIInfo data={data} cur-longLabel={longLabel} />);

    const elWorkplace = screen.getByTestId('data-workplace');
    expect(elWorkplace).toHaveTextContent(expected);
  });
});
```

# RECAP-INTEGRATION TESTING



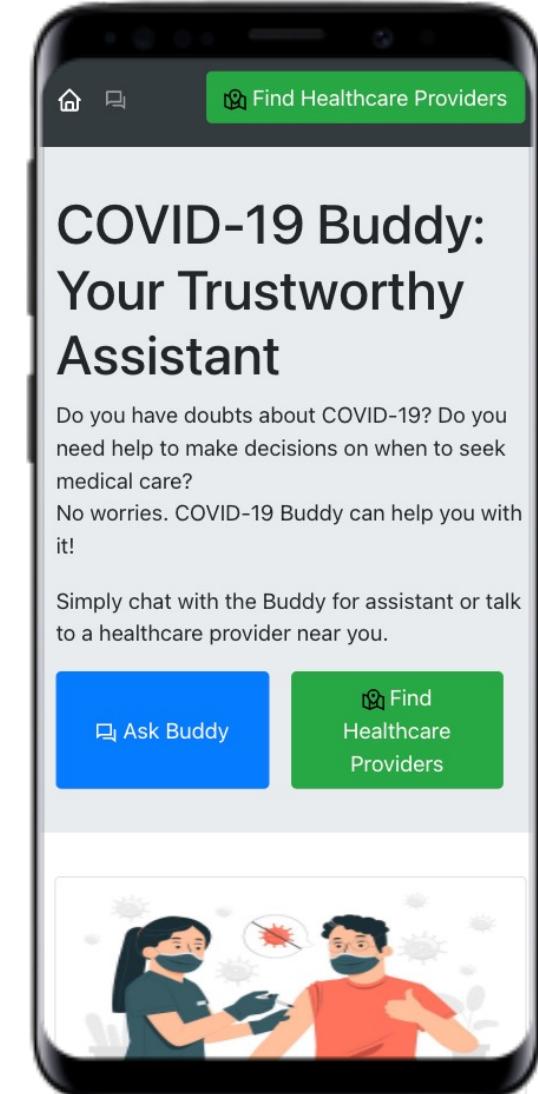
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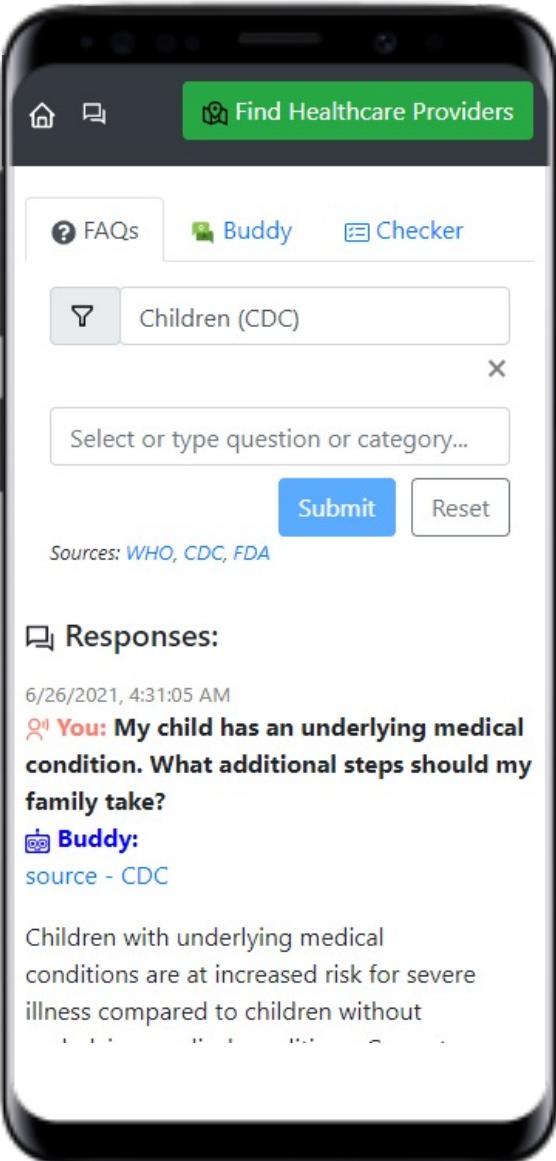
# INTEG TEST CASES

Ensure that after clicking the 'Ask Buddy' icon in the Navigation bar,

- The pathname is updated to '**/askbuddy**'
- The app is re-rendered to show the **Buddy page**



## Source: App.js



## Test: tests/App.test.js

```
it('click "Ask Buddy" in navbar should navigate to the Buddy view',
  async () => {
    const history = createMemoryHistory()
    render(
      <Router history={history}>
        <App />
      </Router>,
    );

    const elNavAskBuddy = await screen.findByTestId('nav-item-askbuddy');
    userEvent.click(elNavAskBuddy);

    // Location should be updated
    expect(history.location.pathname).toEqual('/askbuddy');

    // View should be updated to the Ask Buddy mode
    expect(screen.queryByTestId('qna-container')).toBeInTheDocument();
  });
}
```

# HOW DID WE DO SO FAR?

## CODE COVERAGE COLLECTION

To collect code coverage in jest, using the command below\*

```
% yarn test --coverage --watchAll
```

*\*Note: the ‘—watchAll’ option is required to temporary workaround an open issue as describe below (as of August 13<sup>th</sup>, 2021)*

<https://stackoverflow.com/questions/57451028/jest-finds-tests-but-doesnt-collect-coverage>



# CODE COVERAGE RESULTS (CLI)

File	% Stmt	% Branch	% Funcs	% Lines	Uncovered Line #s
All files	38.31	27.15	36.73	38.18	
src	58.06	45	61.54	58.06	
App.js	69.23	56.25	72.73	69.23	49–55,68–73,94,118,140,156–157,164–166
index.js	0	100	100	0	9–20
reportWebVitals.js	0	0	0	0	1–8
src/components/HCPMap	5.71	0	0	5.88	
HCLSDK.js	5	0	0	5	12–80
HCPMap.js	6.67	100	0	7.14	14–56
src/components/Landing	72.73	100	50	72.73	
CardBody.js	100	100	100	100	
Landing.js	66.67	100	33.33	66.67	25,57–58
src/components/Layout	83.33	50	50	83.33	
Layout.js	83.33	50	50	83.33	23
src/components/QnA	37.84	29.35	34.09	38.12	
Buddy.js	25	0	20	25	16,24–80,111
FAQ.js	41.18	50	40	41.18	25,30,59–90,100–102,105,117–118,125–126,135–136,148–156,166
HCPCard.js	5.56	0	0	5.88	17–60
HCPIInfo.js	72.22	66.67	66.67	75	44–48
QnA.js	36.17	31.82	37.5	36.96	51–52,60–70,90–141,154–164
Response.js	78.57	57.14	50	78.57	13,19,90
Suggestion.js	11.76	0	0	11.76	20–102
src/services	32.17	12	40	30.63	
HCLSDKService.js	23.53	0	28.57	22.22	64–75,124–148,157–168,180–291,305–340
QnAService.js	100	100	100	100	
src/store	100	100	100	100	
hcp-context.js	100	100	100	100	

# CODE COVERAGE RESULTS (REPORT)

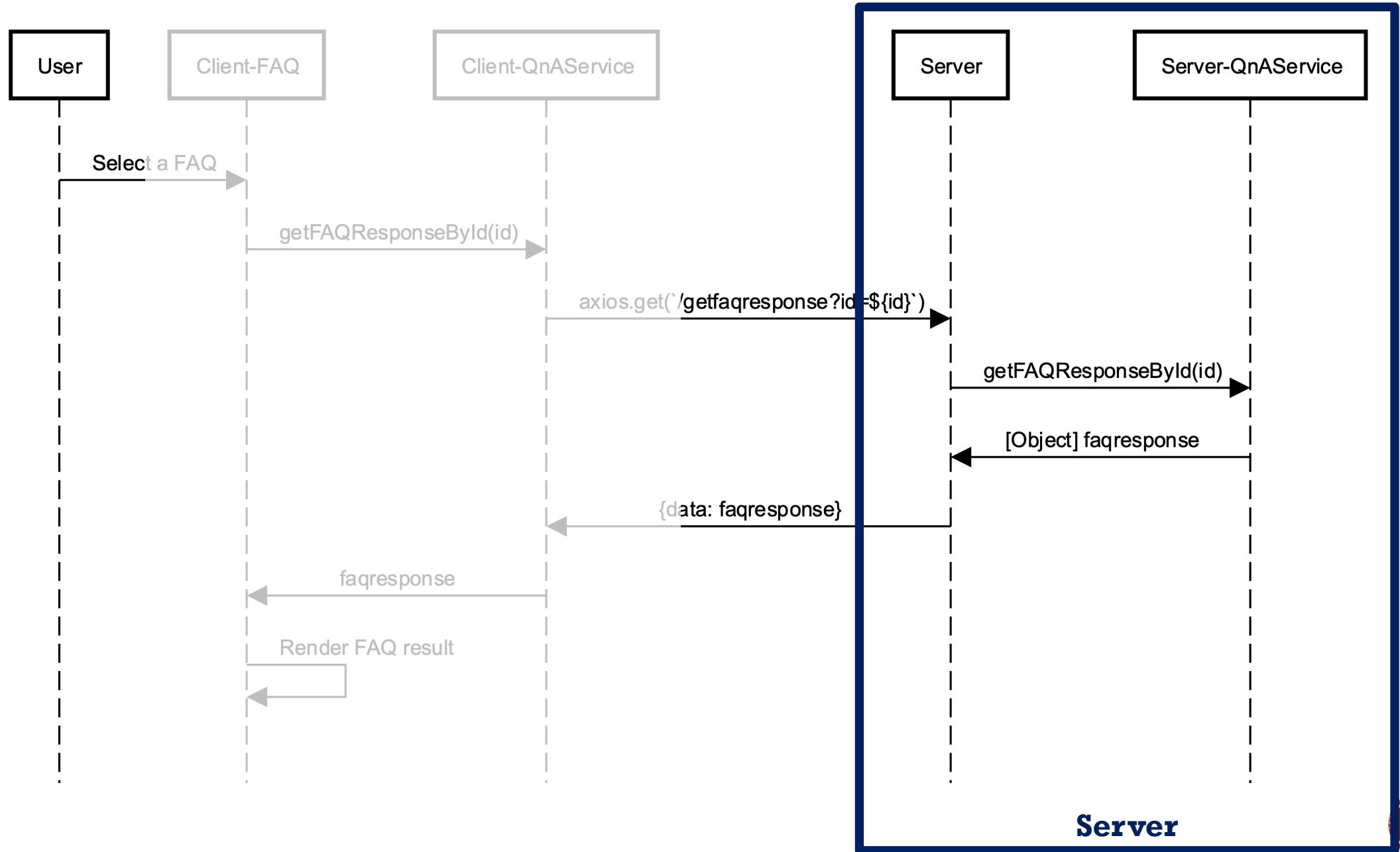


File	Statements	Branches	Functions	Lines
src	58.06%	36/62	45%	9/20
src/components/HCPMap	5.71%	2/35	0%	0/10
src/components/Landing	72.73%	8/11	100%	0/0
src/components/Layout	83.33%	5/6	50%	2/4
src/components/QnA	37.84%	70/185	29.35%	27/92
src/services	32.17%	37/115	12%	3/25
src/store	100%	1/1	100%	0/0



# SERVER-SIDE TESTING

## FAQ Workflow



## Source: [server/Utils.js](#)

```
/**  
 * zipWith :: (a -> b -> c) -> [a] -> [b] -> [c]  
 * @param {function} a function callback that takes in xs and ys  
 * @param {[Number]} xs  
 * @param {[Number]} ys  
 * @returns  
 */  
const zipWith = (f, xs, ys) => {  
  const ny = ys.length;  
  return (xs.length <= ny ? xs : xs.slice(0, ny))  
    .map((x, i) => f(x, ys[i]));  
}  
  
module.exports = {  
  ...  
  zipWith,  
  dotProduct  
};
```

To run test

```
% cd <prj_root>  
% npm run test-server
```

## Test: [tests /server/Utils.test.js](#)

```
it('zipWith should return an appropriate output', () => {  
  
  const myFcn = (a, b) => [a, b];  
  
  // --- When xs and ys has the same number of elements  
  let xs = [1, 2, 3];  
  let ys = [4, 5, 6];  
  
  const actSameElems = zipWith(myFcn, xs, ys);  
  expect(actSameElems).toEqual([  
    [1, 4],  
    [2, 5],  
    [3, 6]  
  ]);  
  
  // --- When a number of Elements in xs of LESS than a number of element of ys  
  xs = [1, 2];  
  ys = [4, 5, 6];  
  
  const actXsLessThanYs = zipWith(myFcn, xs, ys);  
  expect(actXsLessThanYs).toEqual([  
    [1, 4],  
    [2, 5]  
  ]);  
  
  // --- When a number of Elements in xs of GREATER than a number of element of ys  
  xs = [1, 2, 3];  
  ys = [4];  
  
  const actXsGtYs = zipWith(myFcn, xs, ys);  
  expect(actXsGtYs).toEqual([  
    [1, 4]  
  ]);
```

# WHAT IS OUR CODE COVERAGE (SERVER)?

```
% npm run test-server -- --coverage
```

```
> covid-buddy@1.0.0 test-server
> jest __tests__/server "--coverage"

PASS  __tests__/server/Utils.test.js
  tUtils
    ✓ zipWith should return an appropriate output (3 ms)
```

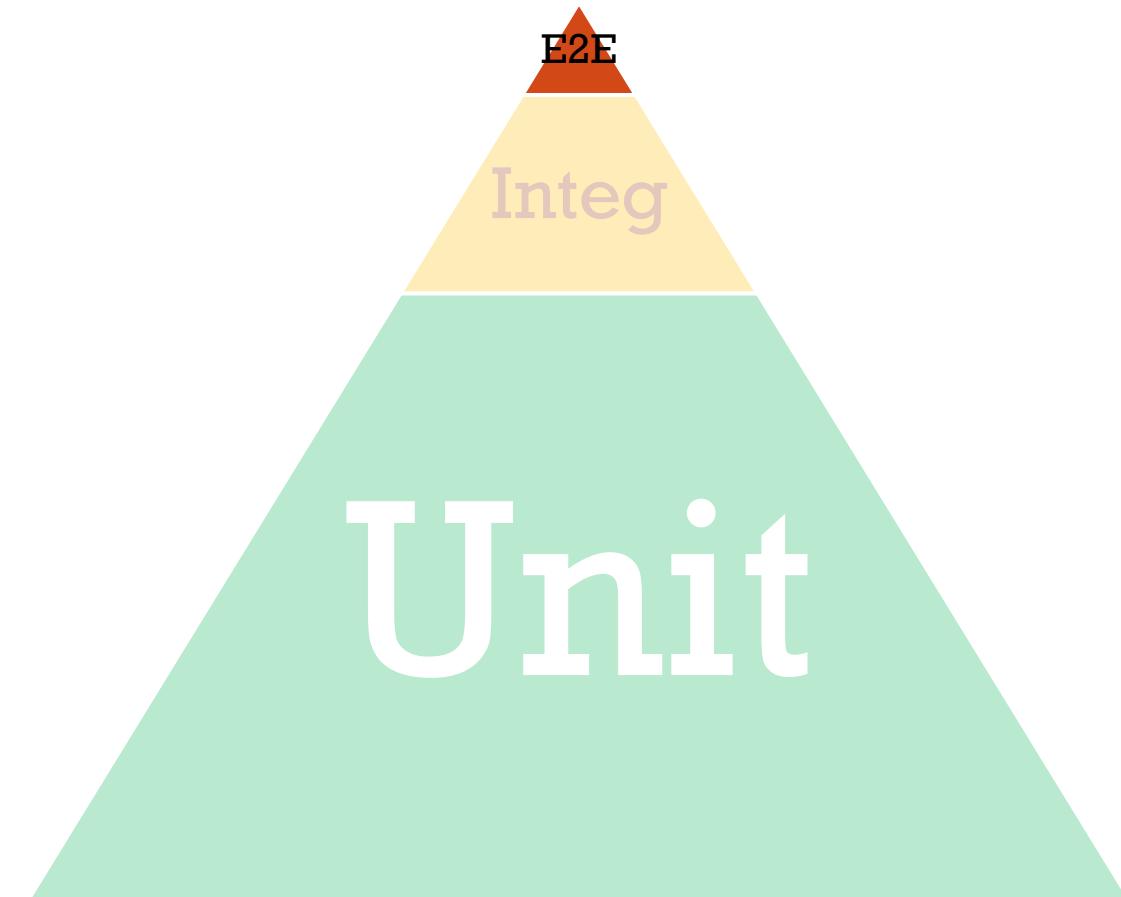
File	%Stmts	%Branch	%Funcs	%Lines	Uncovered Line #s
All files	54.55	33.33	33.33	75	
Utils.js	54.55	33.33	33.33	75	22-24

```
Test Suites: 1 passed, 1 total
Tests:       1 passed, 1 total
Snapshots:   0 total
Time:        0.294 s, estimated 1 s
Ran all test suites matching __tests__/server/i.
```



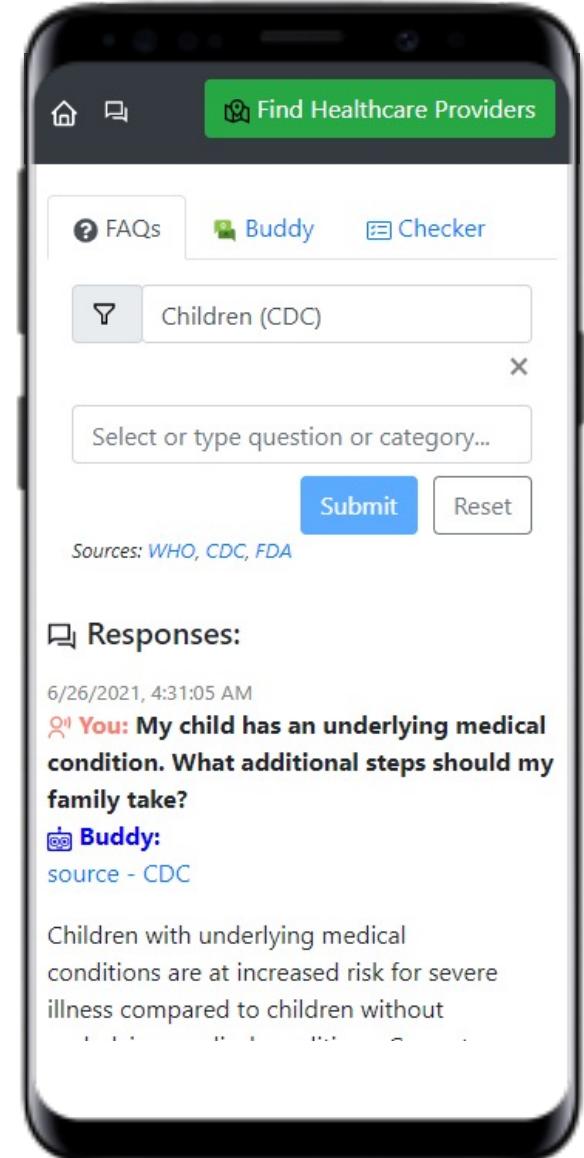
# END-TO-END TESTING

# RECAP: END-TO-END (E2E) TESTING



- Simulate a user level experience across the full stack of a software product
  - These tests are highly valuable to implement as they offer assurance that real users are having a smooth bug free experience, even when new commits are pushed
- E2E tests can be expensive up front to capture and record the user flow sequence
  - Tests at this level should saved to capture design cases and requirements
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# E2E TEST CASES

- Open a production app, then
  - Select a FAQ
  - click Submit
  - Verify that an **appropriate response** retrieved from the server is **rendered properly**
- Ensure that this design case work properly **across browsers** (chromium, webkit, firefox) and **devices** (desktop, mobile devices)

To run E2E tests, use the command below

```
% npm run test-e2e
```



Test: tests /e2e/prodApp.test.js

```
const deviceList = [
  'Galaxy S8',
  'iPad Mini landscape',
  'iPhone 12',
  'Pixel 2 XL',
  'Desktop Safari',
  'Desktop Chrome',
  'Dekstop Edge',
  'Desktop Firefox',
];

describe.each([
  [chromium.name(), chromium],
  [firefox.name(), firefox],
  [webkit.name(), webkit],
])('test on %p', (_browserName, browserType) => {

  let newBrowser;

  beforeAll(async () => {
    newBrowser = await browserType.launch();
  });

  afterAll(async () => {
    await newBrowser.close();
  });
});
```

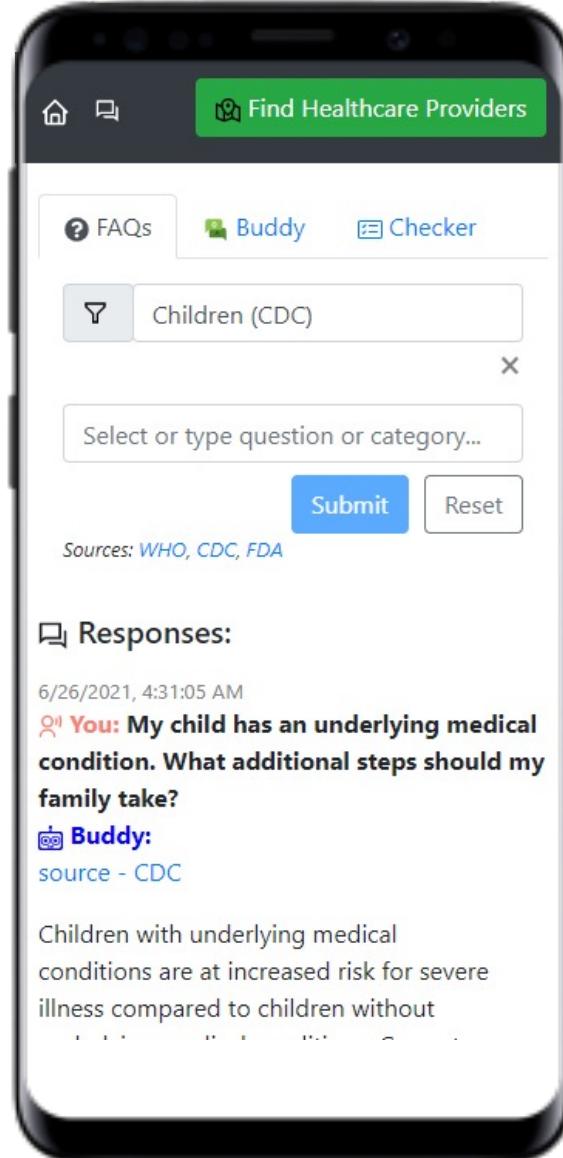
```
let context
try {
  context = await newBrowser.newContext({
    ...devices[curDeviceName],
    // Required when clicking Submit
    geolocation: { longitude: 48.858455, latitude: 2.294474 },
    permissions: ['geolocation']
  });
} catch (e) {
  console.log(`Skip test in "${_browserName}"`);
  return
}

const page = await context.newPage();
await page.goto('http://localhost:8080');

await expect(page).toHaveSelector('[data-testid="nav-item-brand"]');

const selector = '[data-testid="nav-item-askbuddy"]';
await page.click(selector);
await expect(page).toHaveSelector('[data-testid="qna-container"]');

const selectorResContainer = '[data-testid="response-container"]';
const elResContainerBefore = await page.$(selectorResContainer);
const elResContainerContentBefore = await elResContainerBefore.textContent();
expect(elResContainerContentBefore).toBeFalsy();
```



```
// Click [placeholder="Select or type question or category..."]
await page.click('[placeholder="Select or type question or category..."]');

// Click text=What can we do so that other diseases like COVID-19 do not affect us in future?
await page.click('#faq-typeahead-item-0');
const element = await page.$('input[placeholder="Select or type question or category..."]');

const elemValue = await element.inputValue();
expect(elemValue).toBeTruthy();

// Click text=Submit
await page.click('text=Submit');

// Poll until the response shows up
await page.waitForSelector('[data-testid="response-item"]');

const elResContainerAfter = await page.$(selectorResContainer);
const elResContainerContentAfter = await elResContainerAfter.textContent();
expect(elResContainerContentAfter).toBeTruthy();

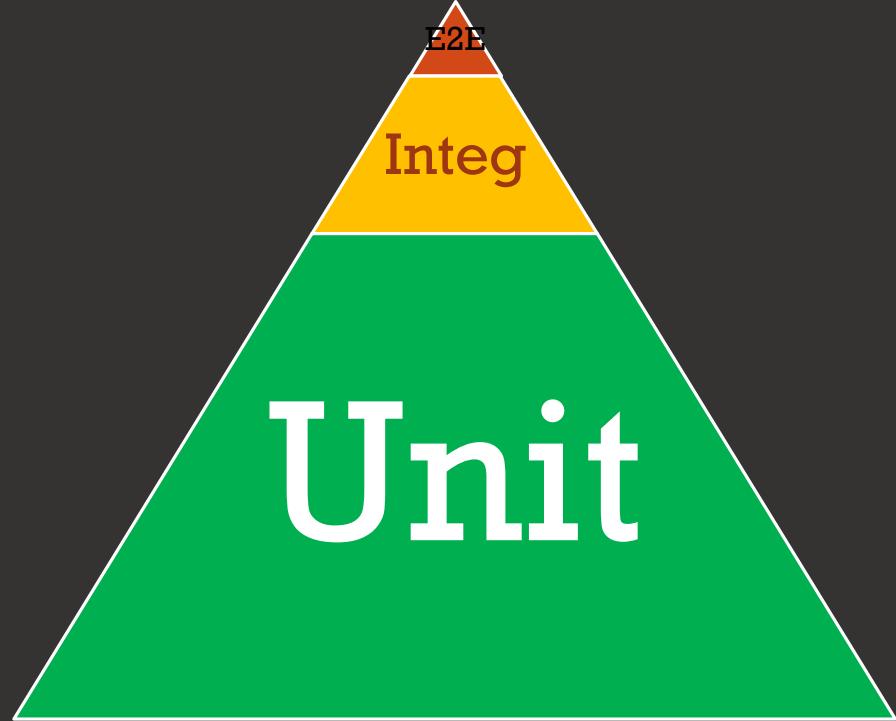
await page.close();
```

These commands to interact with a browser can be **automatically generated** through the '**'recording'** feature that is available after invoking '**'await page.pause()'** 😊



# TAKEAWAYS

- Use **TESTABILITY** as a lens of your **design**
- Adhere to **Test Pyramid** when developing automated tests for your project





**THAT'S IT! HAVE FUN TESTING  
IN YOUR NEXT PROJECT**



# RESOURCES

- GitHub Project: <https://github.com/nongnoochr/covid-buddy>
  - This presentation is available in [artifacts/intro\\_automatedtesting.pptx](#)
- <https://jestjs.io/>
- <https://playwright.dev/>



# QUESTIONS?

